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ABSTRACT

The aim of this paper is to study cross-sectional differences in banks interest rates. It adds to the existing literature in two ways. First, it analyzes in a systematic way both micro and macroeconomic factors that influence the price setting behavior of banks. Second, by using banks' prices (rather than quantities) it provides an alternative way to disentangle loan supply from loan demand shift in the "bank lending channel" literature. The results, derived from a sample of Italian banks, suggest that heterogeneity in the banking rates pass-through exists only in the short run. Consistently with the literature for Italy, interest rates on short-term lending of liquid and well-capitalized banks react less to a monetary policy shock. Also banks with a high proportion of long-term lending tend to change their prices less. Heterogeneity in the pass-through on the interest rate on current accounts depends mainly on banks' liability structure. Bank's size is never relevant.

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1. Introduction[1]

This paper studies cross-sectional differences in the price setting behavior of Italian banks in the last decade. The main motivations of the study are two. First, heterogeneity in the response of bank interest rates to market rates helps in understanding how monetary policy decisions are transmitted through the economy independently of the consequences on bank lending. The analysis of heterogeneous behavior in banks interest setting has been largely neglected by the existing literature. The vast majority of the studies on the "bank lending channel" analyze the response of credit aggregates to a monetary policy impulse, while no attention is paid on the effects on prices. This seems odd because, in practice, when banks interest rates change, real effects on consumption and investment could be produced also if there are no changes in total lending. The scarce evidence on the effects of monetary shocks on banks prices, mainly due to the lack of available long series of micro data on interest rates, contrasts also with some recent works that highlight a different adjustment of retail rates in the euro area (see, amongst others, de Bondt, Mojon and Valla, 2003).

Second, this paper wants to add to the "bank lending channel" literature by identifying loan supply shocks via banks' prices (rather than quantities). So far to solve the "identification problem" it has been claimed that certain bank-specific characteristics (i.e. size, liquidity, capitalization) influence only loan supply movements while banks' loan demand is independent of them. After a monetary tightening, the drop in the supply of credit should be more important for small banks, which are financed almost exclusively with deposits and equity (Kashyap and Stein, 1995), less liquid banks, that cannot protect their loan portfolio against monetary tightening simply by drawing down cash and securities (Stein, 1998; Kashyap and Stein, 2000) and poorly capitalized banks, that have less access to markets for uninsured funding (Peek and Rosengren, 1995; Kishan and Opiela, 2000; van den Heuvel, 2001a; 2001b).[2] The intuition of an identification via prices of loan supply shift is very simple: if loan demand is not perfectly elastic, also the effect of a monetary

[1] This study was developed while the author was a visiting scholar at the NBER. The opinions expressed in this paper are those of the author only and in no way involve the responsibility of the Bank of Italy and the NBER.

[2] All these studies on cross-sectional differences in the effectiveness of the "bank lending channel" refer to the US. The literature on European countries is instead far from conclusive (see Altunbas et al., 2002; Ehrmann et al., 2003). For the Italian case see Gambacorta (2003) and Gambacorta and Mistrulli (2003).

tightening on banks' interest rate should be more pronounced for small, low-liquid and low-capitalized banks .

Apart from these standard indicators other bank-specific characteristics could influence banks' price-setting behavior (Weth, 2002). Berlin and Mester (1999) claim that banks which heavily depend upon non-insured funding (i.e. bonds) will adjust their deposit rates more (and more quickly) than banks whose liabilities are less affected by market movements. Berger and Udell (1992) sustain that banks that maintain a close tie with their customers will change their lending rates comparatively less and slowly.

In this paper the search for heterogeneity in banks' behavior is carried out by using a balanced panel of 73 Italian banks that represent more than 70 per cent of the banking system. Heterogeneity is investigated with respect to the interest rate on short-term lending and that on current accounts. The use of microeconomic data is particularly appropriate in this context because aggregation may significantly bias the estimation of dynamic economic relations (Harvey, 1981). Moreover, information at the level of individual banks provides a more precise understanding of their behavioral patterns and should be less prone to structural changes like the formation of EMU.

The main conclusions of this paper are two. First, heterogeneity in the banking rates pass-through exists, but it is detected only in the short run: no differences exist in the long-run elasticities of banking rates to money market rates. Second, consistently with the existing literature for Italy, interest rates on short-term lending of liquid and well-capitalized banks react less to a monetary policy shock. Also banks with a high proportion of long-term lending tend to change less their prices. Heterogeneity in the pass-through on the interest rate on current accounts depends mainly on banks' liability structure. Bank's size is never relevant.

The paper is organized as follows. Section 2 describes some institutional characteristics that help to explain the behavior of banking rates in Italy in the last two decades. Section 3 reviews the main channels that influence banks' interest rate settings trying to disentangle macro from microeconomic factors. After a description of the econometric model and the data in Section 4, Section 5 shows the empirical results. Robustness checks are presented in Section 6. The last section summarizes the main conclusions.

2. Some facts on bank interest rates in Italy

Before discussing the main channels that influence banks' price setting, it is important to analyze the institutional characteristics that have influenced Italian bank interest rates in the last two decades. The scope of this section is therefore to highlight some facts that could help in understanding differences, if any, with the results drawn by the existing literature for the eighties and mid-nineties.

For example, there is evidence that in the eighties Italian banks were comparatively slow in adjusting their rates (Verga, 1984; Banca d'Italia, 1986, 1988; Cottarelli and Kourelis, 1994) but important measures of liberalization of the markets and deregulation over the last two decades should have influenced the speed at which changes in the money market conditions are transmitted to lending and deposit rates (Cottarelli et al. 1995; Passacantando, 1996; Ciocca, 2000; Angelini and Cetorelli, 2002).

In fact, between the mid-1980s and the early 1990s all restrictions that characterized the Italian banking system in the eighties were gradually removed. In particular: 1) the lending ceiling was definitely abolished in 1985; 2) foreign exchange controls were lifted between 1987 and 1990; 3) branching was liberalized in 1990; 4) the 1993 Banking Law allowed banks and special credit institutions to perform all banking activities.

In particular, the 1993 Banking Law (Testo Unico Bancario, hereafter TUB) completed the enactment of the institutional, operational and maturity despecialization of the Italian banking system and ensured the consistency of supervisory controls and intermediaries' range of operations within the single market framework. The business restriction imposed by the 1936 Banking Law, which distinguished between banks that could raise short-term funds ("aziende di credito") and those that could not ("Istituti di credito speciale"), was eliminated.[3] To avoid criticism of structural breaks, the econometric analysis of this study will be based on the period 1993:03-2001:03, where all the main reforms of the Italian banking system had already taken place.

[3] For more details see Banca d'Italia, Annual Report for 1993.

The behavior of bank interest rates in Italy reveals some stylized facts (see Figures 1 and 2). First, a remarkable fall in the average rates since the end of 1992. Second a strong and persistent dispersion of rates among banks. These stylized facts suggest that both the time series and the cross sections dimensions are important elements in understanding the behavior of bank interest setting. This justifies the use of panel data techniques.

The main reason behind the fall in banking interest rates is probably the successful monetary policy aiming at reducing the inflation rate in the country to reach the Maastricht criteria and the third stage of EMU. As a result, the interbank rate decreased by more than 10 percentage points in the period 1993-1999. Excluding the 1995 episode of the EMS crisis, it is only since the third quarter of 1999 that it started to move upwards until the end of 2000 when it continued a declining trend. From a statistical point of view, this behavior calls for the investigation of a possible structural break in the nineties.[4]

The second stylized fact is cross-sectional dispersion among interest rates. Figure 2 shows the coefficient of variation for loan and deposit rates both over time and across banks in the period 1987-2001.[5] The temporal variation (dotted line) of the two rates show a different behavior from the mid of the nineties when the deposit rate is more variable, probably for a catching-up process of the rate toward a new equilibrium caused by the convergence process. Also the cross-sectional dispersion of the deposit rate is greater than that of the loan rate, especially after the introduction of euro.[6]

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[4] In the period 1995-98, that coincides with the convergence process towards stage three of EMU, it will be necessary to allow for a change in the statistical properties of interest rates (see Appendix 2).

[5] The coefficient of variation is given by the ratio of the standard errors to the mean. The series that refer to the variability "over time" shows the coefficient of variation in each year of monthly figures. In contrast, the series that capture the variability "across banks" shows the coefficient of variation of annual averages of bank-specific interest rates.

[6] In the period before the 1993 Banking Law deposit interest rates were quite sticky to monetary policy changes. Deposit interest rate rigidity in this period has been extensively analyzed also for the US. Among the market factors that have been found to affect the responsiveness of bank deposit rates are the direction of the change in market rates (Ausubel, 1992; Hannan and Berger, 1991), if the bank interest rate is above or below a target rate (Hutchison, 1995; Moore, Porter and Small, 1990; Neumark and Sharpe, 1992) and market concentration in the bank's deposit market (Hannan and Berger, 1991). Rosen (2001) develops a model of price settings in presence of heterogeneous customers explaining why bank deposits interest rates respond sluggishly to some extended movements in monetary market rates but not to others. Hutchinson (1995) presents a model of bank deposit rates that includes a demand function for customers and predicts a linear (but less than one for one) relationship between market interest rate changes and bank interest rate changes. Green (1998) claims that the rigidity is due to the fact that bank interest rate management is based on a two-tier pricing system; banks offer accounts at market related interest rates and at posted rates that are changed at discrete intervals.

3. What does influence banks' interest rate setting?

The literature that studies banks' interest rate setting behavior generally assumes that banks operate under oligopolistic market conditions.[7] This means that a bank does not act as a price-taker but sets its loan rates taking into account the demand for loans and deposits. This section reviews the main channels that influence banks interest rates (see Figure 3). A simple analytical framework is developed in Appendix 1.

Loan and deposit demand

The interest rate on loans depends positively on real GDP and inflation (y and p). Better economic conditions improve the number of projects becoming profitable in terms of expected net present value and, therefore, increase credit demand (Kashyap, Stein and Wilcox, 1993). As stressed by Melitz and Pardue (1973) only increases in permanent income (y^P) have a positive influence on loan demand, while the effect due to the transitory part (y^T) could also be associated with a self-financing effect that reduces the proportion of bank debt (Friedman and Kuttner, 1993).[8] An increase in the money market rate (i_M) raises the opportunity cost of other forms of financing (i.e. bonds), making lending more attractive. This mechanism also boosts loan demand and increases the interest rate on loans.

The interest rate on deposits is negatively influenced by real GDP and inflation. A higher level of income increases the demand for deposits[9] and reduces therefore the incentive for banks to set higher deposit rates. In this case the shift of deposit demand should be higher if the transitory component of GDP is affected (unexpected income is generally first deposited on current accounts). On the contrary, an increase in the money market rate, ceteris paribus, makes more attractive to invest in risk-free securities that represent an alternative to detain deposits; the subsequent reduction in deposits demand determines an upward pressure on the interest rate on deposits.

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[7] For a survey on modeling the banking firm see Santomero (1984). Among more recent works see Green (1998) and Lim (2000).

[8] Taking this into account, in Section 4 I tried to disentangle the two effects using a Beveridge and Nelson (1981) decomposition.

[9] The aim of this paper is not to answer to the question if deposits are input or output for the bank (see Freixas and Rochet, 1997 on this debate). For simplicity here deposits are considered a service supplied by the bank to depositors and are therefore considered an output (Hancock, 1991).

