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EUROSISTEMA

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# MODELLING LOANS TO NON-FINANCIAL CORPORATIONS IN THE EURO AREA

by Christoffer Kok Sørensen[§], David Marqués Ibáñez[*] and Carlotta Rossi[**]

## Abstract

We model the determinants of loans to non-financial corporations in the euro area. Using the Johansen (1992) methodology, we identify three cointegrating relationships. These relationships are interpreted as the long-run loan demand, investment and loan supply equations. The short-run dynamics of loan demand for the euro area are subsequently modelled using a Vector Error Correction Model (VECM). We perform a number of specification tests, which suggest that developments in loans to non-financial corporations in the euro area can be reasonably explained by the model. We then use the estimated model to analyse the impact of permanent and temporary shocks to the policy rate on bank lending to non-financial corporations.

**JEL Classification**: C32; C51.
**Keywords**: loans to non-financial corporations, credit.

## Contents



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# 1. Introduction[1]

Credit developments carry significant information about both economic and financial activity. First of all, changes in credit provide signals about the availability and demand for funds supporting (or deterring) investment and spending decisions by the private non-financial sector. This is particularly the case with respect to the euro area where bank lending is one of the major sources of financing for non-financial corporations (see Figure 1). For example, by the end of 2006 loans from euro area banks (i.e. monetary financial institutions or MFIs) to non-financial corporations amounted to almost €4 trillion, or around 40% of the total external financing of the corporate sector.[2] Moreover, credit has been found to show strong correlation with asset price movements and hence may provide information about cycles in asset prices.[3] In addition, from a monetary policy perspective, the credit market potentially plays a propagating role in transmitting changes in monetary policy to the real side of the economy.[4] Loans are also the major component of euro area banks' asset side of their balance sheet and hence they are a significant counterpart to the monetary aggregates. As a result, corporate lending is an important measure to consider for the regular assessment of the monetary policy stance. Detailed knowledge about the various structural factors determining corporate loan developments is therefore crucial for understanding euro area monetary developments and, ultimately, for the setting of monetary policy in the euro area.[5]

To our knowledge, this paper is the first attempt to provide a framework for explaining the long-term behaviour of loans to non-financial corporations in the euro area as a whole. Most previous studies have either modelled credit to the private sector as a whole (Hofmann, 2001; Hulsewig, 2003; Calza et al., 2006; Gambacorta and Rossi, 2007) or business lending for individual euro area countries (Focarelli and Rossi, 1998; Bridgen and

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[1] We are very grateful for useful comments by an anonymous referee as well as by Francesco Drudi, Leonardo Gambacorta and Mika Tujula. All views expressed are those of the authors alone and do not necessarily reflect those of the ECB, Banca d'Italia or the Eurosystem.

[2] Here we only include bank and market-based sources of external financing. That is, non-bank loans and unquoted shares are not included. It should also be noted that the outstanding amounts of quoted shares in Figure 1 are heavily influenced by market valuation effects.

[3] See e.g. Borio and Lowe (2002).

[4] Some of the seminal contributions to the credit channel literature include Bernanke and Blinder (1988), Bernanke and Gertler (1995), Bernanke, Gertler and Gilchrist (1996) and Kashyap and Stein (2000). Some recent empirical findings can be found in Ehrmann et al. (2001); Angeloni and Ehrmann (2003); Gambacorta and Mistrulli (2004); Altunbas et al. (2004), Gambacorta (2005); Kishan and Opiela (2006) and Van den Heuvel (2002).

[5] Regarding the latter, the particularly strong growth of MFI lending to the non-financial corporate sector observed for instance in the 2005-2006 period years has played a dominant role in the analysis of euro area monetary developments.

Mizen, 1999 and 2004; Kakes, 2000; Casolaro et al., 2006).[6] Furthermore, in our analysis, we exploit a new dataset extending euro area non-financial corporate loans back to 1991.

The paper is organized as follows. Section 2 reviews the empirical literature on the modelling of loans to non-financial corporations in the euro area and indicates how our model fits within the existing literature. Section 3 gives a descriptive analysis of the data used to construct our model. In Sections 4 and 5 the econometric investigation is carried out and the difference between the actual and the long-run level of loans to non-financial corporations is analysed. Section 6 contains the results of a simulation using the estimated model while Section 7 investigates the model's forecasting properties. The last section concludes and provides directions for future research.

## 2. Modelling loans to non-financial corporations

Since the early 1990s, modelling credit to the private sector has been the subject of a fast growing strand of empirical literature. This literature has been particularly active within the central banking community due to its practical use for policy analyses. Recent empirical studies for euro area countries analysing credit to households, credit to firms or credit to the private sector as a whole are summarised in Table 1.

One common feature of this literature is the econometric framework used. Owing to the typically non-stationary nature of the aggregate values for the time series of loans and their determinants, a Vector Error Correction Model (VECM) is usually applied; within the general framework of the VECM approach, one or more long-run relationships are identified. The number of cointegrating vectors that are found to link the variables of interest has significant theoretical implications. Within this literature, one of the main problems when modelling aggregate loan developments is how to identify and disentangle demand from supply factors affecting bank lending particularly at the macroeconomic level. According to the credit view of monetary policy, owing to financial frictions, bank supply effects may play, under certain circumstances, an important role for the allocation of credit.[7] The majority of studies analysing aggregate loan growth identify one single long-run relationship that is typically seen as reflecting long-run developments in credit demand (e.g. Calza et al., 2003 and 2006; Casolaro et al., 2006). The underlying assumption is that the

[6] Only a couple of unpublished papers have analysed lending to non-financial corporations at the euro area level; see Berkel and Werner (2005) and Greiber and Kok Sørensen (2006). Their modelling approaches, however, somewhat differ from ours.

[7] Bernanke and Blinder (1988), Bernanke and Gertler (1995), Bernanke, Gertler and Gilchrist (1999) and Kashyap and Stein (2000).

credit market is predominantly demand driven and that supply effects are largely negligible. A few recent studies, identify two cointegrating vectors in the loans market that are interpreted as, respectively, long-run demand and long-run supply relations (e.g. Kakes, 2000 and Hülsewig, Mayer and Wollmershäuser. 2006).

A further controversial issue in the literature is the decision of whether to focus the analysis on the flows or the outstanding amounts (levels) of loans. The flows-based approach primarily relates to the theoretical study by Friedman and Kuttner (1993) in which the flows of investment is modelled as a function of the financing gap (i.e. the difference between investment outlays and net revenues from operations excluding interest and dividends), the cost of lending and the cost of other sources of financing. From an empirical perspective, only a handful of studies apply the flows of loans to non-financial corporations as the dependent variable (Focarelli and Rossi, 1998). Most studies use the level of loans as the dependent variable instead. According to the latter approach, the model by Friedman and Kuttner (1993) is modified to deal with the level of loans to non-financial corporations as a dependent variable by the inclusion of a scale variable.

As for the cost variables, the literature on loans to non-financial corporations usually assumes that the demand for loans is a function of the cost of lending (Kakes, 2000). In line with Friedman and Kuttner (1993), some studies also include the cost of alternative sources of financing to account for the opportunity cost of loan financing. Thus, Casolaro et al. (2006) model the cost component in the credit demand equation as the spread between the cost of (short-term) lending and the 3-month money market rate that is used as a proxy for the alternative forms of financing.[8]

Our model, within the general VECM approach, uses a more comprehensive measure of the cost of lending and also includes the cost of alternative (non-banks) forms of external financing (see Section 3). Moreover, both the cost of lending and the relative cost of lending (i.e. the spread between the cost of lending and the cost of the other forms of financing) enter the credit demand equation separately. Lastly, we focus the analysis on the amount of lending outstanding rather than on the flows.

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[8] The assumption is that the main alternative form of financing is the issuance of debt securities. The cost of debt securities issuance is then proxied by the money market rate plus a risk premium component that is assumed constant.

## 3. Data

We use quarterly data for the euro area over the period starting in the first quarter of 1991 to the last quarter of 2006. The main data variables involved in the analysis are: loans to non-financial corporations (*L*), gross domestic product (*Y*), investment (*I*), gross operating surplus (*S*), cost of bank lending (*cl*), cost of debt securities and equity issuance (*x*) and the monetary policy rate (*mm*).[9] All the series with the exception of the interest rates are expressed in logarithms and are seasonally adjusted.

The series of the outstanding amount of loans to non-financial corporations is based on the MFI balance sheet statistics constructed by the Eurosystem. The series of GDP, business investment and gross operating surplus are taken from Eurostat for the period 1995-onwards. Prior to 1995, the series are reconstructed by aggregating national historical data. Business investment is calculated as total fixed investment minus housing investment.

A graphical analysis of the annual growth rate of loans to non-financial corporations and GDP shows that the series are highly correlated suggesting the possibility that they are cointegrated (Figure 2). Investment should be related to actual and expected economic developments and, as suggested by Figure 3, there is indeed a positive relationship between the annual increase of fixed investment and gross operating surplus.

The cost of lending for non-financial corporations is constructed as a composite lending rate based on the weighted average of short and long-term lending rates.[10] Euro area aggregate MFI lending rates are available from 2003 onwards. Prior to this period, the euro area composite lending interest rates have been constructed on the basis of comparable national retail lending rates. The cost of the non-bank forms of firms' financing is constructed as a weighted average of the cost of corporate debt securities and equities issued by non-financial corporations where the weights are given by the average flows of debt securities and quoted shares over the sample period. The cost of market debt financing faced by euro area corporations is calculated by aggregating yields of Merrill Lynch wide corporate bond indices available since 1998. Prior to 1998, Merrill Lynch data are extended by aggregating national data. The cost of issuing quoted shares is calculated according to the three-stage Gordon Dividend-Discount model (see ECB, 2005).

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[9] At a first stage, we also tried to incorporate merger and acquisitions (M&A) activity as a possible determinant of loan developments. We fail however to find a direct structural effect of M&A over bank lending. The role of M&A over bank lending is further investigated in Section 5.

[10] The weights are based on the outstanding amounts of short and long-term loan going back to the third quarter of 1997. The weights applying in the third quarter of 1997 have been applied backwards to 1992, thus assuming a fixed maturity structure in that period.

Developments in the cost of bank lending and of other sources of external market financing are illustrated in Figure 4. It shows that the cost of lending was higher than the cost of market-based external financing up to the end of 1998, and that it was constantly lower in the subsequent period. The high but declining lending rate in the earlier part of the sample period reflects most likely the transition from a high inflation-high interest rate environment observed in many euro area countries during the 1990s to a low inflation-low interest rate which characterised the economic environment in the euro area since the start of the EMU. It probably also reflects increasing competition in the euro area banking system. Finally, prior to its bust around 2000-2001 the equity market bubble in the late 1990s also contributed to lowering the cost of financing via the equity markets.

The policy rate is the 3-month Euribor rate, which is available from 1994 onwards. Prior to this date, we used national series to construct the euro area aggregate. The behaviour of the composite lending rate and of the monetary policy indicator clearly shows that both series are cointegrated (Figure 5). The difference between the two series (i.e. *cl-mm*) indicates the mark-up that captures both the credit risk and structural characteristics of the lending market and tends to fluctuate around the average value without exhibiting signs of structural breaks.[11]

# 4. Empirical analysis

## 4.1 General VAR model

We start with a seven-variable VAR system; all the variables that are found to be I(1) without drift (Table 2) are treated as endogenous at this stage. The starting point of the multivariate analysis is therefore:

$$z_t = \mu + \sum_{k=1}^{p} \Phi_k z_{t-k} + \Psi d_t + \varepsilon_t \qquad t = 1,...,T$$
$$\varepsilon_t \sim \mathrm{VWN}(0,\Sigma) \qquad (1)$$

where $z_t$=[*L*, *Y*, *I, S, cl, x, mm*] is the vector of endogenous variables, $d_t$ is a vector of dummy variables and $\varepsilon_t$ is a vector of white noise residuals. The deterministic part of the model includes a constant.