Operating cost, credit risk and interest rate volatility

The costs of intermediation (screening, monitoring, branching costs, etc.) have a positive effect on the interest rate on loans and a negative effect on that of deposits (efficiency is represented by *e*). The interest rate on lending also depends on the riskiness of the credit portfolio; banks that invest in riskier project will have a higher rate of return in order to compensate the higher percentage of bad loans that have to be written off (*j*).

Banking interest rates are also influenced by interest rate volatility. A high volatility in the money market rate (σ) should increase lending and deposit rates. Following the dealership model by Ho and Saunders (1981) and its extension by Angbazo (1997) the interest rate on loans should be more affected by interbank interest rate volatility with respect to that on deposits ($\mathrm{d}i_L/\mathrm{d}\sigma > \mathrm{d}i_D/\mathrm{d}\sigma$). This should reveal a positive correlation between interest rate volatility and the spread.

Interest rate channel

Banking interest rates are also influenced by monetary policy changes. A monetary tightening (easing) determines a reduction (increase) of reservable deposits and an increase (reduction) of market interest rates. This has a "direct" and positive effect on bank interest rates through the traditional "interest rate channel". Nevertheless, the increase in the cost of financing could have a different impact on banks depending on their specific characteristics. There are two channels through which heterogeneity among banks may cause a different impact on lending and deposit rates: the "bank lending channel" and the "bank capital channel". Both mechanisms are based on adverse selection problems that affect banks fund-raising but from different perspectives.

Bank lending channel

According to the "bank lending channel" thesis, a monetary tightening has effect on bank loans because the drop in reservable deposits cannot be completely offset by issuing other forms of funding (i.e. uninsured CDs or bonds; for an opposite view see Romer and Romer, 1990) or liquidating some assets. Kashyap and Stein (1995, 2000), Stein (1998) and Kishan and Opiela (2000) claim that the market for bank debt is imperfect. Since non-reservable liabilities are not insured and there is an asymmetric information problem about the value of banks' assets, a "lemon's premium" is paid to investors. According to these authors, small, low-liquid and low-capitalized banks pay a higher premium because the market perceives them more risky. Since these banks are more exposed to asymmetric information problems they have less capacity to shield their credit relationships in case of a monetary tightening and they should cut their supplied loans and raise their interest rate by more. Moreover, these banks have less capacity to issue bonds and CDs and therefore they could try to contain the drain of deposits by raising their rate by more. In Figure 3 three effects are highlighted: the "average" effect due to the increase of the money market rate (which is difficult to disentangle from the "interest rate channel"), the "direct" heterogeneous effect due to bank-specific characteristics (X_{t-1}) and the "interaction effect" between monetary policy and the bank-specific characteristic ($i_M X_{t-1}$). These last two effects can genuinely be attributed to the "bank lending channel" because bank-specific characteristics influence only loan supply movements. Two aspects deserve to be stressed. First, to avoid endogeneity problems bank-specific characteristics should refer to the period before banks set their interest rates. Second, heterogeneous effects, if any, should be detected only in the short run while there is no *a priori* that these effects should influence the long run relationship between interest rates.

Apart from the standard indicators of size (logarithm of total assets), liquidity (cash and securities over total assets) and capitalization (excess capital over total assets),[10] two other bank-specific characteristics deserve to be investigated: a) the ratio between deposits and bonds plus deposits; b) the ratio between long-term loans and total loans.

The first indicator is in line with Berlin and Mester (1999): banks that heavily depend upon non-deposit funding (i.e. bonds) will adjust their deposits rates by more (and more quickly) than banks whose liabilities are less affected by market movements. The intuition of this result is that, other things being equal, it is more likely that a bank will adjust her terms

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[10] It is important to note that the effect of bank capital on the "bank lending channel" cannot be easily captured by the capital-to-asset ratio. This measure, generally used by the existing literature to analyze the distributional effects of bank capitalization on lending, does not take into account the riskiness of a bank portfolio. A relevant measure is instead the excess capital that is the amount of capital that banks hold in excess of the minimum required to meet prudential regulation standards. Since minimum capital requirements are determined by the quality of bank's balance sheet activities, the excess capital represents a risk-adjusted measure of bank capitalization that gives more indications on the probability of a bank default. Moreover, the excess capital is a relevant measure of the availability of the bank to expand credit because it directly controls for prudential regulation constraints. For more details see Gambacorta and Mistrulli (2004).

for passive deposits if the conditions of her own alternative form of refinancing change. Therefore an important indicator to analyze the pass-through between market and banking rates is the ratio between deposits and bonds plus deposits. Banks which use relatively more bonds than deposits for financing purpose fell more under pressure because their cost increase contemporaneously and to similar extent as market rates.

The Berger and Udell (1992) indicator represents a proxy for long-term business; those credit institutions that maintain close ties with their non-bank customers will adjust their lending rates comparatively less and slowly. Banks may offer implicit interest rate insurance to risk-averse borrowers in the form of below-market rates during periods of high market rates, for which the banks are later compensated when market rates are low. Having this in mind, banks that have a higher proportion of long-term loans should be more inclined to split the risk of monetary policy change with their customers and preserve credit relationships. For example, Weth (2002) finds that in Germany those banks with large volumes of long-term business with households and firms change their prices less frequently than the others.

Bank capital channel

The "bank capital channel" is based on three hypotheses. First, there is an imperfect market for bank equity: banks cannot easily issue new equity for the presence of agency costs and tax disadvantages (Myers and Majluf, 1984; Cornett and Tehranian, 1994; Calomiris and Hubbard, 1995; Stein, 1998). Second, banks are subject to interest rate risk because their assets have typically a higher maturity with respect to liabilities (maturity transformation). Third, regulatory capital requirements limit the supply of credit (Thakor, 1996; Bolton and Freixas, 2001; Van den Heuvel, 2001a; 2001b).

The mechanism is the following. After an increase of market interest rates, a lower fraction of loans can be renegotiated with respect to deposits (loans are mainly long term, while deposits are typically short term): banks suffer therefore a cost due to the maturity mismatch that reduces profits and then capital accumulation.[11] If equity is sufficiently low and it is too costly to issue new shares, banks reduce lending (otherwise they fail to meet

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[11] In Figure 3, the cost per unit of asset due to the maturity transformation at time *t*-1 (ρ_{it-1}) is multiplied by the actual change in the money market rate (Δi_M). For more details see Appendix 1.

regulatory capital requirements) and amplify their interest rate spread. This determines therefore an increase in the interest rates on loans and a decrease in that on deposits:[12] in the oligopolistic version of the Monti-Klein model, the maturity transformation cost has the same effect of an increase in operating costs.

Industry structure

The literature underlines two possible impacts of concentration on pricing behavior of banks (Berger and Hannan, 1989). A first class of models claims that more concentrated banking industry will behave oligopolistically (structure-performance hypothesis), while another class of models stresses that concentration is due to more efficient banks taking over less efficient counterparts (efficient-structure hypothesis). This means that in the first case lower competition should result in higher spreads, while in the second case a decrease in managerial costs due to increased efficiency should have a negative impact on the spread. In the empirical part great care will be given therefore to the treatment of bank mergers (see Appendix 2). Nevertheless, the scope of this paper is not to extract policy implications about this issue, for which a different analysis is needed. The introduction of bank-specific dummy variables (μ_i) tries to control for this and other missing aspects.[13]

4. Empirical specification and data

The equations described in Figure 3 and derived analytically in Appendix 1 are expressed in levels. Nevertheless, since interest rates are likely to be non-stationary variables, an error correction model has been used to capture bank's interest rate setting.[14] Economic theory on oligopolistic (and perfect) competition suggests that, in the long run, both banking rates (on lending and deposits) should be related to the level of the monetary

[12] The "bank capital channel" can also be at work even if capital requirement is not currently binding. Van den Heuvel (2001a) shows that low-capitalized banks may optimally forgo lending opportunities now in order to lower the risk of capital inadequacy in the future. This is interesting because in reality, most banks are not constrained at any given time.

[13] In Section 6 this hypothesis will be tested introducing a specific measure of the degree of competition that each banks faces. For a more detailed explanation on the effect of concentration on the pricing behavior of Italian banks see Focarelli and Panetta (2003).

[14] This is indeed the standard approach used for interest rate equations (Cottarelli et al. 1995; Lim, 2000; Weth 2002). From a statistical point of view, the error correction representation is adopted because the lending rate and the deposit rate result to be cointegrated with the money market rate.

rate, that reflects the marginal yield of a risk-free investment (Klein, 1971). We have:

$$\Delta i_{L\,k,t} = \mu_k + \sum_{j=1}^{2} \kappa_j \Delta i_{L\,k,t-j} + \sum_{j=0}^{1} (\beta_j + \beta_j^* X_{k,t-1}) \Delta i_{M\,t-j} + \varphi\, p_t + \delta_1 \Delta \ln y_t^P + \delta_2 \Delta \ln y_t^T + \lambda X_{k,t-1} + \phi \Delta(\rho_{k,t-1} \Delta i_{M\,t}) + (\alpha + \alpha^* X_{k,t-1}) i_{L\,k,t-1} + (\gamma + \gamma^* X_{k,t-1}) i_{M\,t-1} + \theta\, j_{k,t} + \xi\, e_{k,t} + \psi \sigma_t + \overline{\Phi}_{k,t} + \varepsilon_{k,t} \quad (1)$$

$$\Delta i_{D\,k,t} = \mu_k + \sum_{j=1}^{2} \kappa_j \Delta i_{D\,k,t-j} + \sum_{j=0}^{1} (\beta_j + \beta_j^* X_{k,t-1}) \Delta i_{M\,t-j} + \varphi\, p_t + \delta_1 \Delta \ln y_t^P + \delta_2 \Delta \ln y_t^T + \lambda X_{k,t-1} + \phi \Delta(\rho_{k,t-1} \Delta i_{M\,t}) + (\alpha + \alpha^* X_{k,t-1}) i_{D\,k,t-1} + (\gamma + \gamma^* X_{k,t-1}) i_{M\,t-1} + \xi\, e_{k,t} + \psi \sigma_t + \overline{\Phi}_{k,t} + \varepsilon_{k,t} \quad (2)$$

with *k*=1,…, *N* (*k*=number of banks) and *t*=1, …,*T* (*t*= periods). Data are quarterly (1993:03-2001:03) and not seasonally adjusted. The panel is balanced with N=73 banks. Lags have been selected in order to obtain white noise residuals. The description of the variables is reported in Table 1.[15]

The model allows for fixed effects across banks, as indicated by the bank-specific intercept μ_i. The long-run elasticity between each banking rate and the money market rate is given by: $(\gamma + \gamma^* X_{k,t-1}) / (\alpha + \alpha^* X_{k,t-1})$. Therefore to test if the pass-through between the money market rate and the banking rate is complete it is necessary to verify that this elasticity is equal to one. If this is the case there is a one-to-one long-run relationship between the lending (deposit) rate and the money market rate, while the individual effect μ_i influences the bank-specific mark-up (mark-down). The loading coefficient $(\alpha + \alpha^* X_{k,t-1})$ must be significantly negative if the assumption of an equilibrium relationship is correct. In fact, it represents how many percent of an exogenous variation from the steady state between the rates is brought back towards the equilibrium in the next period.[16]

The degree of banks' interest rate stickiness in the short run can be analyzed by the impact multiplier ($\beta_0 + \beta_0^* X_{k,t-1}$) and the total effect after three months.[17]

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[15] For more details on data sources, variable definitions, merger treatment and trimming of the sample see Appendix 2.

[16] Testing for heterogeneity in the loading coefficient means to verify if α^* is significant or not. At the same time heterogeneity in the long-run elasticity can be proved if $\alpha^* \gamma - \alpha \gamma^*$ is statistically different from zero.

[17] In the first case heterogeneity among banks is simply tested through the significance of β_0^* while in the second case, since the effect is given by a convolution of the structural parameters it is possible to accept the

The variable $X_{k,t\text{-}1}$ represents a bank-specific characteristic that economic theory suggests to influence only loan and deposit supply movements, without affecting loan and deposit demands. In particular, all bank-specific indicators ($\chi_{k,t}$) have been re-parameterized in the following way:

$$X_{k,t} = \chi_{k,t} - \left(\sum_{t=1}^{T} \frac{\sum_{k=1}^{N} \chi_{k,t}}{N} \right) / T$$

Each indicator is therefore normalized with respect to the average across all the banks in the respective sample, in order to obtain a variable whose sum over all observations is zero.[18] This has two implications. First, the interaction terms between interest rates and $X_{k,\,t-1}$ in equations (1) and (2) are zero for the average bank (this because $\overline{X}_{k,t-1}$ =0). Second, the coefficients β_0, β_1, α and γ are directly interpretable as average effects.

To test for the existence of a "bank capital channel" we have introduced the variable $\rho_{k,\,t-1}\Delta i_M$ that represents the bank-specific cost of monetary policy due to maturity transformation. In particular $\rho_{k,\,t-1}$ measures the loss per unit of asset a bank suffers when the monetary policy interest rate is raised of one percent. The cost at time *t* is influenced by the maturity transformation in *t*-1. This variable is computed according to supervisory regulation relative to interest rate risk exposure that depends on the maturity mismatch among assets and liabilities (see Appendix 2 for further details). To work out the real cost we have therefore multiplied $\rho_{k,\,t-1}$ for the realized change in interest rates. Therefore $\rho_{k,\,t-1}\Delta i_M$ represents the cost (gain) that a bank suffers (obtain) in each quarter. As formalized in Appendix 1, this measure influences the level of bank interest rates. Since the model is expressed in error correction form we have included this variable in first difference as well.

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null hypothesis of absence of heterogeneity if and only if $\left[\beta_0\alpha^* + \beta_0^*(1+\alpha+\kappa_1) + \beta_1^* + \gamma^*\right] X_{k,t-1} + \alpha^*\beta_0^* X_{k,t-1}^2$ is equal to zero. The significance of this expression has been checked using the delta method (Rao, 1973).

[18] The size indicator has been normalized with respect to the mean on each single period. This procedure removes trends in size (for more details see Ehrmann et al., 2003).

4.1 Characteristics of the dataset

The dataset includes 73 banks that represent more than 70 per cent of total Italian banking system in term of loans over the whole sample period. Since information on interest rates is not available for Mutual banks, the sample is biased towards large banks. Foreign banks and special credit institution are also excluded.

This bias toward large banks has two consequences. First, the distributional effects of the size variable would be treated with extreme cautious because a "small" bank inside this sample could not be considered with the same characteristic using the full population of Italian banks.[19] The size grouping in this study mainly controls for variations in scale, technology and scope efficiencies across banks but it is not able to shed light on differences between Mutual and other banks. Second, results for the average bank will provide more "macroeconomic insights" than studies on the whole population (where the average bank dimension is very small).

Table 2 gives some basic information on the dataset. Rows are organized dividing the sample with respect to the bank-specific characteristics that are potential candidates to cause heterogeneous shifts in loan supply in case of a monetary policy shock. On the columns, the table reports summary statistics for the two interest rates and for each indicator.

Several clear patterns emerge. Considering size, small banks charge higher interest rates on lending but show a lower time variation. This fits with the standard idea of a close customer relationships between small firms and small banks that provides them with an incentive to smooth the effect of a monetary tightening (Angelini, Di Salvo and Ferri, 1998). Moreover, small banks are more liquid and capitalized than average and this should help them to reduce the effect of cyclical variation on supplied credit. On the liability side, the percentage of deposits (overnight deposits, CDs and savings accounts) is greater among small banks, while their bonds issues are more limited than the ones of large banks. Nevertheless, there are no significant differences that emerge in the level and volatility of the interest rate on current accounts.

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[19] In particular, banks that are considered "small" in this study are labeled as "medium" in other studies for the Italian banking system that analyze quantities (see for example, Gambacorta, 2003; Gambacorta and Mistrulli, 2004). This is clear noting that the average assets of a "small" bank in my data (1.6 billions of euros) over the sample period is very similar to that of the "medium" bank of the total system (1.7 billions of euros).

High-liquid banks are smaller than average and are more capitalized. These characteristics should reduce the speed of the "bank lending channel" transmission through interest rates. In particular, since deposits represent a high share of their funding they should have a smoother transmission on passive rates.

Well-capitalized banks make relatively more short-term loans. They are in general not listed and issue less subordinated debt to meet the capital requirement. This evidence is consistent with the view that, *ceteris paribus*, capitalization is higher for those banks that bear more adjustment costs from issuing new (regulatory) capital. Well-capitalized banks charge a higher interest rate on lending; this probably depend upon their higher ratios of bad loans that increase their credit risk. In other words their higher capitalization is necessary to face a riskier portfolio. Moreover, the interest rate on deposit is lower for low-capitalized banks indicating that agents do not perceive these deposits as riskier than those at other banks. This has two main explanations. First, the impact of bank failures has been very small in Italy, especially with respect to deposits.[20] Second, the presence of deposit insurance that insulates deposits of less capitalized banks from the risk of default.[21]

The Berlin-Mester and the Berger-Udell indicators seem to have a high power in explaining heterogeneity in banks' price setting behavior. Differences in the standard deviations of the two groups are particularly sensitive, calling for a lower interest rates variability of banks with a high percentage of deposits and long-term loans.

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[20] During our sample period, the share of deposits of failed banks to total deposits approached 1 per cent only twice, namely in 1987 and 1996 (Boccuzzi, 1998).

[21] Two explicit limited-coverage deposit insurance schemes (DISs) currently operate in Italy. Both are funded ex-post; that is, member banks have a commitment to make available to the Funds the necessary resources should a bank default. All the banks operating in the country, with the exception of mutual banks, adhere to the main DIS, the 'Fondo Interbancario di Tutela dei Depositi' (FITD). Mutual banks ('Banche di Credito Cooperativo') adhere to a special Fund ('Fondo di Garanzia dei Depositanti del Credito Cooperativo') created for banks belonging to their category. The 'Fondo Interbancario di Tutela dei Depositi' (FITD), the main DIS, is a private consortium of banks created in 1987 on a voluntary basis. In 1996, as a consequence of the implementation of European Union Directive 94/19 on deposit guarantee schemes, the Italian Banking Law regulating the DIS was amended, and FITD became a compulsory DIS. FITD performs its tasks under the supervision of and in cooperation with the banking supervision authority, Banca d'Italia. The level of protection granted to each depositor (slightly more than 103,000 euros) is one of the highest in the European Union. FITD does not adopt any form of deposit coinsurance.

5. Results

The main channels that influence the interest rate on short term lending and that on current accounts are summarized, respectively, in Tables 3 and 4. The first part of each table, show the influence of the permanent and transitory component of real GDP and inflation. These macro variables capture cyclical movements and serves to isolate shifts in loan and deposit demand from monetary policy changes. The second part of the tables presents the effects of bank's efficiency, credit risk and interest rate volatility. The third part highlights the effects of monetary policy. These are divided into four components: i) the immediate pass-through; ii) the one-quarter pass-through; iii) the long-run elasticity between each banking rate and the monetary policy indicator; iv) the loading coefficient of the cointegrating relationship.[22] The last part of the tables shows the significance of the "bank capital channel". Each table is divided in five columns that highlight, one at the time, heterogeneous behavior of banks with different characteristics in the response to a monetary shock. The existence of distributional effects is tested for all the four components of the monetary policy pass-through. The models have been estimated using the GMM estimator suggested by Arellano and Bond (1991) which ensures efficiency and consistency provided that the models are not subject to serial correlation of order two and that the instruments used are valid (which is tested for with the Sargan test).[23]

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[22] The immediate pass-trough is given by the coefficient $\beta_0+\beta_0^* X_{k,t-1}$ and heterogeneity among banks is simply tested through the significance of β_0^*. The effect for a bank with a low value of the characteristic under evaluation is worked out through the expression $\beta_0+\beta_0^* \overline{X}_{k,t-1}^{0.25}$, where $\overline{X}_{k,t-1}^{0.25}$ is the average for the banks below the first quartile. Vice versa the effect for a bank with a high value of the characteristic is calculated using $\overline{X}_{k,t-1}^{0.75}$. The total effect after three months for the average bank is given by $\beta_0(1+\alpha_1+\kappa_1)+\beta_1+\gamma'$ while heterogeneity among banks can be accepted if and only if the expression $\left[\beta_0\alpha^*+\beta_0^*(1+\alpha+\kappa_1)+\beta_1^*+\gamma^*\right]X_{k,t-1}+\alpha^*\beta_0^* X_{k,t-1}^2$ is equal to zero. The long run elasticity is given by: $(\gamma+\gamma^* X_k)/(\alpha+\alpha^* X_k)$, while the loading coefficient is $\alpha_1+\alpha_1^* X_{k,t-1}$. Standard errors have been approximated with the "delta method" (Rao, 1973).

[23] In the GMM estimation, instruments are the second lag of the dependent variable and of the bank-specific characteristics included in each equation. Inflation, GDP growth rate and the monetary policy indicator are considered as exogenous variables.

Loan and deposit demand

As predicted by theory only changes in permanent income have a positive and significant effect on the interest rate on short term lending while the transitory component is never significant. In fact, as discussed in Section 3, the effect of transitory changes may be also due to a self-financing effect that reduces the proportion of bank debt. On the contrary the interest rate on deposits is negatively influenced by real GDP. In this case the effect is higher when a change in the transitory component occurs because it is directly channeled through current accounts. The effect of inflation is positive on both interest rates but is significantly higher for short-term lending.

Operating costs, credit risk and interest rate volatility

Bank's efficiency reduces the interest rate on loans and increase that of deposits. Nevertheless, the effect is not always significant at conventional levels, especially in the equation for the interest rate on current accounts. These results call for further robustness checks using a cost-to-asset ratio (see Section 6).

The relative amount of bad loans has a positive and significant effect on the interest rate on loans. This is in line with the standard result that banks that invest in riskier project ask for a higher rate of return to compensate credit risk.

Both banking rates are positively correlated with money market rate volatility. The correlation is higher for the interest rate on loans with respect to that of deposits. This is consistent with the prediction of the dealership model by Ho and Saunders (1981) and its extension by Angbazo (1997) where an increase in interbank interest rate volatility is associated with a higher spread.