[11] This result is in opposition with Gambacorta and Rossi (2007) who identify three different values for the average mark up in the period 1985-2005. The difference may be related to the fact that we focus only on loans to the corporate sector and apply a shorter sample period.

The lag length of the VAR model is set equal to 3 (in levels) according to the results showed in Table 3. The Godfrey test suggests that the residuals are serially uncorrelated, while normality is reached only with the inclusion of three point dummies, which seems reasonable during this period of significant changes in the euro area financial structure (see Table 3).[12]

### 4.2 Cointegration analysis

As illustrated in Table 2, all the series included in the VAR are found to be I(1) calling for the existence of one or more cointegrating relationships. Equation (1) is then rearranged in the following way:

$$\begin{aligned}\Delta z_t &= \Pi(\mu, z_{t-1}) + \sum_{k=1}^{p-1} \Gamma_k \Delta z_{t-k} + \Psi d_t + \varepsilon_t \qquad t = 1,\dots,T \\ \Pi &= \alpha\beta'\end{aligned} \tag{2}$$

According to Johansen's trace test, the rank of matrix Π suggests the existence of three cointegrating relationships such that $\alpha$ is a *7 x 3* matrix of loading coefficients and $\beta$ is a *7 x 3* matrix of cointegrating vectors (see Table 5). In order to deal with the presence of dummy variables, the asymptotic critical values of the Johansen's trace test have been calculated according to Johansen and Nielsen (1993).

The three cointegrating vectors (which we call c.v.) are defined as follows:

$$L = \beta_{1,1}Y + \beta_{1,2}cl + \beta_{1,3}x + \beta_{1,0} \qquad \text{(c.v. 1)}$$

$$I = \beta_{2,1}S + \beta_{2,2}cl + \beta_{2,0} \qquad \text{(c.v. 2)}$$

$$cl = mm - \beta_{3,0} \qquad \text{(c.v. 3)}$$

The first cointegrating vector can be interpreted as a long-run credit demand equation, the second as a long-run investment equation, and the third as a cost of lending equation. Regarding the cost of lending equation, economic theory on oligopolistic competition suggests that in the long run the lending rate should be related to the monetary policy rate that represents the cost of banks financing. For example, Klein (1971) and Monti (1972) show that in a model of imperfect competition among N banks each one sets its lending rate as the sum of the exogenous money market rate and a constant mark-up (see Freixas and Rochet, 1997). According to this literature, c.v. 3 may be broadly interpreted as a long-run credit supply equation.

[12] The dummies equal to 1 in 1991 Q4, 1995 Q1 and 2001 Q1, respectively, and 0 elsewhere

The cointegrating vectors are further simplified according to the following restrictions:

i) $\beta_{1,1} = 1$. This restriction suggests that there is homogeneity between loans and the scale variable. This homogeneity hypothesis between loans and GDP is accepted by the data. This is not an univocal result in the literature as usually the long-run elasticity of loans and GDP is found to be higher than one (see Calza et al., 2003 and 2006, and Gambacorta and Rossi, 2007, for loans to private sector in the euro area). The presence of omitted variables could however have contributed to the latter result.

ii) $\beta_{1,2} = -\beta_{1,3}$. This hypothesis suggests that loans demand depends on the relative price of funding compared to other sources of financing (*cl* - *x*).[13]

iii) Finally, due to the non significance of the $\beta_{2,0}$ parameter, it has been set equal to 0. This helps to interpret $\beta_{3,0}$ as the mark-up in the cost of lending equation which in the long-term has been set equal to 1.5 per cent, or the average difference between the cost of lending and the policy rate over the sample period.

All the identifying and over-identifying restrictions are accepted by the model.[14]

### 4.3 Estimating the VECM

After the identification of the long-run relationships within the 7-variable VECM, weak exogeneity tests are performed on all the endogenous variables in order to determine whether, in the spirit of a general-to-specific approach, it would be legitimate to specify the model in a more parsimonious way. Following Johansen (1992), the test is performed by assessing the statistical significance of the coefficients of the three cointegrating vectors in each of the equations of the system. If the error-correction terms are found not to be significant, it would imply that there is no information loss from excluding that variable from the specific equation. The results of the weak exogeneity tests are shown in Table 6. It suggests that the cost of the alternative sources of financing and the policy rate can be regarded as being weakly exogenous. The final model is depicted in Table 7.

According to the first cointegrating vector, loan demand depends on the GDP (i.e. the scale variable) and negatively on the relative cost of lending (cl-x). In turn, cointegration vector 2 suggests that business investment depends positively on the gross operating surplus (a proxy for firms' internal financing sources) and negatively on the cost of lending. Thus, the relative cost of lending enters directly the equilibrium loan demand equation while the

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[13] Clearly developments in economic activity (GDP) also take into account implicitly developments in levels in the real interest rate and thereby in the real cost of financing.

[14] The result of the LR test for identifying and over-identifying restrictions is shown in table 5, panel b.

level of the cost of lending affects the long-run credit market relationship through the investment equation.

The loading coefficients exhibit the expected signs. In particular, in the loan equation $\alpha_1$ is negative and quite small, in line with the literature. Similar to Gambacorta and Rossi (2007), $\alpha_3$ is close to zero in the lending equation (but cannot be set equal to 0 without incurring a significant loss of information).

As for the GDP, investment, gross operating surplus, and the cost of lending equations we underline the following results. First, the loading coefficient of the third cointegrating vector (interpreted as long-run credit supply equation) is, as expected, significant in the equation of the cost of lending. This suggests that, even if the supply equation has a very limited direct effect in the lending equation, it affects the credit market through its own price equation. Second, the loading coefficient of the first cointegrating vector (long-run credit demand equation) enters the investment equation, in line with Bridgen and Mizen (1999, 2004), suggesting that the adjustment of bank lending toward the equilibrium level involves business investment.

In order to investigate the stability properties of the model, we examine the recursive estimates of the long run and the loadings coefficients (under the assumption of constant short-run parameters). Figure 6 shows the coefficients of the cointegrating vectors and the loading coefficients. As for the cointegrating vectors, Figure 6.a clearly suggests that the coefficient of the gross operating surplus ($\beta_{2,1}$ in c.v. 2) and the coefficient of the cost of lending ($\beta_{2,2}$ in c.v. 2) are fairly stable over the 1999-2006 period. In contrast, the coefficient of the spread between the cost of lending and the cost of the alternative source of financing ($\beta_{1,2}$=- $\beta_{1,3}$ in c.v. 1) exhibits signs of instability: the coefficient declines significantly during 2002 and increases somewhat thereafter, but in both cases it returns to its historical values. Figure 6.b shows that the loading coefficients of the three cointegrating vectors in the lending equation are stable over time.[15]

A more formal analysis of the stability properties of the model is carried out according to Hansen-Johansen (1993). The Hansen-Johansen procedure allows to evaluate the stability of the model when the short-run parameters are considered fixed, and estimated only once in the full sample (the R-model), and when all the parameters, including the short run ones, are estimated for each sample size ( Z-model). According to Figure 6.c, the test for parameter stability excludes the existence of structural breaks in the parameters of the

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[15] Also the loading coefficients of the GDP, investment, gross operating surplus, and the cost of lending equations look stable over time (results are available upon request).

cointegrating vector when looking at the R-model, while the presence of structural breaks is not ruled out when looking at the Z-model. In line with Hansen-Johansen preference for the *R-model*'s results when the two models give conflicting results, we interpret this evidence as pointing to a general stability of the parameters.

## 5. Overhang of loans to non-financial corporations

Anecdotal evidence suggests that prior to the recent crisis euro area banks increased their lending to non-financial corporations by more than expected on the basis of developments in structural factors such as fixed investment, internal financing and the cost of financing, which traditionally explain loan growth fairly well (see ECB, 2007a and 2008a). The VECM model estimated in section 4 can be employed to provide a measure of how much bank lending deviates from its long-term determinants during that period.

Figure 7 illustrates the error-correction term corresponding to the cointegration relation (c.v. 1) defined as the long-run credit demand. Following Calza et al. (2003), the error-correction term is scaled so that deviations from the long-term equilibrium relationship average zero over the sample period. Positive deviations from the zero horizontal line could be interpreted as departures from the long-run equilibrium (or *loan-demand overhang*). In other words, when the error-correction term is above (below) the horizontal line, the level of loans to the private sector is above (below) the equilibrium level implied by the model. As illustrated in Figure 7, since the beginning of 2005 loans to non-financial corporations have been higher than the equilibrium level and by end-2006 deviated as much as 15 percentage points.

The observed deviation of bank lending from the equilibrium level (as resulting from the long-run credit demand equation) affects also the difference between actual and simulated developments in loans to non-financial corporations: Figure 8 compares the annual increases of actual loans to non-financial corporations and that implied by the VECM model (including both long and short-run dynamics). In this respect, the *lending gap*, defined as the difference between these series, may therefore be interpreted as the annual growth rate of bank lending not captured by the model. As the loan overhang, the lending gap has also increased since the beginning of 2005. At the end of 2006, the annual increase in bank lending was close to 4 percentage points higher than the one simulated by the VECM model.[16]

A number of possible explanations for this deviation from the equilibrium can be ascribed to omitted effects that presumably have become relevant only over the past few years. Such effects may be related to both demand-side and supply-side factors.

Apart from the favourable bank financing conditions facing euro area corporations in those years, as exemplified by the low level of interest rates and easy bank credit standards,[17] a number of additional factors have been suggested to contribute to the unusually strong loan growth in this period.

One demand-side factor, which may have contributed in particular to strong credit growth, was the demand for funding derived from mergers and acquisitions (M&A), including leveraged buyout transactions. These operations surged in the period ranging from 2005 to mid-2007 (ECB, 2007c and 2008b). The existence of significant loan demand to fund M&A activity was also confirmed via survey evidence. According to the evidence provided by the bank lending survey for the euro area (Figure 9), for the 2005-2006 period the increase in M&A transactions was an important explanatory factor for credit growth. The empirical literature (De Bondt, 2002) suggests that short-term loans are mainly used as bridge financing for the initial phases of M&A transactions while, at a second stage, the bridge loans are substituted for long-term bank lending or debt securities issuance. The empirical evidence suggests that long-term financing of M&A transactions in the past has been mainly carried out primarily by issuing debt securities, or shares, while long-term loans only played a minor role in this respect. However, during that latter period the wave of M&A activity seems to have been mainly financed via long-term bank loans (see e.g. Greiber and Kok Sørensen, 2006; ECB, 2006 and 2008b). Indeed, there was a strong link between the acceleration of cash and debt-based M&A transactions and long-term loan flows.

It is, however, difficult to find a structural relationship between M&A activity and loan demand. First, M&A activity is expected to have a positive impact on short-term bank lending in the same quarter. Yet the period in which the demand for funds impacts on the long-term loan component could vary significantly (i.e. ranging from the same quarter and up to 5 quarters later), and works only if the bridge loan is refinanced by a bank loan. More

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[16] In comparison to Calza et al. (2006) who found a positive loan overhang in the period around 2000, our model does not point to any significant overhang in this period. One reason for the different findings, apart from the different modelling approaches, might be that Calza et al. model overall loans to the non-financial private sector, whereas we focus exclusively on loans to non-financial corporations.