Bank capital channel

As expected the "bank capital channel" (based on the maturity mismatch between bank's assets an liabilities, see Section 3) has a positive effect on the interest rate on short-term lending and a negative effect on the interest rate on current account. The absolute values of the coefficients are greater in the first case calling for a stronger adjustment on credit contracts than on deposits. Since this channel can be interpreted similarly to a general increase in the costs for the banks, it is worth comparing this result with that obtained for the efficiency indicator. In both cases the effect is strongest for the interest rate on short-term lending and this is consistent with the view that the interest rate on deposit is more sluggish.

Interest rate channel

A monetary tightening positively influences banks' interest rate. After a one per cent increase in the monetary policy indicator, interest rate on short term lending are immediately raised of around 0.5 per cent and of around 0.9 per cent after a quarter. Moreover, the pass-through is complete in the long run (the null hypothesis of a unitary elasticity is accepted in all models). The reaction of the short term lending rate is higher with respect to previous studies on the Italian case and this calls for an increase in competition after the introduction of the 1993 Banking Law. Cottarelli et al. (1995), analyzing the period 1986:02-1993:04, find that the immediate pass through is of around 0.2, while the effect after three months is 0.6 per cent. Their long run elasticity is equal to 0.9 per cent but also in their model the null hypothesis of a complete pass-through in the long run is accepted.[24]

The long run elasticity of the interest rate on current accounts is around 0.7 per cent. This result is in line with the recent findings by de Bondt et al. (2003) under a similar sample period and only a little higher with respect to the long-run elasticity in Angeloni et al. (1995) for the period 1987:1-1993:04.[25]

The standard answer to the incomplete pass-through of money market changes on the deposit rate is the existence of market power by banks. Another explanation is the presence of compulsory reserves. To analyze this, we can refer to the theoretical elasticity in the case

[24] The main differences between Cottarelli et al. (1995) and this paper are three. First, they use the Treasury bill rate as the reference monetary interest rate. However from the early nineties this indicator became less important as "reference rate" because the interbank market became more competitive and efficient (Gaiotti, 1992). This is indeed stated also by Cottarelli et al. (page 19). Second, they do not include macro variables controls in their equation. Third, their dataset is based on monthly data. To allow comparability among the results of this paper and those in Cottarelli et al. (1995) I have: 1) checked the results to different monetary policy indicators (i.e. the interbank rate; see Section 6); 2) excluded the macro variables from equation (1) to verify if the results were sensitive to their inclusion. In all cases the conclusion of an increase of speed in the reaction of short-term interest rate on loans to money market rate resulted unchanged.

[25] The VAR model in Angeloni et al. considers the interest rate on total deposits (sight, time deposits and CDs), which is typically more reactive to monetary policy than that on current account because the service component in time deposits and CDs is less important. This means that in comparing our result with Angeloni et al. we are underestimating the potential effect of competition.

of perfect competition.[26] This benchmark case is very instructive because it allows to analyze what happens if banks are price takers (they take as given not only the monetary market rate but also the interest rate on loans and that on deposits), set the quantity of loans and deposits and obtain a zero profit (the sum of the intermediation margins equals management costs). In this case the long-run elasticities become: $\frac{\partial i_L}{\partial i_M}=1$ and $\frac{\partial i_D}{\partial i_M}=1-\alpha$ where α is the fraction of deposits invested in risk-free assets (this includes the "compulsory" reserves). Therefore in principle, an incomplete pass-through from market rates to deposits rates is also consistent with the fact that banks decide (or are constrained by regulation) to detain a certain fraction of their deposits in liquid assets.

The loading coefficients are significantly negative. It is around –0.4 in the loan equation and –0.6 in the current account equation. This means that if an exogenous shock occurs, respectively 40 and 60 per cent of the deviation is canceled out within the first quarter in each banking rate.

Bank lending channel

In case of a monetary shock, banks with different characteristics behave differently only in the short run. On the contrary no heterogeneity emerges in the long run relationship between each banking rate and the monetary policy indicator.

Considering each bank's specific characteristic one at the time (Tables 3 and 4), interest rates of small, liquid and well-capitalized banks react less to a monetary policy shock. Also the Berlin-Mester and the Berger-Udell indicators have an high power in explaining heterogeneity in banks' price setting behavior.

Nevertheless, the robustness of these distributional effects has to be checked in a model that takes all these five indicators together into account. In this model, in order to save degrees of freedom, the long-run elasticity between the money market rate and the short-

[26] The case of perfect competition can be easily obtained from equation (A1.8) and A1.9) in Appendix 1 considering loan and deposit demand (equations A1.3 and A1.4) infinitely elastic with respect the bank rates ($c_0\rightarrow\infty$, $d_0\rightarrow\infty$). Moreover, we will consider the benchmark case were no heterogeneity emerges in the "bank lending channel" (b_1=0) and bonds can be issued at the risk free rate (b_0=1). See Freixas and Rochet (1997) for an analogous treatment.

term lending rate has been imposed to one; that with the interest rate on current account has been fixed to 0.7.

Results are reported in Table 5. Interest rates on short-term lending of liquid and well-capitalized banks react less to a monetary policy shock. Also banks with a high proportion of long-term lending tend to change less their prices. Size is not significant.

This evidence matches with previous results on lending. Liquid banks can protect their loan portfolio against a monetary tightening simply by drawing down cash and securities (Gambacorta, 2003). Well-capitalized banks that are perceived as less risky by the market are better able to raise uninsured funds in order to compensate the drop in deposits (Gambacorta and Mistrulli, 2004). Therefore the effects on lending detected for liquid and well-capitalized banks are mirrored by their higher capacity to insulate the clients also from the effects on interest rates. It is interesting to note that, in contrast with the evidence for the US (Kashyap and Stein; 1995), the interaction terms between size and monetary policy are insignificant. The fact that the interest rate on short term lending of smaller banks is not more sensitive to monetary policy than that of larger banks is well documented in the literature for Italy and reflects the close customer relationship between small banks and small firms (Angeloni et al. 1995; Conigliani et al., 1997; Angelini, Di Salvo and Ferri, 1998; Ferri and Pittaluga, 1996). This result is also consistent with Ehrmann et al. (2003) where size does not emerge as a useful indicator for the distributional effect of monetary policy on lending not only in Italy but also in France, Germany and Spain.

As regards the interest rate on current accounts, the Berlin-Mester indicator is the only bank-specific characteristic that explains heterogeneity in banks price setting behavior. In particular, banks that heavily depend upon non-deposit funding (banks with a low BM indicator) will adjust their interest rate on current account by more (and more quickly) than banks whose liabilities are less affected by market movements. As explained in Section 3, the intuition of this result is that, other things being equals, it is more likely that a bank will adjust her terms on deposits if the other conditions of her refinancing change. The liability structure seems to influence not only the short-run adjustment but also the loading coefficient. This implies that banks with a high BM ratio react less when there is a deviation in the long run mark-down: banks with a higher percentage of deposits have more room in adjusting their prices toward the optimal equilibrium. As expected, no cross sectional differences emerges among banks due to size, liquidity and capitalization because current accounts are typically insured.

6. Robustness checks

The robustness of the results has been checked in several ways. The first test was to introduce as additional control variable a bank-specific measure of the degree of competition that each bank faces in the market. In particular, the average value of the Herfindahl index in the different "local markets" (corresponding to the administrative provinces of Italy) in which the bank operates was introduced in each equation. The reason of this test is that the fixed effect (that captures also industry structure) remains stable over the whole period while the degree of competition could change over time due to the effect of concentration. Therefore this test allows us also to check if the treatment of bank mergers is carried out properly. The Herfindahl index did not show to be statistically significant and the results of the study did not change.

The second test was to use as bank's efficiency indicator the cost-to-total asset ratio instead than the ratio of total loans and deposits to the number of branches. In all cases the results remained unchanged.

The third test was to consider if different fiscal treatments over the sample period could have changed deposit demand (from June 1996 the interest rate on current account is subject to a fiscal deduction of 27 per cent; 12.5 per cent before). However, using the net interest rate on current account instead than the gross rate nothing changed.

The fourth robustness check was the introduction of a dummy variables to take into account of the spike in the change of the repo interest rate caused by the EMS crisis in the first quarter of 1995. Also in this case results remained the same.

The fifth test was to introduce additional interaction terms combining the bank-specific characteristic with inflation, permanent and transitory changes in real income. The reason for this test is the possible presence of endogeneity between bank characteristics and cyclical factors. Performing the test, however, nothing changed, and the double interactions were almost always not significant (it turned out to be statistically not different from zero in the case of the interaction of capitalization and permanent income).

The final robustness check was to introduce a dummy variable that indicates if the bank belongs to a group (1) or not (0). Banks belonging to a group may be less influenced by monetary changes if they can benefit of an internal liquidity management; in other words, bank holding companies establish internal capital markets in an attempt to allocate capital among their various subsidiaries (Houston and James, 1998; Upper and Worms, 2001). The introduction of this dummy did not change the results of the study.

7. Conclusions

This paper investigates which factors influence price setting behavior of Italian banks. It adds to the existing literature in two ways. First, it analyzes systematically a wide range of micro and macroeconomic variables that have an effect on bank interest rates: permanent and transitory changes in income, interest and credit risk, interest rate volatility, banks' efficiency. Second, the analysis of banks' prices (rather than quantities) provides an alternative way to disentangle loan supply from loan demand shift in the "bank lending channel" literature.

The search for heterogeneity in banks' behavior is carried out by using a balanced panel of 73 Italian banks that represent more than 70 per cent of the banking system. The use of microeconomic data help in reducing the problems of aggregation that may significantly bias the estimation of dynamic economic relations and it is less prone to structural changes like the formation of EMU.

The main results of the study are the following. First, heterogeneity in the banking rates pass-through exists, but it is detected only in the short run: no differences exist in the long-run elasticities of banking rates to the money market rate. Second, consistently with the existing literature for Italy, interest rates on short-term lending of liquid and well-capitalized banks react less to a monetary policy shock. Also banks with a high proportion of long-term lending tend to change their prices less. Heterogeneity in the pass-through on the interest rate on current accounts depends on banks' liability structure. Bank's size is never relevant.

Appendix 1 - A simple theoretical model

This Appendix develops a one-period model of a risk neutral bank that operates under oligopolistic market conditions.

The balance sheet of the representative bank is as follows:

(A1.1) $L + S = D + B + K$

where *L* stands for loans, *S* for securities, *D* for deposits, *B* for bonds, *K* for capital.

The bank holds securities as a buffer against contingencies. We assume that security holdings are a fixed share of the outstanding deposits (α). They represent a safe asset and fruit the risk-free interest rate.[27] We have therefore:

(A1.2) $S = \alpha D$

For simplicity, bank capital is exogenously given in the period and greater than capital requirements.[28]

The bank faces a loan demand and a deposit demand. The first one is given by:

(A1.3) $L^d = c_0 i_L + c_1 y + c_2 p + c_3 i_M$ (c_0<0, c_1>0, c_2>0, c_3>0)

that is negatively related to the interest rate on loans (i_l) and it is positively related to real income (*y*) and prices (*p*) and the opportunity cost of self-financing, proxied by the money market interest rate (i_m).[29]

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[27] Alternatively *S* can be considered as the total amount of bank's liquidity, where α is the coefficient of free and compulsory reserves. In this case reserves are remunerated by the money market rate fixed by the Central Bank. This alternative interpretation does not change the results of the model.

[28] In the spirit of the actual BIS capital adequacy rules, capital requirements on credit risks are given by a fixed amount (*k*) of loans. If bank capital perfectly meets Basle standard requirement the amount of loans would be *L*=*K*/*k*. We rule out this possibility because banks typically hold a buffer as a cushion against contingencies (Wall and Peterson, 1987; Barrios and Blanco, 2001). Excess capital allows them to face capital adjustment costs and to convey positive information on their economic value (Leland and Pile, 1977; Myers and Majluf, 1984). Another explanation is that banks face a private cost of bankruptcy, which reduces their expected future income (Dewatripont and Tirole, 1994). Van den Heuvel (2001a) argues that even if capital requirement is not currently binding, a low capitalized bank may optimally forego profitable lending opportunities now, in order to lower the risk of future capital inadequacy. A final explanation for the existence of excess capital is given by *market discipline*; well-capitalized banks obtain a lower cost of uninsured funding, such as bonds or CDs, because they are perceived less risky by the market (Gambacorta and Mistrulli, 2004).

[29] As far as the GDP is concerned, there is no clear consensus about how economic activity affects credit demand. Some empirical works underline a positive relation because better economic conditions would

The deposit demand is standard. It depends positively on the interest rate on deposits, the level of real income (the scale variable) and the price level and negatively on the interest rate on securities that represent an alternative to the investment to deposits.

(A1.4) $$D^d = d_0 i_d + d_1 y + d_2 p + d_3 i_m$$ (d_0>0, d_1>0, d_2>0, d_3<0)

Because banks are risky and bonds are not insured, bond interest rate incorporates a risk premium that we assume depends on specific banks' characteristics. The latter are balance sheet information or institutional characteristics exogenously given at the end of previous period.

(A1.5) $$i_b\left(i_m, x_{t-1}\right) = b_0 i_m + b_1 i_m x_{t-1} + b_2 x_{t-1}$$ (b_0>1)

In other words, this assumption implies that the distributional effects via the *bank lending channel* depends on some characteristics that allow the bank to substitute insured, typically deposits, with uninsured banks' debt, like bonds or CDs (Romer and Romer, 1990). For example, theory predicts that big, liquid and well-capitalized banks should be perceived less risky by the market and obtain a lower cost on their uninsured funding (b_2<0). Moreover they could react less to monetary change (b_1<0)

The effects of the so-called "bank capital channel" are captured by the following equation:

(A1.6) $$C^{MT} = \rho_{t-1} \Delta i_m (L+S)$$ (ρ >0)

where C^{MT} represents the total cost suffered by the bank in case of a change in monetary policy due to the maturity transformation. Since loans have typically a longer maturity than

improve the number of project becoming profitable in terms of expected net present value and, therefore, increase credit demand (Kashyap, Stein and Wilcox, 1993). This is also the hypothesis used in Bernanke and Blinder (1988). On the contrary, other works stress the fact that if expected income and profits increase, the private sector has more internal source of financing and this could reduce the proportion of bank debt (Friedman and Kuttner, 1993). A compromise position is taken by Melitz and Pardue (1973): only increases in permanent income have a positive influence on loan demand, while the effect due to the transitory part could also be associated with a self-financing effect in line with Friedman and Kuttner. Taking this into account, in the econometric part (see Section 4) I will try to disentangle the two effects using a Beveridge and Nelson (1981). For simplicity in the model I assume that the first effect dominates and that a higher income determines an increase in credit demand (c_2>0). This is indeed consistent with the evidence provided by Ehrmann et al. (2001) for the four main countries of the euro area.

bank fund-raising, the variable ρ represents the cost (gain) per unit of asset that the bank incurs in case of a one per cent increase (decrease) in the monetary policy interest rate.

The cost of intermediation is given by:

(A1.7) $C^{IN} = g_1 L + g_2 D$ (g_1>0, g_2>0)

where the component g_1L can be interpreted as screening and monitoring cost while g_2D as the cost of the branching.[30]

Loans are risky and, in each period, a percentage j of them is written off from the balance sheet, therefore reducing bank's profitability.

The representative bank maximizes her profits subject to the balance-sheet constraint. The bank optimally sets the interest rates on loans and deposits (i_L, i_D), while she takes the money market interest rate (i_M) as given (it is fixed by the Central Bank).

$$\underset{i_l, i_d}{Max}\ \pi = (i_L - j)L + i_m S - i_D D - i_B B - C^{MT} - C^{IN}$$

$$s.t.$$

$$L + Q = D + B + K$$

Solving the maximization problem, the optimal levels of the two interest rates are:

(A1.8) $i_L = \Psi_0 + \Psi_1 p + (\Psi_2 + \Psi_3 x_{t-1}) i_m + \Psi_4 y^P + \Psi_5 \rho_{t-1} \Delta i_m + \Psi_6 j + \Psi_7 x_{t-1}$

(A1.9) $i_d = \Phi_0 + \Phi_1 p + (\Phi_2 + \Phi_3 x_{t-1}) i_m + \Phi_4 y^P + \Phi_5 \rho_{t-1} \Delta i_m + \Phi_6 x_{t-1}$

where:

$$\Psi_0 = \frac{g_1}{2} > 0;\quad \Psi_1 = \frac{c_2}{-2c_0} > 0;\quad \Psi_2 = \frac{b_0}{2} + \frac{c_3}{-2c_0} > 0;\quad \Psi_3 = \frac{b_1}{2};\ \Psi_4 = \frac{c_1}{-2c_0} > 0;\quad \Psi_5 = \frac{1}{2};$$

$$\Psi_6 = \frac{1}{2};\quad \Psi_7 = \frac{b_2}{2}\quad \Phi_0 = -\frac{g_2}{2} < 0;\quad \Phi_1 = -\frac{d_2}{2d_0} < 0;\quad \Phi_2 = \frac{b_0(1-\alpha)}{2} + \frac{-d_3}{2d_0} + \frac{\alpha}{2} > 0;$$

$$\Phi_3 = -\frac{b_1(1-\alpha)}{2d_0};\ \Phi_4 = -\frac{d_1}{2d_0} < 0;\ \Phi_5 = -\frac{\alpha}{2} < 0;\ \Phi_6 = \frac{b_2(1-\alpha)}{2}.$$

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[30] The additive linear form of the management cost simplifies the algebra. The introduction of a quadratic cost function would not have changed the result of the analysis. An interesting consequence of the additive form of the management cost is that bank's decision problem is separable: the optimal interest rate on deposits is independent of the characteristic of the loan market while the optimal interest rate on loans is independent of the characteristics of the deposit market. For a discussion see Dermine (1991).

Equation (A1.8) states that a monetary tightening determines an increase in the interest rate on loans (Ψ_2>0): the total effect could be divided into two parts: the "bank lending channel" (b_0/2>0) and the "opportunity cost" effect ($-c_3/2c_0$>0) The effect of a monetary squeeze is smaller if the bank-specific characteristic reduces the impact of monetary policy on the cost of funding (b_1<0 and Ψ_3<0). In this case banks have a greater capacity to compensate the deposit drop by issuing uninsured funds at a lower price. Loan interest rate reacts positively to an output expansion (Ψ_4>0) and to a raise in prices (Ψ_1>0). The effect of the so-called "bank capital channel" is also positive ($\Psi_5 > 0$); due to the longer maturity of bank assets with respect to liabilities (ρ>0), in case of a monetary tightening (Δi_m>0) the bank suffers a cost and a subsequent reduction in profit; given the capital constraint, this effect determines an increase in loan interest rates (the mirror effect is a decrease in lending).

The equation (A1.9) for deposit interest rate is slightly different. Also in this case the impact of a monetary tightening is positive (Φ_2>0) but it can now be split in three parts: the "bank lending channel" ($b_0(1-\alpha)/2$>0), the "opportunity cost" ($-d_3/2d_0$>0) and the "liquidity buffer"($\alpha/2$>0) effects. The intuition of this result is that a monetary squeeze automatically increase the cost of borrowing of bank uninsured fund and the return on securities (the alternative investment for depositors); therefore the first two effects push the bank to increase the interest rate on deposits to raise more insured funds. The percentage of deposits invested in securities (α) act, on the one hand, as a simple "reserve coefficient" that reduces the effectiveness of the "bank lending channel" while, on the other, it increases the revenue on liquid portfolio and the market power of the bank to offset the interest rate on deposits. The distributional effects of monetary policy are equal to the ones described above for the interest rate on loans. The effects on the cost of deposits are smaller for banks with certain characteristics only if b_1<0 and Ψ_3<0. Deposit interest rate reacts negatively to an output expansion (Φ_4<0) and to an increase in prices (Φ_1<0). An economic expansion pushes the deposits demand to the left and causes a decrease in cost of deposits (remember that deposit demand is upward sloping with respect to i_d). The effect should be greater for increases in transitory income. Also the effect of the "bank capital channel" are negative (Φ_5<0); as we have seen, in case of a monetary tightening ($\rho\Delta i_m$>0) the bank suffers a cost and a reduction in profit; this induces the bank to increase her interest rate margin, reducing the interest rates on deposits.

Appendix 2 – Technical details on the data

The dataset has been constructed using three sources. Interest rates are taken from the 10-day report survey conducted by the Bank of Italy. Bank's balance sheet information comes from the Banking Supervision Register at the Bank of Italy. Data on macroeconomic variables are taken from the International Financial Statistics.

Data on interest rates refer to transactions in euros (Italian lira before 1999). The deposit interest rate is the weighted average rate paid by the single banks on current accounts, which are highly homogenous deposits products.[31] The rate on domestic short-term lending for the single bank is the weighted average of all lending positions. From this computation, overdraft fees are excluded. The choice of the short-term rate as a measure of the bank interest lending pass-through is due to several reasons. First, short-term lending excludes subsidized credit. Second, short-term loans typically are not collateralised and this allows insulating the "bank lending" channel from the "balance sheet" channel. Broadly speaking, the pass-through from market interest rates to the interest rate on loans does not depend upon market price variations that influence the value of collateral. Nearly half of bank's business is done at this rate.

Both interest rates are posted rates that are changed at discrete intervals (often less frequently than weekly, see Green, 1998). In our case, the quarterly frequency of the data is sufficient enough to capture all relevant changes due to a monetary policy shock. Both rates are gross of fiscal deduction.

The interest rate taken as monetary policy indicator is that on repurchase agreements between the Bank of Italy and credit institutions in the period 1993-1998, and the interest rates on main refinancing operation of the ECB for the period 1999-2001.[32]

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[31] Current accounts are the most common type of deposit (at the end of 2001 they represented around 70 per cent of total bank deposits and passive repos). Current accounts allow unlimited checking for depositor that can close the account without notice. The bank, in turn, can change the remuneration of the account at any point in time. Therefore differences in deposit rates are not influenced by heterogeneity in maturity (see Focarelli and Panetta, 2003).

[32] As pointed out by Buttiglione, Del Giovane and Gaiotti (1997), in the period under investigation the repo rate mostly affected the short-term end of the yield curve and, as it represented the cost of banks' refinancing, it represented the value to which market rates and bank rates eventually tended to converge. The interest rate on main refinancing operation of the ECB does not present any particular break with the repo rate.