[17] As illustrated by the results of the Eurosystem's bank lending survey. See also Jimenez et al. (2007).

importantly, M&A activity is subject to boom-bust behaviour implying that it is only important for explaining loans in certain temporary periods and hence it is difficult to find any long-run relationship (perhaps with the exception of short-term loans). The aforementioned evidence suggests that understanding the timing and the sign of the relationship between M&A activities and lending is not straightforward. This is a possible explanation of why we fail to find a direct effect of M&A within our VECM set-up.

As an illustration, we further investigate the relationship of the residual of the estimated model and M&A activity for the most recent wave of M&A activity. The correlation analysis between M&A activity (considered at different lags), the dynamic lending gap and the loan overhang suggests that the correlation is generally low over the full sample size, while increasing significantly over the period of higher M&A activity (2005-2006).[18]

Supply-side factors have also been suggested as supporting credit expansions and/or restrictions during certain periods. The "credit channel" focuses on how financial imperfections on credit markets (i.e. asymmetries of information between borrowers and lenders) would affect the supply and conditions of credit.[19] In this respect, the bank lending channel focuses on how financial imperfections *within* the banking system affect the transmission mechanism of monetary policy.[20] In other words, according to the bank lending channel, banks' conditions are expected to have an impact on banks' ability and willingness to grant credit to borrowers and on how they respond to monetary policy changes.[21]

A recent strand of the empirical literature analyses the effect of financial innovations in the area of securitisation and credit risk transfer on credit supply.[22] In this respect, a spectacular surge from 2004 onwards in financial innovation in the form of securitisation and credit risk transfer instruments potentially impacted on the supply of bank credit. There is indeed significant evidence suggesting that securitisation activity strengthens the capacity of banks to supply new loans to households and firms. It is also likely that the past years' historically low level of interest rates contributed to both developments in financial innovation and risk taking by banks in the form of larger amounts of lending.[23]

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[18] Results are available upon request.
[19] See ECB (2008a) for a literature review and ECB (2007b) for a review of recent changes to corporate finance in the euro area.
[20] See Bernanke (2008) for a review. See also Chami and T.F. Cosimano (2001) and Van den Heuvel (2002).
[21] For recent evidence for the euro area see for instance Angeloni, Mojon and Kashyap (2003), Ehrmann, Gambacorta, Martinez Pagés, Sevestre and Worms (2001).
[22] See e.g. Estrella (2002), Loutskina and Strahan (2006), Hirtle (2007) and Altunbas et al. (2007).
[23] See Jimenez et al. (2007) and Rajan (2005).

As our objective is to consider long-run developments, in our model the supply-side of the bank lending market is modelled through the third cointegrating vector. This vector suggests that banks set the lending rate as a mark-up over the policy rate. Using our interpretation of this vector as supply effects, one can analyse possible structural changes in the supply-side of credit markets by testing the presence of a structural break in the mark up. The hypothesis of a constant mark up over the long run is however not rejected by the data, while the presence of breaks or a time trend in the mark up is rejected.[24] The cointegrating vector that represents the supply-side of the model is stable and stationary over the sample period. This finding suggests that shifts in the loan supply as interpreted in our model – if any – are not captured by our simple supply equation.

## 6. Impulse response functions

In order to examine the sensitivity of our main variables to changes in monetary policy, a simulation exercise was performed to generate time paths for the endogenous variables in response to shocks to the policy rate, to the cost of the other sources of financing and to the risk premium, respectively.

As for the shock to the policy rate, in the long run, its impact works through two main channels: through a relative-price channel and via the investment channel. Namely, as the policy rate increases, the cost of lending tends to adjust toward the new long-run level (cl= 1.5+mm, c.v.3). The increase in the cost of lending implies a negative direct effect on investment (c.v.2) that, in turn, reduces loan demand. The increase in the cost of lending also produces a direct effect on the demand for loans, which declines as the cost of lending becomes more expensive than other forms of financing (c.v.1).

Figure 10 shows the adjustment paths of loans to non-financial corporations, GDP, investment, gross operating surplus, and the cost of lending to changes in the cost of bank lending. Starting from a base where the system is in equilibrium, the experiment implies a permanent increase of the money market rate by 25bp. The policy rate increase implies a reduction of all the endogenous variables with the exception of the cost of lending. The latter exhibits a gradual upward adjustment, reflecting the traditional sluggish pass-through of

[24] According to the definition of cointegrating vectors, the long-run credit supply equation, as identified by the third cointegrating relationship (equation 5), is stationary. The stationarity of the vector does not rule out the presence of linear trend and break points that could signal changes in the credit supply conditions over time. Johansen, Mosconi and Nielsen (2000) study the cointegration analysis in the presence of structural breaks and propose a cointegration model with piecewise linear trend and break points. We exploited the Johansen, Mosconi and Nielsen procedure to look for linear trend or break points in the third cointegrating vector. As the procedure is developed for known time trend and known break points, the analysis has been replicated at several periods of time. We did not find any evidence in favour of trend or breaks in the third cointegrating relationship (for different results in the literature, see footnote 10).

bank interest rates to changes in market rates.[25] Loans to non-financial corporations start to decline after two quarters but the adjustment is only gradual. The time path and the strength of the adjustment are both in line with other studies on loans to the non-financial private sector in the euro area.[26] There is a maximum decline of 6.5 percentage points over 40 quarters. In line with the real business cycle theory, the time path of investment is similar to the GDP response, although the magnitude of the effect on investment is as much as five times as large as the magnitude of the effect on GDP. Finally, the adjustment of the lending rate is quicker to the policy shock than the impact on loans and GDP (the adjustment is fully realized in 12 quarters).

Figure 11 shows the impact of a temporary (4 quarters) 25bp increase in the policy rate: the effect is fully absorbed by the system in a period ranging from 25 to 29 quarters for loans, GDP, investment and gross operating surplus and 13 quarters for the cost of lending (Table 8.a). As for the shock to the cost of other sources of financing, in the long run, an increase in the cost of other sources of financing determines an increase in the loan demand as the relative cost of bank lending decline (relative price effect). In the short run, different effects seem to be at work: an increase in the cost of other sources of financing causes some downward effects over loans, GDP, investment and gross operating surplus (for example, through the increase in the cost of lending) that are not offset, over a 10-year horizon, by the price effects. As shown in Table 8.b, after 10 years the increase in the cost of other sources of financing causes a (small) decline in the endogenous variables (with the exclusion of the cost of lending).

As for the shock to the risk premium, the experiment consists of increasing by 20 basis points the mark-up of cointegrating vector 3. The increase in the mark-up is supposed to reflect higher risk in the lending market and thus tighter lending conditions. The increase in the mark-up may also be interpreted as a price restriction in the loan supply. Table 8.c summarises the response of the endogenous variables to this (permanent) shock: the time path of the variables is similar to the policy rate increase scenario, even if the size of the contraction in lending, GDP, investment and surplus is smaller.

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[25] See e.g. De Bondt (2002) and Kok Sørensen and Werner (2006).

[26] For instance, Gambacorta and Rossi (2007) find that a 25bp exogenous shock to the policy rate causes the adjustment to loans to fully realise in 48 quarters with a maximum negative impact of 6 percentage points

## 7. Forecasting

Finally, we evaluate the forecasting ability of the estimated equation of loans to non-financial corporations estimated according to the VECM as opposed to a standard AR (1) model. For this purpose, we re-estimate the VECM up to the last quarter of 2003 and use the remaining 12 observations to evaluate the out-of-sample forecasting properties of the model.

Figure 12 shows the static and dynamic forecasts of loans to non-financial corporations for the period ranging from the first quarter of 2004 to the last quarter of 2006. The static forecast calculates the predicted bank lending amount at time t using the actual lagged bank lending amount, while the dynamic forecast uses past forecasts of bank lending. For the VECM model, the actual loans to non-financial corporations lies within the 95% confidence band of the static forecast all over the forecasting sample, and lies within the band of the dynamic forecast up to the last quarter of 2005 suggesting a reliable forecasting performance up to two years ahead. The "overshooting" towards the end of the forecast horizon possibly reflects that the model does not fully capture the extraordinary acceleration of corporate loan growth in the euro area observed in this period (see also discussion above). The same exercise, carried out using the AR(1) equation, shows that the forecasted values lie within the (wider) bands with lower frequency. When comparing the conventional forecasting performance indicators for both the VECM and the AR(1) equations, the VECM equation yields the smallest errors for both the static and the dynamic method. This would suggest an improved forecasting performance against the AR(1) equation.

## 8. Conclusions

This study provides an empirical investigation for modelling developments of loans to non-financial corporations in the euro area. In line with the literature on money demand and credit to the private sector, the econometric framework is based on the identification of the long and short-run dynamics. As for the long run, we identify three relationships driving the loan market. These relationships are interpreted as the credit demand, the investment equation and a cost of lending equation that, under certain conditions, may be seen as a credit supply equation. The latter aims at overcoming the problem of identifying the supply-side which is typical of conventional macro models of bank lending. This study also contributes to the empirical literature on bank lending by modelling a substitution effect between bank lending and the other sources of financing working mainly through a price channel.

Out of sample forecasts suggest that, overall, the model seems to offer a reasonable framework to analyse developments in loans to non-financial corporations and its main determinants which can be used for a policy perspective. We also consider how a number of factors (such as M&A activity or supply effects) could alter loan dynamics in the short-term due to impacts on both the demand and the supply of loans. These factors seem to be often correlated with developments in our model residuals and are often useful to explain "the loan overhang", or "the lending gap", during certain periods, although not in a systematic way. This would suggest than the analysis of residuals of the model in connection with other factors can potentially offer significant information content during certain periods.

The model is finally used to carry out a number of policy experiments. The main finding regards the impact of shocks to the policy rate on bank lending. Namely a 25bp permanent increase in the policy rate causes a reduction in bank lending of about 1.4, 5.4 and 6.4 percent after 2, 5 and 10 years, respectively. A second finding regards the reaction of lending to an increase in the lending risk premium. A 20bp increase in the risk premium reduces bank lending to non-financial corporations by about 0.6, 4.0 and 5.1 percent after 2, 5 and 10 years, respectively.

Future research should be directed towards at least three additional issues. First, an analysis of bank lending to non-financial corporations by different maturities would get some further insight about the determinant of bank lending. For instance, it is often argued that short-term lending is more cyclical than developments in long-term loans. Second, further research could also be directed towards the analysis of direct substitution effects between the alternative external financing instruments for non-financial corporations (i.e. debt securities and equities issuance). Finally, particular attention should be devoted in the future to develop more sophisticated econometric frameworks to disentangle and quantify the effect over bank lending of supply factors (such as credit restrictions, or the effect of financial innovation) or additional demand elements (such as M&A activity).

*Table 1*

**EMPIRICAL LITERATURE ON THE CREDIT MARKET IN THE EURO AREA (1)**

| **Paper** | **Country** | **Method** | **Cointegrating equation(s)** | **Main conclusions** |
|---|---|---|---|---|
| **A. LOANS TO NON FINANCIAL CORPORATIONS** | | | | |
| Focarelli and Rossi (1998) | Italy (1984-1996) | Starting from a 5-variable VECM (1 lag), the model is then reduced to a one credit equation (as all the variables, but credit, are found to be weakly exogenous). Credit is taken in first difference (Δ). | $\Delta(L^{n,e}) = 0.11\ (I^{n,e} - E)$ (1)<br>$I^{n,e} = 0.46\ E$ (2)<br>$l^{n,e} = igov^{n}$ (3) | Three cointegrating relationships are found: (1) loan demand; (2) relationship between investment and borrowing requirement; (3) the lending rate equals the risk free government bonds yields. The underlying hypothesis is that credit market is both demand and supply determined. Credit supply schedule is flat; banks are price maker (3). |
| Berkel and Werner (2005) | Euro area (1991-2004) | A 3-endogenous and 3-exogenous variables VECM is employed. The exogenous variables, which do not enter the cointegrating relationship, are: (1) real market based cost of debt, (2) the GOS/GDP ratio, (3) debt/GDP. | $L^{r,e} = 0.82\ inv^{r} - 0.05 l^{r,e}$ (1) | One cointegrating relationship is found and it is interpreted as the loans demand. The exogenous variables are found to be not significant. A forecast exercise is conducted (with a reduction from a three-equation system to a one equation system). |
| Kakes (2000) | The Netherlands (1983-1996) | Long and short term loans to the corporate sector are analyzed using two VECM models (4 lags). All variables are treated as endogenous. | Short term loans<br>$L^{r,e} = 1.8\ y^{r} - 0.6\ l^{n,e}$ (1)<br>$L^{r,e} = 1.7\ y^{r} + 0.1\ (l^{n,e} - i^{n})$ (2)<br>Long term loans<br>$L^{r,ps} = 2.5\ y^{r} - 0.2\ l^{n,e}$ (3) | Two cointegrating relationships are found in the short term loan model (credit demand (1) and supply (2)). In the model for long term loans just one cointegrating vector is found (3) and is interpreted as the credit demand equilibrium. |
| Casolaro et al. (2006) | Italy (1988-2003) | Starting from a 4-variable VECM, the model is reduced to two equations as k and ($l^{n,e}$-$i^{n,e}$) are found to be weakly exogenous. | $L^{n,e} = 1.4 + k^{n} - 0.2\ (l^{n,e} - i^{n,e}) + 2.2\ (I^{n,e}/E)$ | One cointegrating relationship is detected. It represents the equilibrium between demand and supply. The two schedules, however, are not disentangled**.** |

| B. CREDIT TO PRIVATE SECTOR | | | | |
|---|---|---|---|---|
| Hofman (2001) | 8 euro area countries (1980-1998) | A 4-variable VECM is estimated for different countries. All variables are endogenous. The lags vary depending on the country under analysis. | $L^{r,ps}=\beta_1 y^r+\beta_2 l^{r,ps}+\beta_3 ph^{re}$ <br><br> (values of the β vector vary across countries) | Without the inclusion of $p^{re}$ within the set of the endogenous variables the model fails to detect cointegrating relationships. The inclusion of $p^{re}$ allows the identification of one long run relationship in all countries but Germany. The cointegrating vector is interpreted as the credit demand equilibrium. The credit market is demand determined. |
| Hulsewig (2003) | Germany (1975-1998) | A 5-variable VECM (4 lags) is used. *PY* and $eq^r$ are found to be weakly exogenous. | $L^{n,ps} = 0.9\, PY - 0.2\, l^{n,ps}$ *(1)* <br><br> $L^{r,ps} = 0.1\, (l^{n,ps}-i^n)+0.8\, eq^r$ *(2)* | Two cointegrating relationships are found and are interpreted as the credit demand and the credit supply equilibrium. Credit reacts only slowly in the direction of the long run credit demand and supply equation (the loadings of the two cointegrating vectors are not significant in the credit equation). Supply effects are significant through their impact on lending rate |
| Calza et al. (2006) | Euro area (1980-2001) | 4-variables VECM (4 lags). The variables *y* and *l* are found to be weakly exogenous. | $L^{n,ps}-p = 1.6\, y^r - 5.0\, l^n + 5.9\, \pi$ | One cointegrating relationship is detected and it is interpreted as the credit demand equilibrium. The credit market is assumed to be demand driven. |

*Note: **(1)** All papers use quarterly data. Superscripts have the following meaning: **n** refers to nominal variables and **r** to real variables. As for sectors, **e** indicates enterprises, **h** households (**hh** for housing finance **ho** for other purposes), **ps** private sector. As for explicatory variables, according to the definition in section 2, **L** refers to loans, **y** to GDP, **l** to lending rate, **p** to consumer price index and **i** to the short term interest rate. As for other symbols, **ph** is the house price index, **x** is the equity price index, **C** is consumption expenditure, **H** is the housing investment, **I** is the investment expenditure and **E** is the earnings before interest, taxes, depreciation and amortization, **igov** is the interest rate on government bonds up to one year, **π** is the inflation rate, **PY** is the private share of real GDP, **eq** is the banks equity position and **k** is the firms' capital stock. As a general rule, all variables are in logs with the exclusion of interest rates and ratios.*

*Table 2*

**TESTING FOR UNIT ROOT(1)**

| | **Null hypothesis** | **Alternative hypothesis** | **Test statistics** | | | |
|---|---|---|---|---|---|---|
| | | | **ADF(2)** | **lags** | **PP(3)** | **lags** |
| **L** | I(1) | I(0) | -2.95 | 2 | 0.21 | 5 |
| | I(2) | I(1) | -2.255 | 1 | -4.54*** | 4 |
| **Y** | I(1) | I(0) | -3.24 | 1 | -2.88 | 4 |
| | I(2) | I(1) | -5.11*** | 0 | -5.19*** | 1 |
| **I** | I(1) | I(0) | -3.37 | 2 | -2.06 | 4 |
| | I(2) | I(1) | -2.60* | 1 | -5.69*** | 3 |
| **S** | I(1) | I(0) | -2.5 | 0 | -2.5 | 0 |
| | I(2) | I(1) | -6.84**** | 0 | -6.79*** | 5 |
| **cl** | I(1) | I(0) | -1.64 | 1 | -1.65 | 4 |
| | I(2) | I(1) | -3.90*** | 0 | -3.98*** | 2 |
| **x** | I(1) | I(0) | -1.35 | 1 | -1.41 | 1 |
| | I(2) | I(1) | -7.12*** | 0 | -7.12*** | 0 |
| **mm** | I(1) | I(0) | -1.87 | 1 | -1.93 | 3 |
| | I(2) | I(1) | -4.59*** | 0 | -4.59*** | 0 |

*Note: **(1)***** Rejection of the null at 1% significance level, ** Rejection of the null at 5% significance level, Rejection of the null at 10% significance level. **(2)** ADF is the Augmented Dickey Fuller (1991) test. The number of the lags used in the model for each series is chosen by comparing three different information criteria (Schwarz, Hannan-Quinn and Akaike). Constant included in all the auxiliary regressions, deterministic trend only if statistically significant at the 5% level. **(3)** PP is the Phillips Perron (1988) test. The number of truncation lags is suggested by the Newey West criterion. Constant included in all the auxiliary regressions, deterministic trend only if statistically significant at the 5% level*

*Table 3*

## LAG ORDER DETERMINATION

Information criteria: AK=Akaike and HQ=Hannan-Quinn. The Likelihood Ratio (LR) are computed taking into account the small sample correction suggested by Sims (1980). GODF=Godfrey portmanteau test for autocorrelation of order 4. The symbol * indicates lag order selected by the criterion.

| lag (h) | LR: L[h] vs L[h-1] | df | p-value | LR: L[4] vs L[h] | df | p-value | AK | HQ | GODF p-value |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | 49 | n.a. | 163.94 | 147 | 0.161 | -46.97 | -46.48* | 0.02 |
| 2 | 85.07 | 49 | 0.00 | 103.753 | 98 | 0.326 | -47.12 | -45.95 | 0.05 |
| 3 | 67.68 | 49 | 0.04* | 47.66 | 49 | 0.527 | -47.14* | -45.31 | 0.14* |
| 4 | 47.66 | 49 | 0.52 | n.a. | 0 | n.a. | -46.91 | -44.42 | 0.12 |

*Table 4*

## JARQUE-BERA NORMALITY TESTS

| Equation | Skewness | p-value | Kurtosis | p-value | Skewness & Kurtosis | p-value |
|---|---|---|---|---|---|---|
| L | 3.958 | 0.05 | 1.016 | 0.31 | 4.974 | 0.08 |
| Y | 0.262 | 0.61 | 2.733 | 0.10 | 2.994 | 0.22 |
| I | 0.064 | 0.80 | 5.558 | 0.02 | 5.622 | 0.06 |
| S | 0.001 | 0.98 | 5.625 | 0.02 | 5.630 | 0.06 |
| cl | 1.867 | 0.17 | 0.233 | 0.63 | 2.112 | 0.35 |
| x | 0.414 | 0.52 | 2.686 | 0.10 | 3.090 | 0.21 |
| mm | 0.459 | 0.50 | 0.523 | 0.47 | 0.982 | 0.61 |

*Note: **(1)** Normality is accepted when the p-value is larger than 5 per cent.*

*Table 5*

**COINTEGRATION ANALYSIS**

**A.** Test for the cointegration rank of the models. ** denotes rejection of the null at the 5 per cent significance level. Johansen λ-trace tests take into account the adjustment for degrees of freedom proposed by Reimers (1992) for small samples. In order to make the test result consistent with the presence of three point dummies in the model, asymptotic critical values are calculated with the approach suggested by Johansen and Nielsen (1993). The asymptotic estimates of the critical values involve 100,000 simulations with 800 steps in the approximation to Brownian motion. **B.** LR test on the overidentifying restrictions. **C.** Identified cointegrating vectors.

**A. Number of cointegrating vectors**

| $H_0$: $r$=0 | $H_0$: $r$≤1 | $H_0$: $r$≤2 | $H_0$: $r$≤3 | $H_0$: $r$≤4 | $H_0$: $r$≤5 | H0: r≤6 |
|---|---|---|---|---|---|---|
| 200.38** | 130.93** | 83.18** | 51.55 | 28.37 | 13.05 | 3.46 |

**B. LR test**

| Chi-sq | D.F | P-value |
|---|---|---|
| 18.73 | 11 | 0.07 |

**C. Cointegrating vectors**

(standard errors in brackets)

$$L = Y - \underset{(0.00)}{0.04}(cl - x) + \underset{(0.357)}{11.4}$$

$$I = \underset{(0.02)}{0.13}S - \underset{(0.00)}{0.07}\,\mathrm{cl}$$

$$cl = mm + 1.5$$

*Table 6*

**WEAK EXOGENEITY(1)**

| H0: weak exogeneity of | LR test | DF | P-value |
|---|---|---|---|
| $L$ | 14.09 | 3 | 0.00 |
| $y$ | 45.12 | 3 | 0.00 |
| $I$ | 29.87 | 3 | 0.00 |
| $S$ | 41.28 | 3 | 0.00 |
| $l$ | 32.17 | 3 | 0.00 |
| $x$ | 4.76 | 3 | 0.19 |
| $mm$ | 5.80 | 3 | 0.12 |

*Note: **(1)** Weak exogeneity is accepted when the p-value is larger than 5 per cent.*