The cost a bank suffers from her maturity transformation function is due to the different sensitivity of her assets and liabilities to interest rates. Using a maturity ladder, we have:

$$\rho_i = \frac{\sum_j \left(\chi_j \cdot A_j - \zeta_j P_j \right)}{\sum_j A_j} * 100$$

where A_j (P_j) is the amount of assets (liabilities) of j months-to-maturity and χ_j (ζ_j) measures the increase in interest on assets (liabilities) of class j due to a one-per-cent increase in the monetary policy interest rate (Δi_m=0.01). In other words, if $\sum_j \left(\chi_j \cdot A_j - \zeta_j P_j \right)$>0, ρ_i represents the cost per unit of asset bank i suffers in case the monetary policy interest rate is raised of one percentage point. We obtain χ_i and ζ_{i} directly from supervisory regulation on interest rates risk exposure. In particular, the regulation assumes, for any given class j of months-to-maturity: 1) the same sensitivity parameter ($\chi_j = \zeta_j$) and 2) a non-parallel shift of the yield curve (Δi_m=0.01 for the first maturity class and then decreasing for longer maturity classes). Then, for each bank, after having classified assets and liabilities according to their months-to-maturity class, we have computed the bank specific variable ρ_i. This variable has been then multiplied by the change of the monetary policy indicator (Δi_m) to obtain the realized loss (or gain) per unit of asset in each quarter.

In assembling our sample, the so-called special credit institutions (long-term credit banks) have been excluded since they were subject to different supervisory regulations regarding the maturity range of their assets and liabilities. Nevertheless, special long-term credit sections of commercial banks have been considered part of the banks to which they belonged.

Particular attention has been paid to the treatment of mergers. In practice, it has been assumed that these have been taken place at the beginning of the sample period, summing the balance-sheet items of the merging parties. For example, if bank A has been incorporated by bank B at time t, bank B has been reconstructed backward as the sum of the merging banks before the merger. Bank interest rates have been reconstructed backwards using as weights short-term loans and current accounts of the merging parties.[33]

Only banks reporting detailed lending and deposit rates over the whole sample period were considered. I refrain from adopting short time series to ensure sufficient asymptotic in the context of the error correction estimation. Bank observations that were missing or misreported or that constituted clear outliers were excluded from the sample.

Bad loans are defined as loans for which legal procedures aimed at their repayment have been started.

The permanent component of GDP has been computed using the Beveridge and Nelson (1981) decomposition. An ARIMA model (1,1,1) was applied to the logarithm of the series. Computations have been carried out using the algorithm described in Newbold (1990). Robustness of the results have been checked by means of a statistical analysis of the residuals.

The possible presence of structural breaks in interest rates series have been investigated by means of the procedure developed by Banerjee, Lumsdaine and Stock (1992). Figure A1 shows sequential test for changes in the mean of each interest rate series. The hypothesis of this procedure is that, if there is a break, its date is not known a priori but rather is gleaned from the data. The results clearly show that unit-root/no-break null can be rejected at the 2.5 per cent critical value level against the stationarity/mean-shift alternative for the period 1995:03-1998:03. In equation (1) and (2) a convergence dummy, that takes the value of 1 in this period and 0 elsewhere, has been introduced.

[33] The same methodology has been used, among others by Peek and Rosengreen (1995), Kishan and Opiela (2000) and Ehrmann et al. (2001).

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Table 1

VARIABLES DESCRIPTION

Variables	Symbols	Description
Dependent variables	i_{Lt}	Interest rate on domestic short term loans
	i_{Dt}	Interest rate on current account deposits
Fixed effects	μ_i	Bank-specific dummy variable
Macro variables	i_{mt}	Monetary policy indicator
	y_t^P , y_t^T	Permanent and transitory components of real GDP computed using the Beveridge and Nelson (1981) decomposition
	p_t	Inflation rate
Bank-specific characteristics that influence the "bank lending channel"	X_{it-1}	Size: log of total assets (Kashyap and Stein, 1995; Ehrmann et al. 2003)
		Liquidity: cash and securities over total assets (Stein, 1998; Kashyap and Stein, 2000)
		Excess capital: difference between regulatory capital and capital requirements (Peek and Rosengren, 1995; Kishan and Opiela, 2000; Gambacorta and Mistrulli, 2004)
		Deposit strength: ratio between deposits and bonds plus deposits (Berlin and Mester,1999; Weth, 2002)
		Credit relationship: ratio between long term loans and total loans (Berger and Udell, 1992)
Measure for the "bank capital channel"	ρ_{it-1}	Cost per unit of asset that the bank incurs in case of a one per cent increase in *MP*
Risk-measure	j_{it}	Ratio between bad loans and total loans. This variable captures the riskiness of lending operations and should be offset by a higher expected yield of loans.
Efficiency ratio	e_{it}	Management efficiency: ratio of total loans and deposits to the number of branches.
Interest rate volatility	σ_t	Interest rate volatility: coefficient of variation of i_M .
Control variables	Φ_{it}	Convergence dummy: step dummy that takes the value of 1 in the period 1995:03-1998:03 and 0 elsewhere.
		Seasonal dummies.

Note: For more information on the definition of the variables see Appendix 2.

Table 2

SUMMARY STATISTICS
(1993:03-2001:03)

Ex special credit institutions, foreign banks and "banche di credito cooperativo" are excluded. The sample represents more than 70 per cent of total system in terms of lending. All interest rate are annualized and given in percentages. (1) The size indicator is given by total asset (billions of euros). (2) The liquidity indicator is represented by the sum of cash and government securities over total assets. (3) The capital ratio is given by excess capital divided by total assets. Excess capital is the difference between regulatory capital and total capital requirements. (4) The Berlin and Mester indicator (BM) is the ratio between deposits and deposits plus bonds. (5) The Berger and Udell indicator (BU) is the ratio between long-term loans and total loans. A bank with a "high" characteristic has the average ratio above the first quartile of the distribution. (*) A bank with a "low"characteristic has the average ratio below the third quartile. Since the characteristics of each bank could change through time, percentiles have been worked out on mean values. For more details on the definition of the variables see Appendix 2. The sources of the dataset are Bank of Italy supervisory returns and 10-days reports.

	Bank-characteristics (*)	Number of banks	Interest rate on short term lending				Interest rate on current accounts				Size (1)	Liq. (2)	Cap. (3)	BM (4)	BU (5)
			Mean	St. dev.	Min	Max	Mean	St. dev.	Min	Max					
	Total sample	73	9.51	2.72	3.69	16.12	3.58	1.79	0.52	8.21	16.20	24.00	3.91	82.40	37.66
(1)	Big banks	18	9.28	2.81	3.69	15.06	3.57	1.74	0.73	7.35	51.15	19.01	2.56	77.60	38.98
	Small banks	18	10.02	2.73	5.03	16.12	3.55	1.79	0.52	8.21	1.55	25.11	4.81	84.40	41.72
(2)	Liquid banks	18	9.51	2.72	3.69	15.94	3.57	1.80	0.65	8.21	4.67	33.07	4.27	86.27	36.15
	Low liquid banks	18	9.33	2.73	4.42	14.86	3.61	1.71	0.73	7.35	43.75	14.91	3.13	72.43	43.66
(3)	Well capitalized banks	18	9.71	2.73	3.69	16.12	3.68	1.80	0.52	7.18	9.66	26.15	6.86	85.49	37.22
	Low capitalized banks	18	9.42	2.81	4.75	15.93	3.53	1.79	0.74	8.21	24.28	20.82	1.49	78.40	38.46
(4)	Banks with high BM ratio	18	11.78	1.49	4.88	16.12	5.15	0.96	0.74	8.21	6.58	29.69	4.46	98.53	28.72
	Banks with low BM ratio	18	7.77	2.24	3.69	15.06	2.41	1.45	0.52	7.35	27.00	18.56	3.42	66.10	45.30
(5)	Banks with high BU ratio	18	8.51	2.59	3.69	15.06	2.80	1.67	0.65	7.36	21.92	19.98	3.80	71.84	53.29
	Banks with low BU ratio	18	10.97	2.12	4.00	16.12	4.68	1.44	0.53	7.43	8.51	28.26	3.95	93.13	22.46

Table 3

RESULTS FOR THE EQUATION ON THE INTEREST RATE ON SHORT-TERM LENDING

This table shows the results of the equation for the interest rate on short term lending. The model is given by the following equation, which includes interaction terms that are the product of the monetary policy indicator and a bank specific characteristic:

$$\Delta i_{L\,k,t} = \mu_k + \sum_{j=1}^{2} \kappa_j \Delta i_{L\,k,t-j} + \sum_{j=0}^{1} (\beta_j + \beta_j^* X_{k,t-1}) \Delta i_{M\,t-j} + \varphi\, p_t + \delta_1 \Delta \ln y_t^P + \delta_2 \Delta \ln y_t^T + \lambda X_{k,t-1} + \phi \Delta(\rho_{k,t-1} \Delta i_{M\,t}) +$$
$$+ (\alpha + \alpha^* X_{k,t-1}) i_{L\,k,t-1} + (\gamma + \gamma^* X_{k,t-1}) i_{M\,t-1} + \theta\, j_{k,t} + \xi\, e_{k,t} + \psi \sigma_t + \overline{\Phi}_{k,t} + \varepsilon_{k,t}$$

with k=1,…, N (k=number of banks) and t=1, …,T (t= periods). Data are quarterly (1993:03-2001:03) and not seasonally adjusted. The panel is balanced with N=73 banks. Lags have been selected in order to obtain white noise residuals. The description of the variables is reported in Table 1. The model have been estimated using the GMM estimator suggested by Arellano and Bond (1991) which ensures efficiency and consistency provided that the models are not subject to serial correlation of order two and that the instruments used are valid (which is tested for with the Sargan test). A bank with "low characteristic" has the average ratio of the banks below the first quartile, a bank with "high characterisic" has the average ratio of the banks above third quartile. For more details on the data see Appendix 2. *=significance at the 10 per cent; **=significance at the 5 per cent; ***=significance at the 1 per cent.