*Table 7*

**COEFFICIENTS OF THE MODEL IN REDUCED FORM**

**(x and mm exogenous)**

$$L = Y - \underset{(0.00)}{0.038}(cl - x) + \underset{(0.463)}{14.5} \quad \text{(c.v. 1)}$$

$$I = \underset{(0.01)}{0.38}S - \underset{(0.00)}{0.04}\,\mathrm{cl} \quad \text{(c.v. 2)}$$

$$cl = mm + 1.5 \quad \text{(c.v. 3)}$$

| | **Eq. L** | | **Eq. Y** | | **Eq. I** | | **Eq. S** | | **Eq. cl** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **coeff.** | **p-value** | **coeff.** | **p-value** | **coeff.** | **p-value** | **coeff.** | **p-value** | **coeff.** | **p-value** |
| $\alpha_1$ | -0.041 | 0.04 | 0.011 | 0.01 | 0.064 | 0.00 | 0.023 | 0.00 | | |
| $\alpha_2$ | 0.042 | 0.03 | -0.020 | 0.02 | -0.125 | 0.00 | -0.043 | 0.01 | | |
| $\alpha_3$ | -0.002 | 0.40 | -0.002 | 0.00 | | | | | -0.167 | 0.00 |
| $\Delta(L)_1$ | | | | | | | | | | |
| $\Delta(L)_2$ | 0.252 | 0.02 | | | | | | | | |
| $\Delta(Y)_1$ | | | | | | | 0.168 | 0.32 | | |
| $\Delta(Y)_2$ | -0.438 | 0.08 | -0.194 | 0.07 | | | -0.657 | 0.00 | | |
| $\Delta(I)_1$ | 0.153 | 0.02 | 0.085 | 0.01 | | | | | | |
| $\Delta(I)_2$ | 0.458 | 0.00 | | | 0.350 | 0.00 | | | | |
| $\Delta(S)_1$ | | | 0.036 | 0.38 | | | 0.046 | 0.63 | | |
| $\Delta(S)_2$ | -0.202 | 0.07 | 0.147 | 0.00 | 0.146 | 0.13 | 0.325 | 0.00 | | |
| $\Delta(cl)_1$ | | | | | | | | | 0.202 | 0.00 |
| $\Delta(cl)_2$ | | | | | | | | | | |
| $\Delta(x)_1$ | | | | | | | | | | |
| $\Delta(x)_2$ | | | 0.001 | 0.47 | | | | | | |
| $\Delta(mm)_0$ | 0.004 | 0.04 | 0.001 | 0.23 | 0.007 | 0.001 | | | 0.467 | 0.00 |
| $\Delta(mm)_1$ | | | | | | | | | | |
| $\Delta(mm)_2$ | -0.004 | 0.05 | -0.002 | 0.01 | | | | | | |
| **Dummy01q1** | 0.01 | 0.07 | 0.027 | 0.00 | 0.034 | 0.00 | 0.041 | 0.00 | | |
| **Dummy95q1** | | | -0.004 | 0.14 | | | 0.039 | 0.00 | | |
| **Dummy91q4** | | | 0.016 | 0.00 | 0.028 | 0.00 | 0.032 | 0.00 | -0.361 | 0.02 |

## IMPULSE RESPONSE FUNCTION (1)

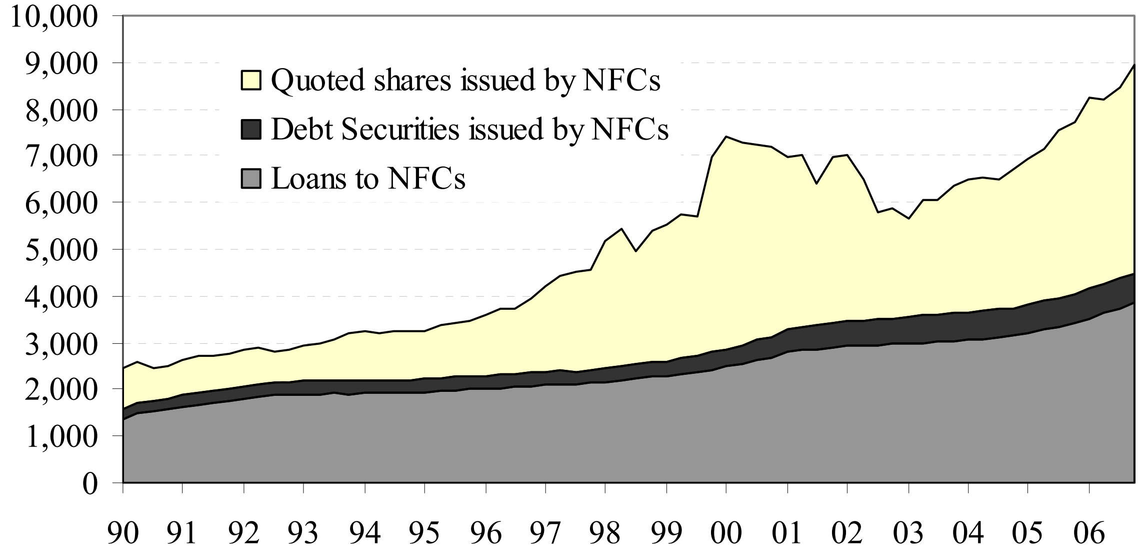
| | L | Y | I | S | cl | x | mm |
|---|---|---|---|---|---|---|---|
| | | | | **PERMANENT SHOCK** | | | |
| | **a. 25bp shock to mm** | | | | | | |
| **2Y** | -1.4 | -1.5 | -7.2 | -2.2 | 23 | 0.0 | 25 |
| **5Y** | -5.4 | -2.6 | -12.5 | -3.1 | 25 | 0.0 | 25 |
| **10Y** | -6.4 | -2.8 | -13.6 | -3.3 | 25 | 0.0 | 25 |
| | **b. 25bp shock to x** | | | | | | |
| **2Y** | -0.4 | -0.3 | -1.1 | -0.3 | 1.0 | 25 | 0.0 |
| **5Y** | -0.4 | -0.2 | -0.7 | -0.2 | 0 | 25 | 0.0 |
| **10Y** | -0.3 | -0.2 | -0.6 | -0.2 | 0 | 25 | 0.0 |
| | **c. 20bp increase in the mark-up** | | | | | | |
| **2Y** | -0.6 | -0.8 | -4.7 | -1.5 | 17.7 | 0.0 | 0.0 |
| **5Y** | -4.0 | -1.9 | -9.8 | -2.5 | 19.9 | 0.0 | 0.0 |
| **10Y** | -5.1 | -2.1 | -10.9 | -2.7 | 20.0 | 0.0 | 0.0 |
| | | | | **TEMPORARY SHOCK** | | | |
| | **d. 25bp shock to mm** | | | | | | |
| **2Y** | -1.7 | -0.9 | -4.0 | -1.0 | 3.0 | 0.0 | 0.0 |
| **5Y** | -0.8 | -0.2 | -0.9 | -0.2 | 0.1 | 0.0 | 0.0 |
| **10Y** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **e. 25bp shock to x** | | | | | | |
| **2Y** | -0.4 | -0.1 | -0.3 | 0.0 | -1.0 | 0.0 | 0.0 |
| **5Y** | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| **10Y** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **f. 20bp increase in the mark-up** | | | | | | |
| **2Y** | -0.8 | -0.6 | -3.0 | -0.9 | 4.0 | 0.0 | 0.0 |
| **5Y** | -0.8 | -0.2 | -0.9 | -0.2 | 0.2 | 0.0 | 0.0 |
| **10Y** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

*Note:**(1)**The experiment consists in analyzing the effect, over the endogenous variables of a 25 permanent increase in the policy rate (panel a), of a 25bp permanent increase in the cost of other forms of financing (b), of a 20bp permanent increase in risk premium (c), of a 25bp temporary (4 quarters) increase in the policy rate (d), of a 25bp temporary increase in the cost of other forms of financing (e), of a 20bp temporary increase in risk premium (f).*

*Fig.1.*

**SOURCES OF FINANCING FOR NON-FINANCIAL CORPORATIONS**

*(EUR billions, outstanding amounts, end of period values)*

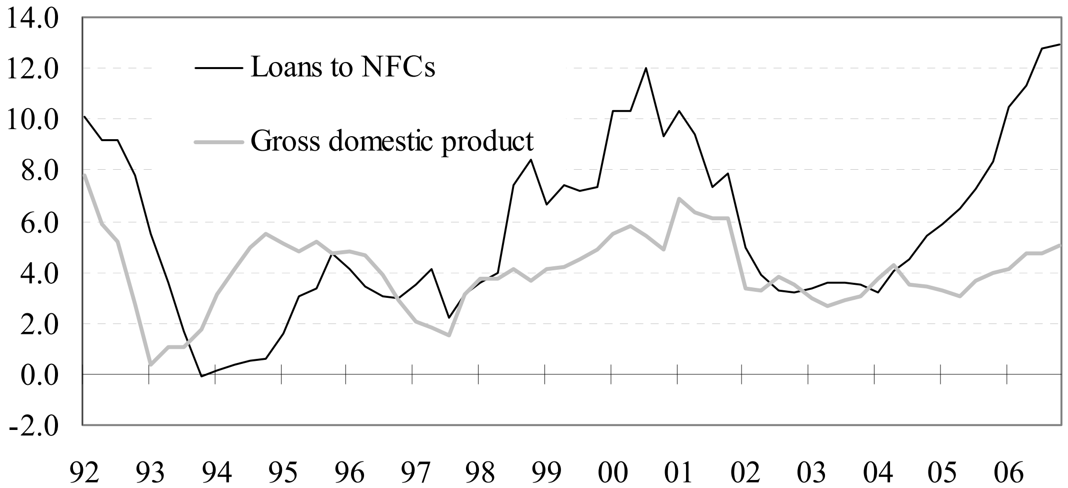



*Source: ECB*

*Fig. 2*

**LOANS TO NON-FINANCIAL CORPORATIONS AND GROSS DOMESTIC PRODUCT**

*(annual percentage changes)*

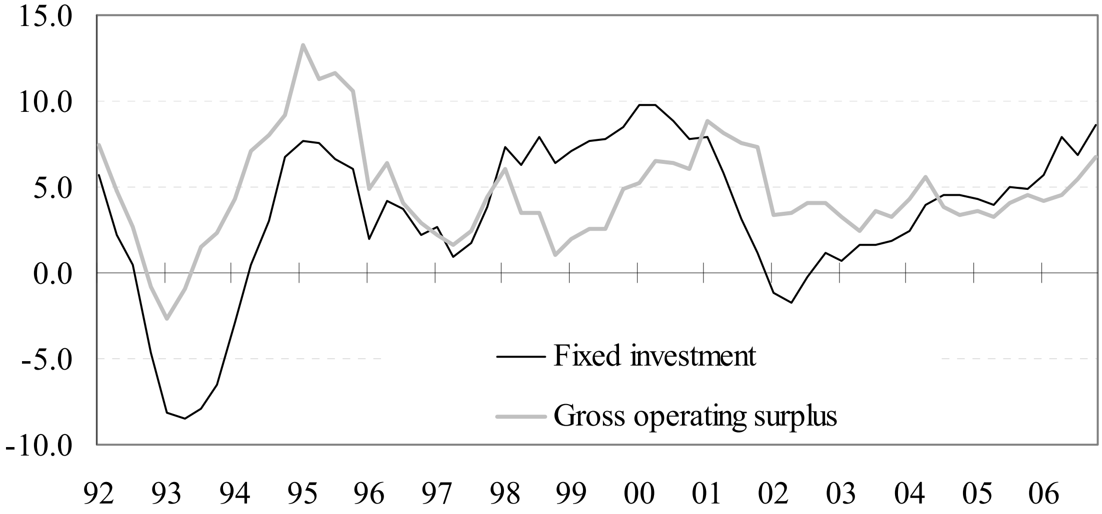



*Source: ECB*

*Fig. 3*

**INVESTMENT AND GROSS OPERATING SURPLUS**

*(annual percentage changes)*

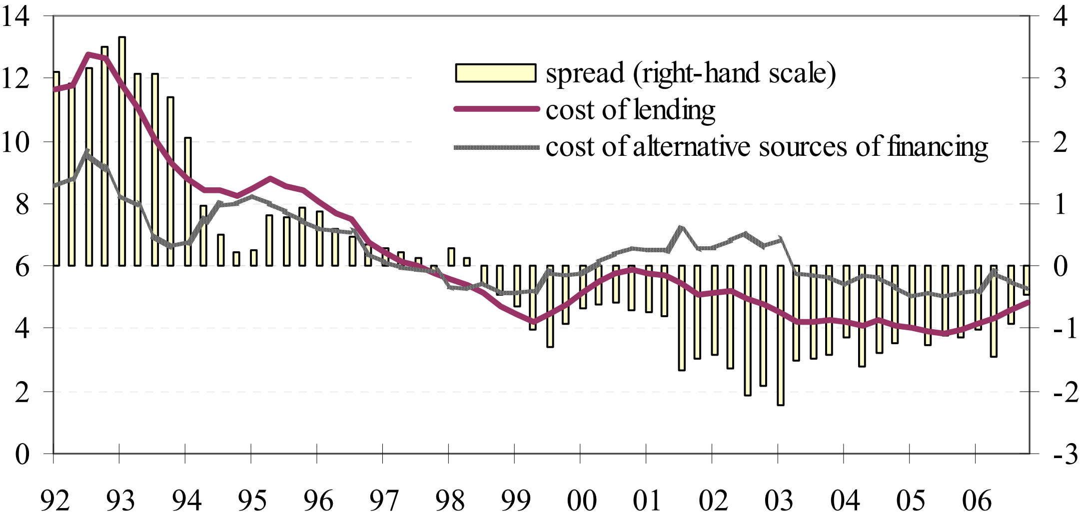



*Source: ECB*

*Fig.4*

**FINANCING COST (1)**

*(percentage points)*



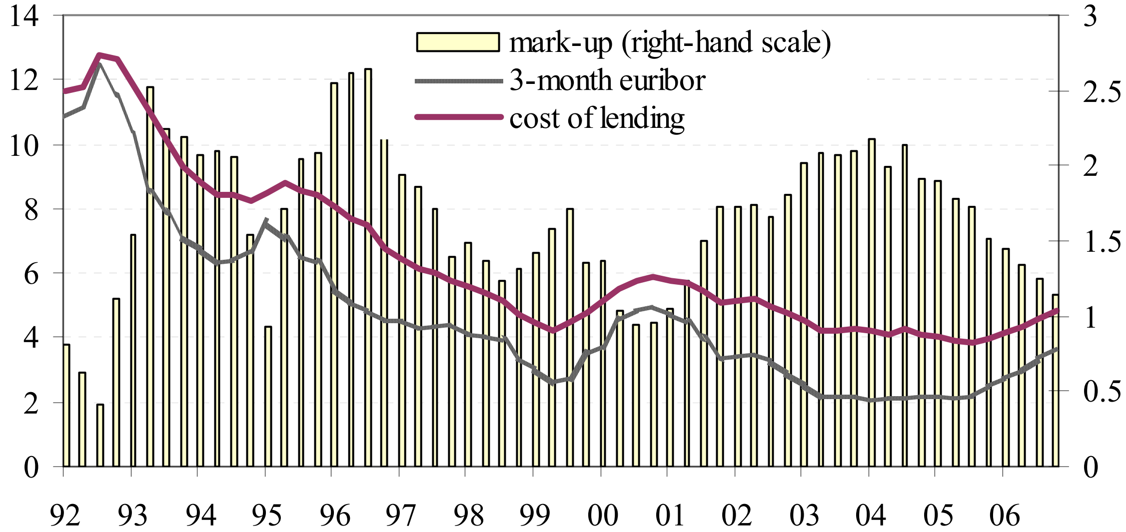

*Source: authors' calculation on ECB data*

*Note: (1) For a description of how the cost of lending and the cost of the other sources of financing are calculated, see Section 3.*

*Fig.5*

**COST OF BANK LENDING**

*(percentage points)*

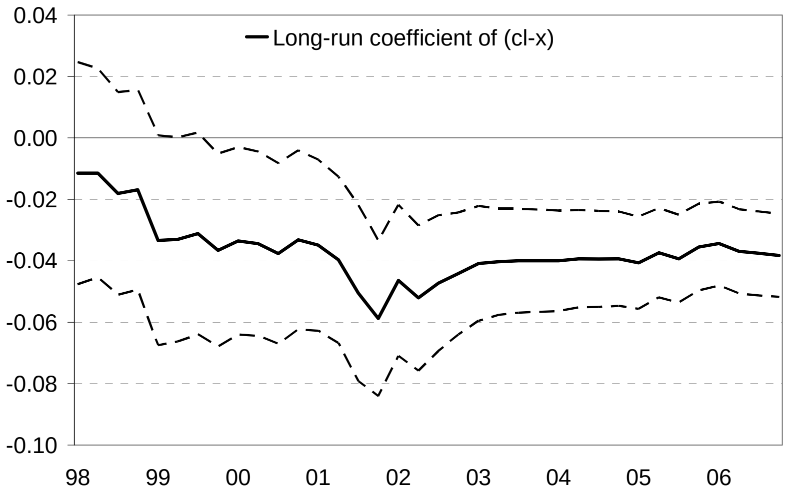


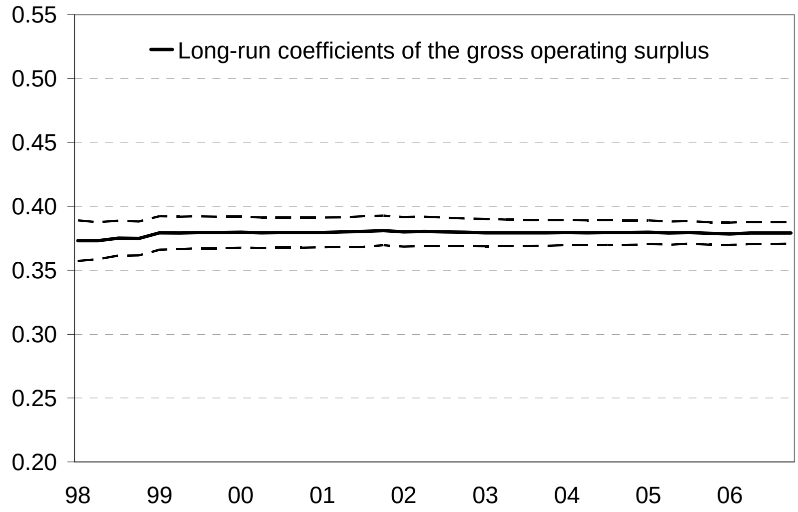

*Source: authors' calculation on ECB data*

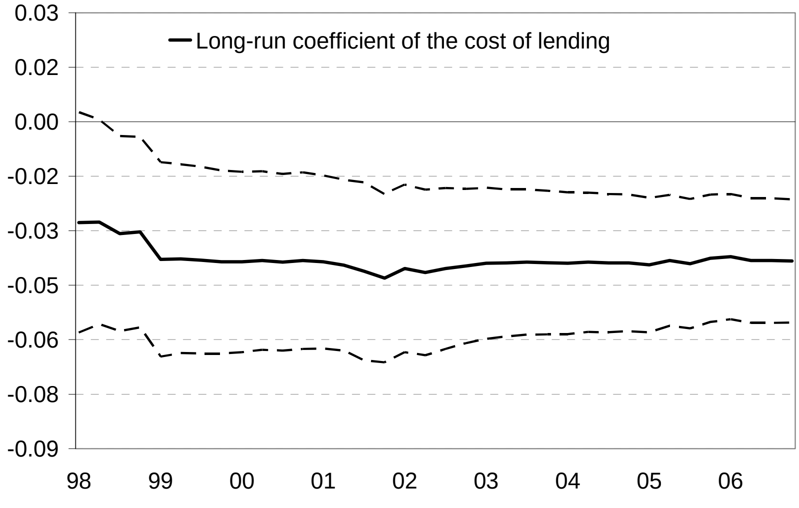
*Fig.6*

**STABILITY OF COEFFICIENTS**

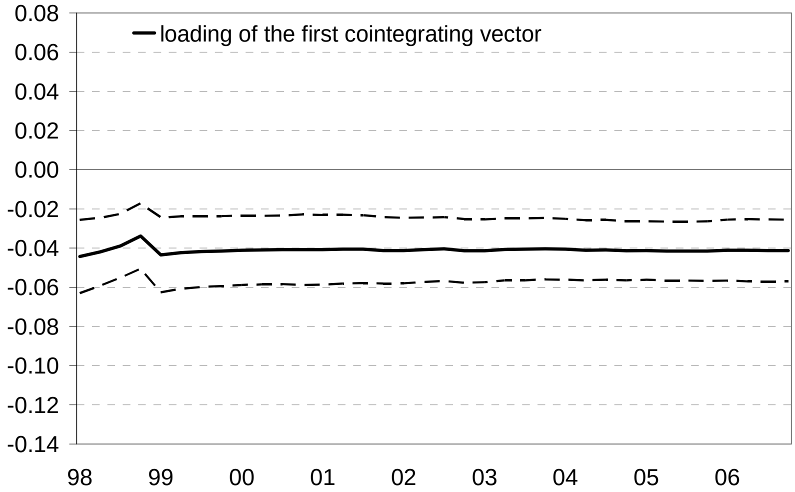
*a) Recursive estimates of the long run coefficients*