Dependent variable: quarterly change of the interest rate on short-term lending	(1) Size		(2) Liquidity		(3) Capitalization		(4) Dep./(Bonds+Dep.)		(5) Long term loans/ Total loans	
	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error
Loan demand										
Inflation:	0.159 ***	0.019	0.145 ***	0.017	0.145 ***	0.015	0.149 ***	0.018	0.187 ***	0.015
Permanent Income:	0.033 **	0.015	0.030 ***	0.012	0.032 **	0.013	0.025 **	0.012	0.043 ***	0.010
Transitory Income:	0.012	0.031	0.013	0.025	0.012	0.026	0.012	0.024	0.026	0.020
Costs, credit risk and int.rate volatility										
Bank's efficiency:	-0.004 **	0.002	-0.001	0.002	-0.006 **	0.002	-0.001	0.001	-0.001	0.001
Bad loans:	0.020 ***	0.002	0.016 ***	0.002	0.017 ***	0.001	0.020 ***	0.002	0.019 ***	0.002
Interest rate volatility:	0.011 ***	0.001	0.012 ***	0.001	0.010 ***	0.001	0.014 ***	0.001	0.012 ***	0.001
Immediate pass-through										
Average bank:	0.569 ***	0.027	0.403 ***	0.031	0.533 ***	0.023	0.465 ***	0.030	0.497 ***	0.034
Ho: no heterogeneity (p-value)		0.003		0.018		0.418		0.023		0.000
Low characteristic	0.556 ***	0.028	0.414 ***	0.027	0.536 ***	0.022	0.474 ***	0.028	0.529 ***	0.033
High characteristic	0.586 ***	0.026	0.383 ***	0.036	0.529 ***	0.026	0.456 ***	0.032	0.463 ***	0.035
Pass-through after a quarter										
Average bank:	0.938 ***	0.013	0.941 ***	0.018	0.954 ***	0.012	0.869 ***	0.016	0.878 ***	0.013
Ho: no heterogeneity (p-value)		0.000		0.000		0.037		0.159		0.000
Low characteristic	0.913 ***	0.015	0.962 ***	0.018	0.958 ***	0.011	0.862 ***	0.017	0.889 ***	0.014
High characteristic	0.971 ***	0.014	0.920 ***	0.018	0.949 ***	0.015	0.878 ***	0.016	0.863 ***	0.012
Long run elasticity										
Average bank:	1.017 ***	0.014	0.996 ***	0.014	1.023 ***	0.012	0.982 ***	0.015	1.012 ***	0.018
Ho: unitary long run elasticity (p-val.)		0.056		0.816		0.047		0.235		0.489
Ho: no heterogeneity (p-value)		0.509		0.822		0.883		0.924		0.644
Low characteristic	0.996 ***	0.014	0.987 ***	0.015	1.031 ***	0.013	0.990 ***	0.026	0.992 ***	0.016
High characteristic	1.049 ***	0.016	1.005 ***	0.015	1.015 ***	0.012	0.978 ***	0.012	1.040 ***	0.023
Loading of the long run relationship										
Average bank:	-0.477 ***	0.023	-0.422 ***	0.019	-0.507 ***	0.023	-0.381 ***	0.043	-0.382 ***	0.017
Ho: no heterogeneity (p-value)		0.000		0.000		0.035		0.000		0.000
Low characteristic	-0.505 ***	0.026	-0.391 ***	0.023	-0.482 ***	0.028	-0.234 ***	0.021	-0.434 ***	0.017
High characteristic	-0.441 ***	0.023	-0.451 ***	0.019	-0.539 ***	0.026	-0.519 ***	0.020	-0.330 ***	0.020
Bank capital channel	0.104 *	0.055	0.409 ***	0.070	0.178 ***	0.051	0.197 ***	0.066	0.109 *	0.066
Miss-specification tests										
MA(1), MA(2) (p-value)	0.000	0.949	0.000	0.367	0.000	0.702	0.000	0.185	0.000	0.116
Sargan test (p-value)		0.087		0.099		0.088		0.101		0.057
No of banks, no of observations	73	2336	73	2336	73	2336	73	2336	73	2336

Table 4

RESULTS FOR THE EQUATION ON INTEREST RATE ON CURRENT ACCOUNTS

This table shows the results of the equation for the interest rate on current accounts. The model is given by the following equation, which includes interaction terms that are the product of the monetary policy indicator and a bank specific characteristic:

$$\Delta i_{D\,k,t} = \mu_k + \sum_{j=1}^{2} \kappa_j \Delta i_{D\,k,t-j} + \sum_{j=0}^{1} (\beta_j + \beta_j^* X_{\,k,t-1}) \Delta i_{M\;t-j} + \varphi\, p_t + \delta_1 \Delta \ln y_t^P + \delta_2 \Delta \ln y_t^T + \lambda X_{\,k,t-1} + \phi \Delta (\rho_{k,t-1} \Delta i_{M\;t}) +$$

$$+ (\alpha + \alpha^* X_{\,k,t-1}) i_{D\,k,t-1} + (\gamma + \gamma^* X_{\,k,t-1}) i_{M\;t-1} + \xi\, e_{k,t} + \psi \sigma_t + \overline{\Phi}_{k,t} + \varepsilon_{k,t}$$

with k=1,…, N (k=number of banks) and t=1, …,T (t= periods). Data are quarterly (1993:03-2001:03) and not seasonally adjusted. The panel is balanced with N=73 banks. Lags have been selected in order to obtain white noise residuals. The description of the variables is reported in Table 1. The model have been estimated using the GMM estimator suggested by Arellano and Bond (1991) which ensures efficiency and consistency provided that the models are not subject to serial correlation of order two and that the instruments used are valid (which is tested for with the Sargan test). A bank with "low characteristic" has the average ratio of the banks below the first quartile, a bank with "high characterisic" has the average ratio of the banks above third quartile. For more details on the data see Appendix 2. *=significance at the 10 per cent; **=significance at the 5 per cent; ***=significance at the 1 per cent.

Dependent variable: quarterly change of the interest rate on current accounts	(1) Size		(2) Liquidity		(3) Capitalization		(4) Dep./(Bonds+Dep.)		(5) Long term loans/ Total loans	
	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error
Deposit demand										
Inflation:	0.049 ***	0.015	0.091 ***	0.012	0.058 ***	0.015	0.099 ***	0.008	0.039 ***	0.009
Permanent Income:	-0.058 ***	0.006	-0.048 ***	0.006	-0.058 ***	0.005	-0.024 *	0.013	-0.052 ***	0.004
Transitory Income:	-0.222 ***	0.012	-0.204 ***	0.012	-0.223 ***	0.011	-0.102 ***	0.012	-0.202 ***	0.010
Costs, credit risk and int.rate volatility										
Bank's efficiency:	0.001	0.001	0.001	0.001	0.001	0.002	0.012 ***	0.001	0.002 *	0.001
Interest rate volatility:	0.001 **	0.001	0.002 ***	0.001	0.001 ***	0.001	0.005 ***	0.000	0.002 ***	0.001
Immediate pass-through										
Average bank:	0.413 ***	0.013	0.411 ***	0.010	0.410 ***	0.008	0.418 ***	0.009	0.388 ***	0.008
Ho: no heterogeneity (p-value)		0.000		0.000		0.742		0.000		0.000
Low characteristic	0.400 ***	0.015	0.431 ***	0.010	0.411 ***	0.009	0.451 ***	0.009	0.408 ***	0.007
High characteristic	0.429 ***	0.012	0.394 ***	0.010	0.409 ***	0.009	0.387 ***	0.010	0.366 ***	0.010
Pass-through after a quarter										
Average bank:	0.546 ***	0.009	0.541 ***	0.008	0.544 ***	0.007	0.507 ***	0.006	0.540 ***	0.006
Ho: no heterogeneity (p-value)		0.000		0.000		0.049		0.000		0.776
Low characteristic	0.512 ***	0.010	0.551 ***	0.008	0.551 ***	0.007	0.526 ***	0.006	0.536 ***	0.006
High characteristic	0.588 ***	0.008	0.530 ***	0.008	0.535 ***	0.009	0.493 ***	0.008	0.542 ***	0.008
Long run elasticity										
Average bank:	0.685 ***	0.013	0.685 ***	0.009	0.676 ***	0.009	0.643 ***	0.007	0.669 ***	0.010
Ho: unitary long run elasticity (p-val.)		0.000		0.000		0.000		0.000		0.000
Ho: no heterogeneity (p-value)		0.905		0.205		0.463		0.444		0.717
Low characteristic	0.688 ***	0.014	0.670 ***	0.010	0.663 ***	0.009	0.631 ***	0.006	0.675 ***	0.010
High characteristic	0.682 ***	0.013	0.699 ***	0.009	0.694 ***	0.011	0.654 ***	0.009	0.661 ***	0.011
Loading of the long run relationship										
Average bank:	-0.572 ***	0.018	-0.646 ***	0.018	-0.609 ***	0.020	-0.760 ***	0.016	-0.572 ***	0.016
Ho: no heterogeneity (p-value)		0.000		0.016		0.000		0.000		0.000
Low characteristic	-0.537 ***	0.018	-0.657 ***	0.020	-0.645 ***	0.019	-0.725 ***	0.019	-0.610 ***	0.017
High characteristic	-0.610 ***	0.023	-0.634 ***	0.017	-0.564 ***	0.025	-0.795 ***	0.017	-0.533 ***	0.017
Bank capital channel	-0.055 ***	0.015	-0.036 ***	0.012	-0.049 ***	0.009	-0.039 ***	0.013	-0.034 ***	0.009
Miss-specification tests										
MA(1), MA(2) (p-value)	0.000	0.953	0.000	0.976	0.000	0.785	0.000	0.340	0.000	0.508
Sargan test (p-value)		0.091		0.960		0.094		0.092		0.095
No of banks, no of observations	73	2336	73	2336	73	2336	73	2336	73	2336

Table 5

BANK LENDING CHANNEL

This table shows the results of the equation for the interest rate on short-term lending (panel A) and current accounts (panel B) when all bank-specific characteristics are taken simultaneously into account. The model is given by the following equation, which includes interaction terms that are the product of the monetary policy indicator and each bank-specific characteristic:

$$\Delta i_{\psi\,k,t} = \mu_k + \sum_{j=1}^{2} \kappa_j \Delta i_{\psi\,k,t-j} + \sum_{m=1}^{5}\sum_{j=0}^{1} (\beta_j + \beta_j^* X_{k,m,t-1}) \Delta i_{M\,t-j} + \varphi\, p_t + \delta_1 \Delta \ln y_t^P + \delta_2 \Delta \ln y_t^T + \sum_{m=1}^{5} \lambda_m X_{k,m,t-1} +$$

$$+ \phi \Delta(\rho_{k,t-1} \Delta i_{M\,t}) + (\alpha + \sum_{m=1}^{5} \alpha_m^* X_{k,m,t-1})(i_{\psi\,k,t-1} - \gamma\, i_{M\,t-1}) + \theta\, j_{k,t} + \xi\, e_{k,t} + \psi \sigma_t + \overline{\Phi}_{k,t} + \varepsilon_{k,t}$$

with $i\,\psi$= quarterly change of the interest rate on short-term lending or current accounts k=1,…, N (k=number of banks) and t=1, …,T (t= periods). Bank-specific characteristics are size,liquidity, capitalization, Berlin-Mester and Berger-Udell indicators (m=5). Data are quarterly (1992:03-2001:03) and not seasonally adjusted. The panel is balanced with N=73 banks. Lags have been selected in order to obtain white noise residuals. The description of the variables is reported in Table 1. The model have been estimated using the GMM estimator suggested by Arellano and Bond (1991) which ensures efficiency and consistency provided that the models are not subject to serial correlation of order two and that the instruments used are valid (which is tested for with the Sargan test). A bank with "low characteristic" has the average ratio of the banks below the first quartile, a bank with "high characterisic" has the average ratio of the banks above third quartile. For more details on the data see Appendix 2. *=significance at the 10 per cent; **=significance at the 5 per cent; ***=significance at the 1 per cent.