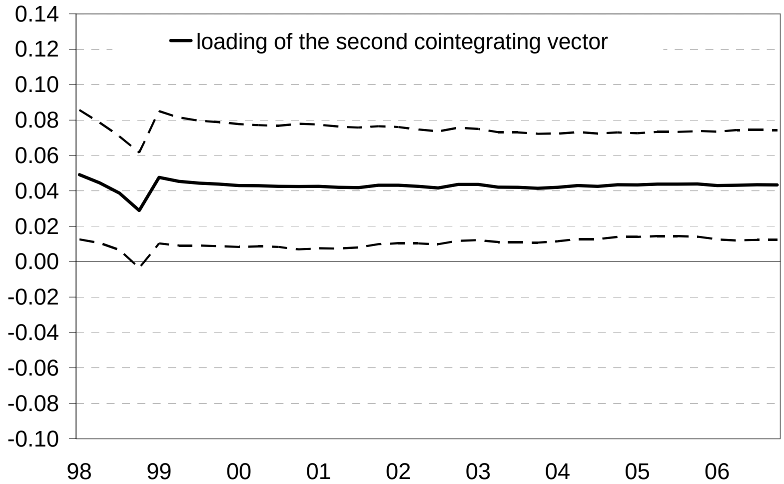


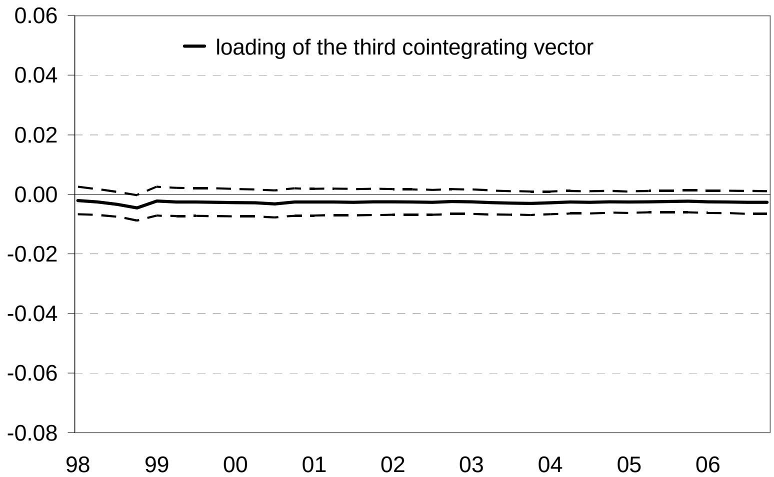



*b) Recursive estimates of the loading coefficients of the lending equation*



*c) Recursive Hansen and Johansen (1993) parameter constancy test*

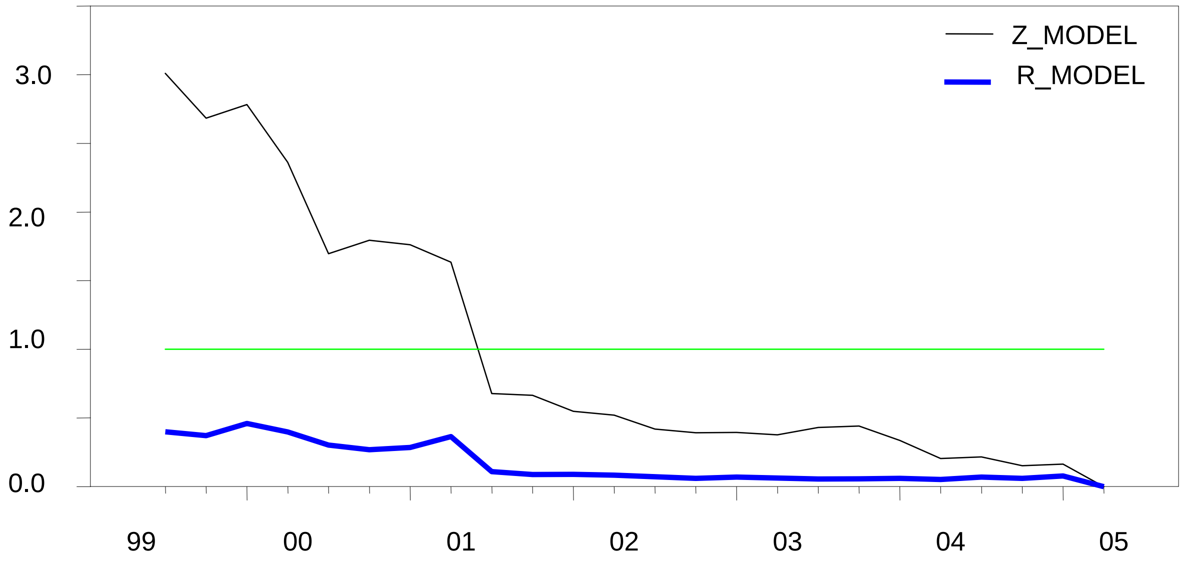
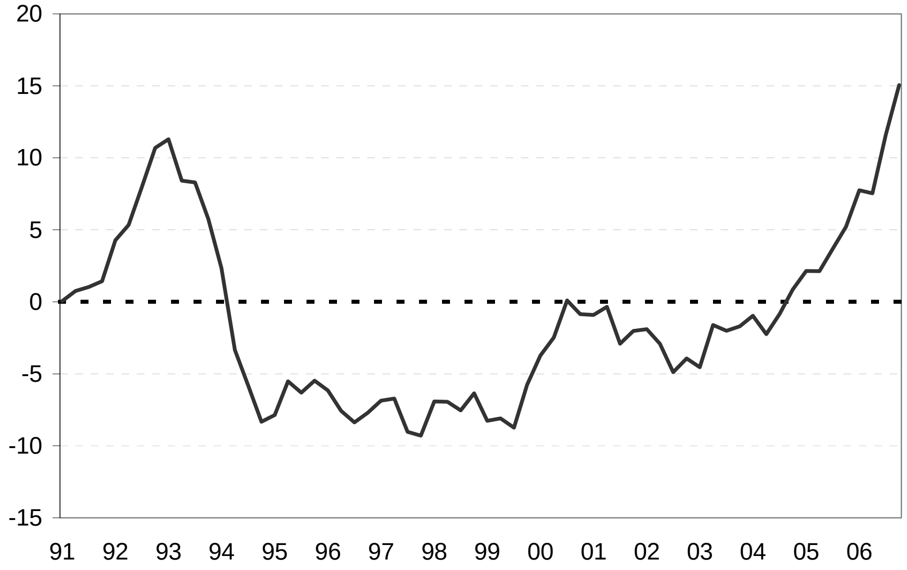


*Fig.7*

**LOAN DEMAND "OVERHANG"(1)**

*( percentage points)*



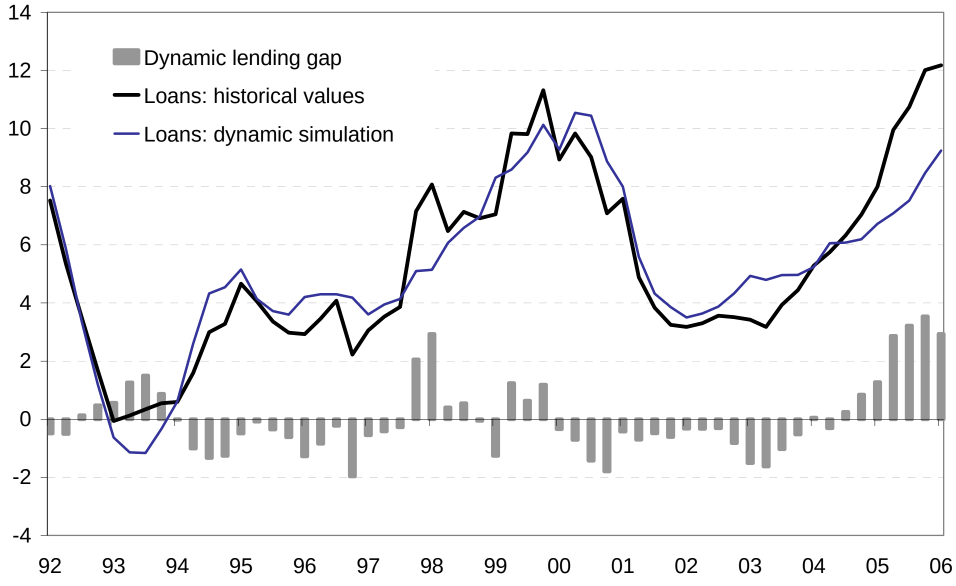

*Source: authors' calculation on ECB data*

*Note: (1) Loan demand error correction term (c.v.1) rescaled to average zero over the sample period.*

*Fig.8*

**LENDING GAP (1)**

*( percentage points)*



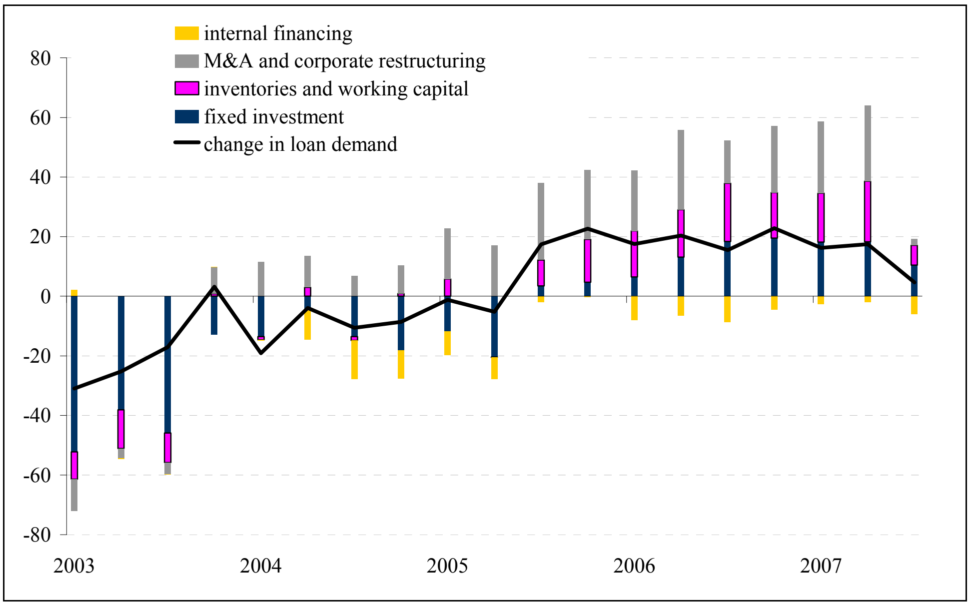

*Source: authors' calculation on ECB data*

*Note: (1) Loans to non-financial corporations has been dynamically simulated over the 1992-2006 period using the model estimated over the whole sample size (see. Table 7).*

*Fig.9*

**CHANGES IN DEMAND FOR LOANS TO ENTERPRISES AND FACTORS CONTRIBUTING (1)**

*(net percentages of banks reporting a positive contribution to demand)*




*Source: The euro area bank lending survey*

*Note: (1) The net percentages for the questions on demand for loans are defined as the difference between the sum of the percentages for "increased considerably" and "increased somewhat" and the sum of the percentages for "decreased considerably" and "decreased somewhat".*

*Fig.10*

**ADJUSTMENT PATHS TO POSITIVE 25 PERMANENT CHANGE IN THE MONETARY POLICY INDICATOR**

*(Percentage values and basis points; the horizontal axis shows the number of quarters after the shock )*

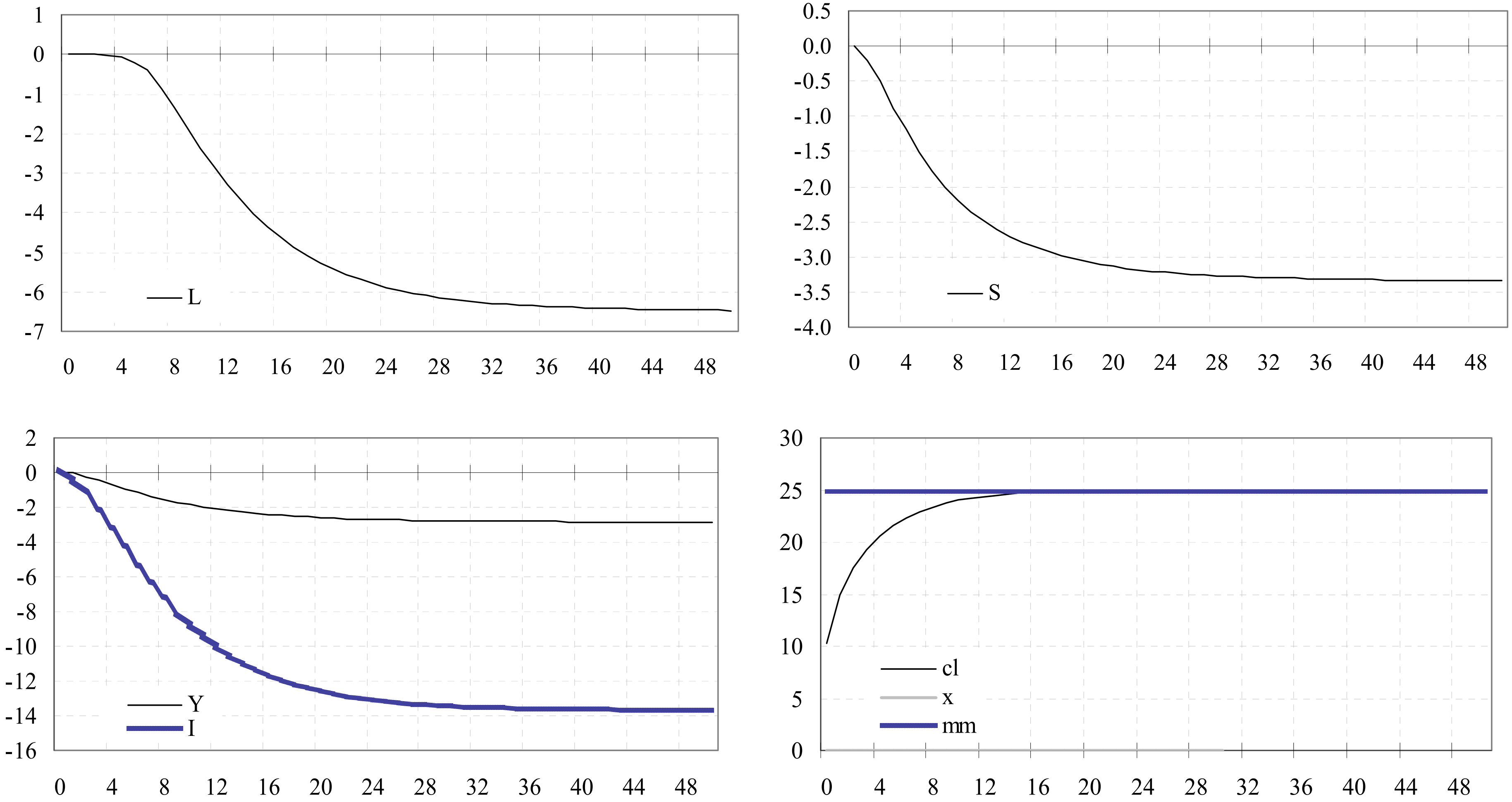


*Fig.11*

**ADJUSTMENT PATHS TO POSITIVE 25 TEMPORARY CHANGE IN THE MONETARY POLICY INDICATOR**

*(Percentage values and basis points)*

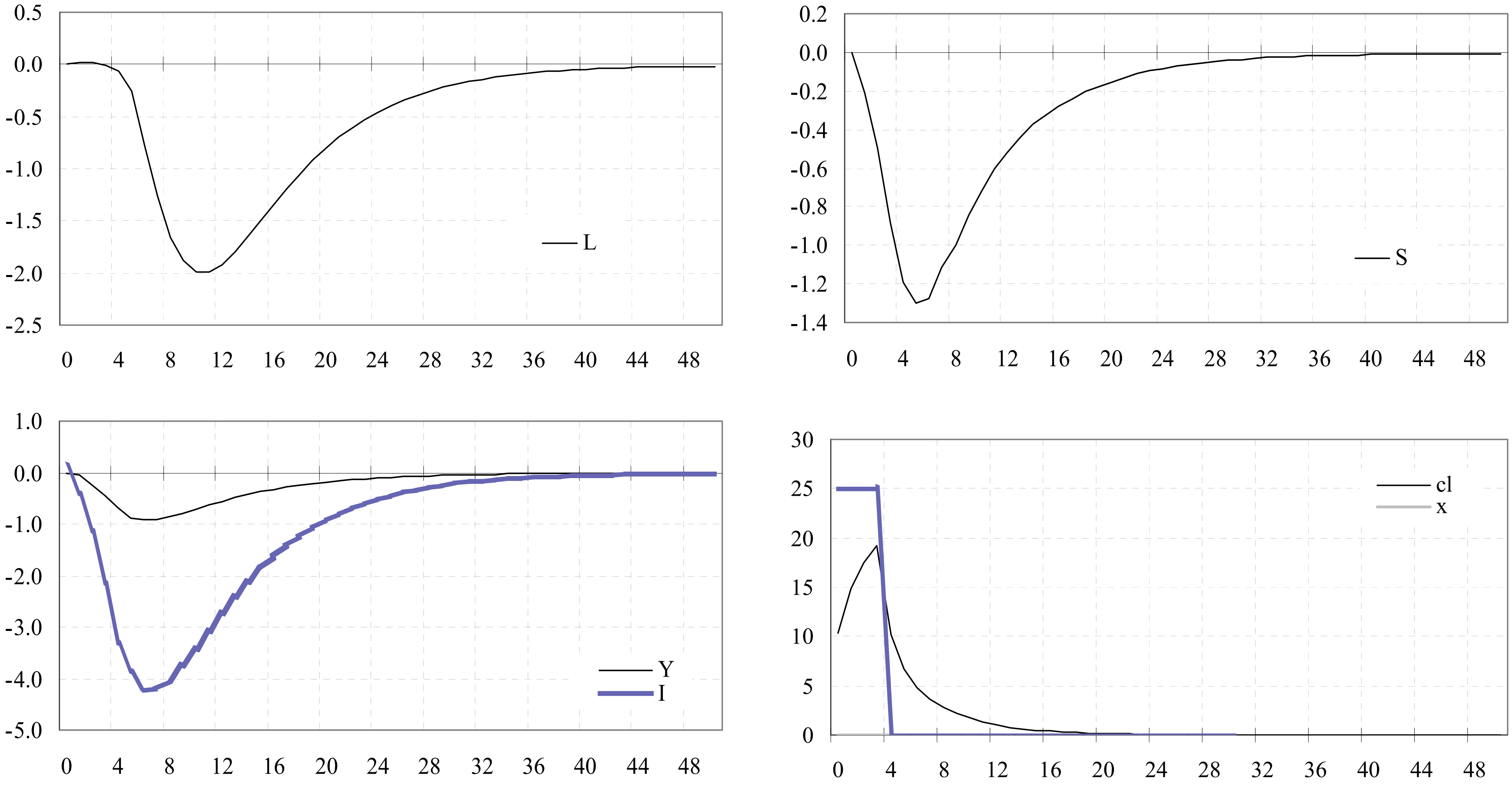
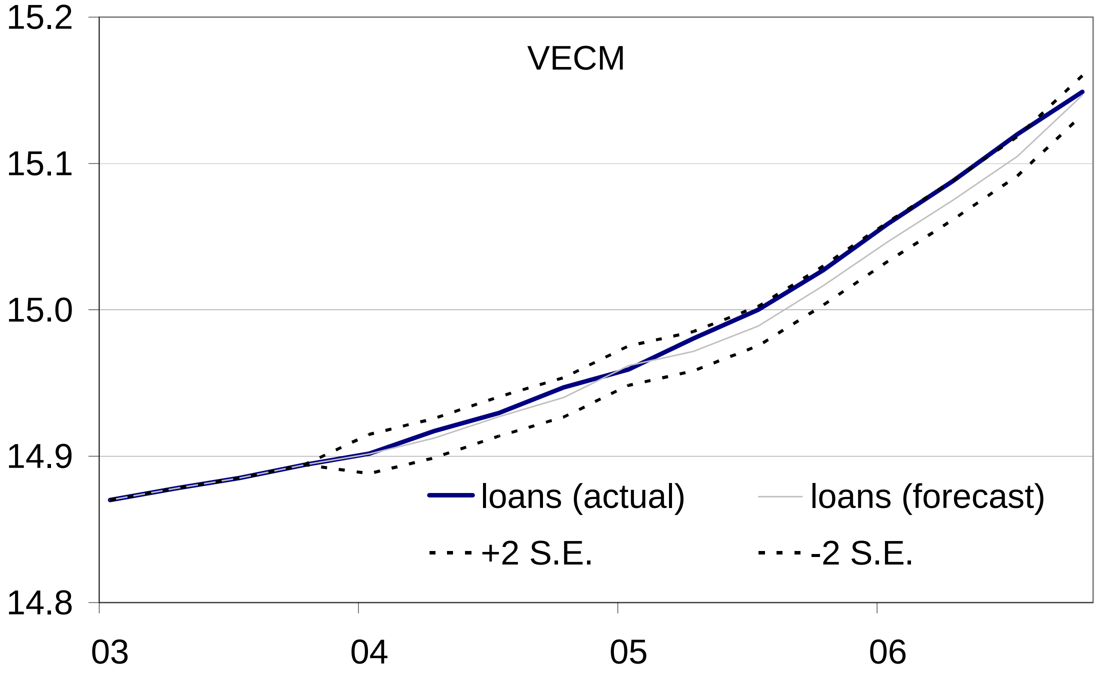


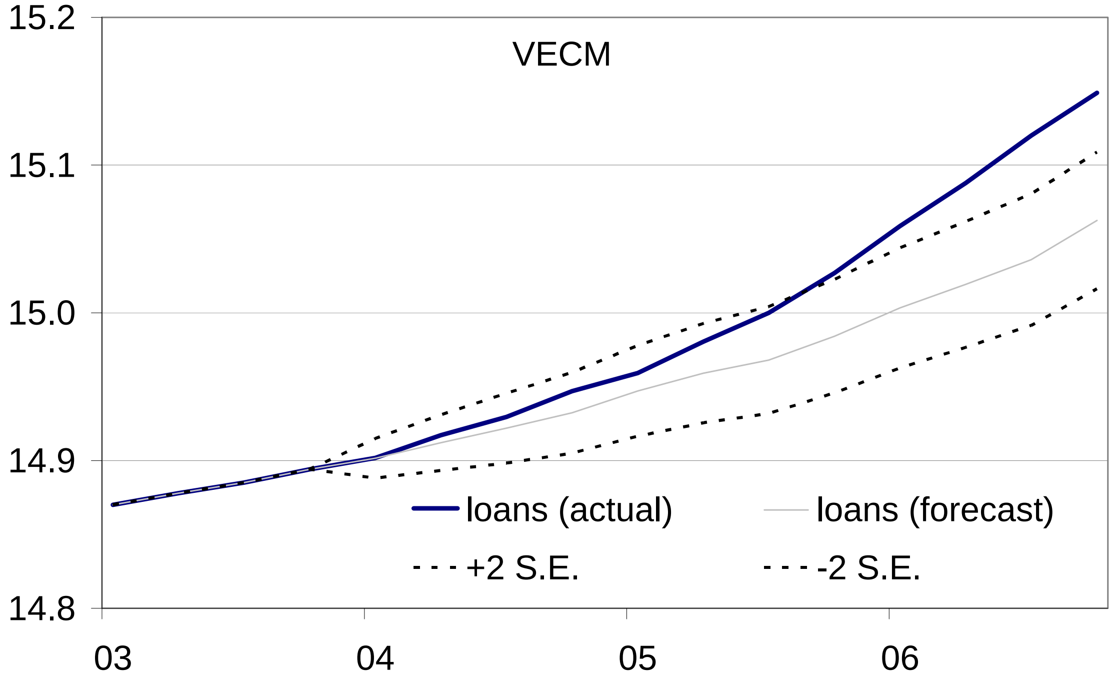
*Fig.12*

**FORECASTING LOANS TO NON-FINANCIAL CORPORATIONS**

a) Static Forecasts (logs)




b) Dynamic Forecasts (logs)



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