	(1) Size		(2) Liquidity		(3) Capitalization		(4) Dep./(Bonds+Dep.)		(5) Long term loans/ Total loans	
	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error	Coeff.	S.Error
(A) Dependent variable is the quarterly change of the interest rate on short-term lending										
Immediate pass-through										
Average bank:	0.452 ***	0.062	0.452 ***	0.062	0.452 ***	0.062	0.452 ***	0.062	0.452 ***	0.062
Ho: no heterogeneity (p-value)		0.159		0.027		0.043		0.702		0.016
Low characteristic	0.492 ***	0.064	0.476 ***	0.058	0.558 ***	0.065	0.460 ***	0.059	0.519 ***	0.050
High characteristic	0.393 ***	0.080	0.421 ***	0.069	0.308 ***	0.110	0.437 ***	0.077	0.375 ***	0.084
Pass-through after a quarter										
Average bank:	0.879 ***	0.039	0.879 ***	0.039	0.879 ***	0.039	0.879 ***	0.039	0.879 ***	0.039
Ho: no heterogeneity (p-value)		0.639		0.317		0.744		0.913		0.912
Low characteristic	0.895 ***	0.058	0.891 ***	0.036	0.914 ***	0.082	0.883 ***	0.050	0.888 ***	0.039
High characteristic	0.857 ***	0.040	0.868 ***	0.033	0.847 ***	0.075	0.876 ***	0.047	0.873 ***	0.053
Long run elasticity										
All banks:	1.000 -	-	1.000 -	-	1.000 -	-	1.000 -	-	1.000 -	-
Loading of the long run relationship										
Average bank:	-0.354 ***	0.050	-0.354 ***	0.050	-0.354 ***	0.050	-0.354 ***	0.050	-0.354 ***	0.050
Ho: no heterogeneity (p-value)		0.681		0.990		0.536		0.761		0.773
Low characteristic	-0.377 ***	0.072	-0.354 ***	0.063	-0.318 ***	0.070	-0.332 ***	0.089	-0.332 ***	0.086
High characteristic	-0.324 ***	0.092	-0.354 ***	0.046	-0.399 ***	0.095	-0.375 ***	0.085	-0.376 ***	0.095
Miss-specification tests										
MA(1), MA(2) (p-value)	0.000	0.073								
Sargan test (p-value)		0.985								
No of banks, no of observations	73	2336								
(B) Dependent variable is the quarterly change of the interest rate on current accounts										
Immediate pass-through										
Average bank:	0.452 ***	0.042	0.452 ***	0.042	0.452 ***	0.042	0.452 ***	0.042	0.452 ***	0.042
Ho: no heterogeneity (p-value)		0.972		0.129		0.529		0.032		0.112
Low characteristic	0.453 ***	0.043	0.470 ***	0.050	0.479 ***	0.054	0.509 ***	0.044	0.497 ***	0.062
High characteristic	0.452 ***	0.050	0.434 ***	0.037	0.419 ***	0.074	0.400 ***	0.054	0.406 ***	0.062
Pass-through after a quarter										
Average bank:	0.545 ***	0.033	0.545 ***	0.033	0.545 ***	0.033	0.545 ***	0.033	0.545 ***	0.033
Ho: no heterogeneity (p-value)		0.160		0.978		0.481		0.203		0.224
Low characteristic	0.572 ***	0.032	0.546 ***	0.038	0.566 ***	0.055	0.590 ***	0.045	0.563 ***	0.041
High characteristic	0.524 ***	0.043	0.545 ***	0.033	0.517 ***	0.045	0.516 ***	0.039	0.525 ***	0.034
Long run elasticity										
Average bank:	0.700 -	-	0.700 -	-	0.700 -	-	0.700 -	-	0.700 -	-
Loading of the long run relationship										
Average bank:	-0.570 ***	0.043	-0.570 ***	0.043	-0.570 ***	0.043	-0.570 ***	0.043	-0.570 ***	0.043
Ho: no heterogeneity (p-value)		0.388		0.820		0.481		0.004		0.575
Low characteristic	-0.537 ***	0.048	-0.565 ***	0.050	-0.607 ***	0.019	-0.452 ***	0.062	-0.589 ***	0.059
High characteristic	-0.612 ***	0.074	-0.575 ***	0.047	-0.523 ***	0.025	-0.680 ***	0.054	-0.550 ***	0.051
Miss-specification tests										
MA(1), MA(2) (p-value)	0.000	0.915								
Sargan test (p-value)		0.180								
No of banks, no of observations	73	2336								

Fig. 1

Banking interest rates
(quarterly data, percentage points)

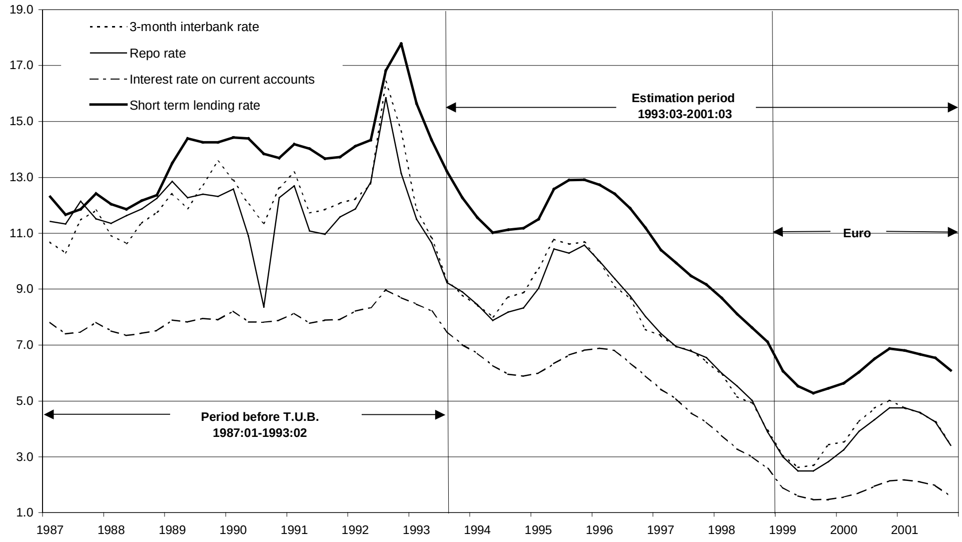


Fig. 2

Cross sectional and time series dispersion of interest rates

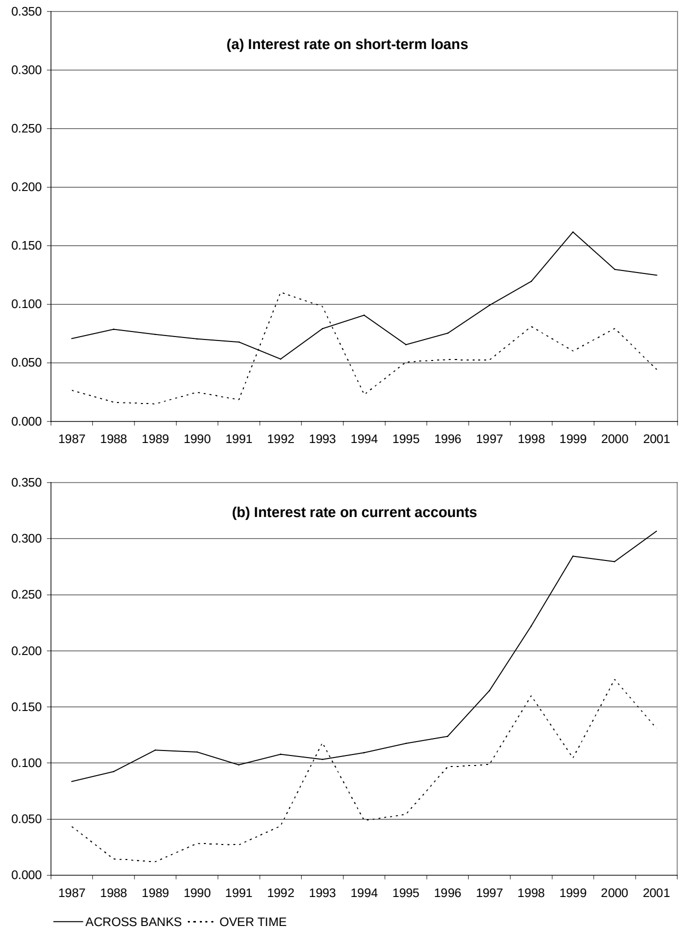
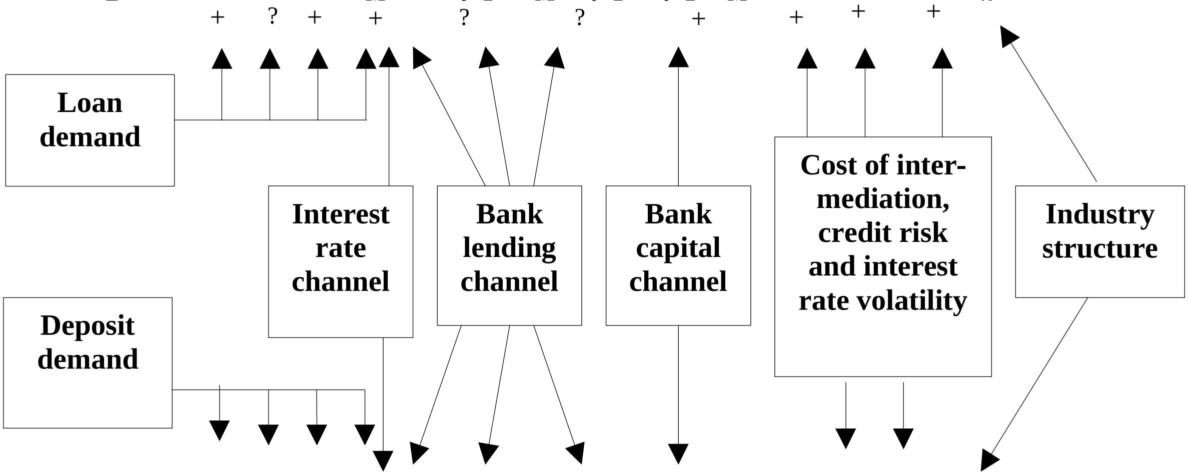


Fig. 3

Determinants of bank's interest rates

$$i_L = f(\underset{+}{y^P}, \underset{?}{y^T}, \underset{+}{p}, \underset{+}{i_M}, \underset{?}{X_{t-1}}, \underset{?}{i_M X_{t-1}}, \underset{+}{\rho_{t-1}\Delta i_M}, \underset{+}{j}, \underset{+}{\text{costs}}, \underset{+}{\sigma, \mu_k})$$



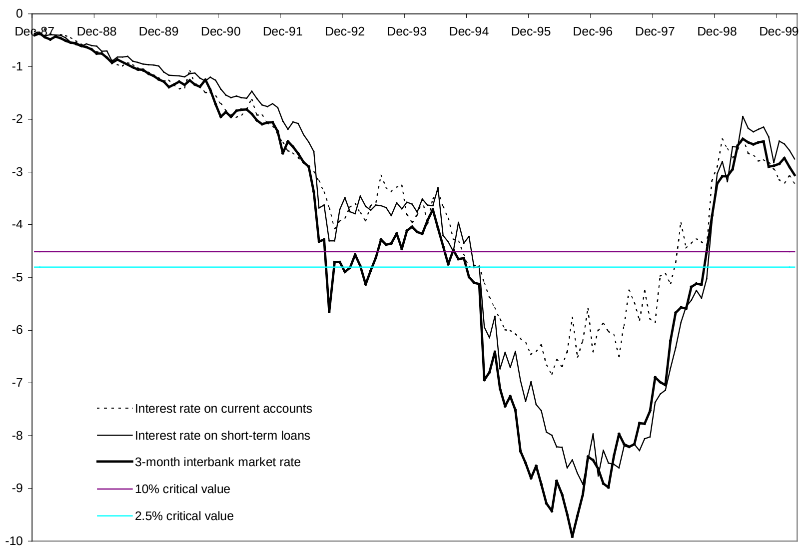
$$i_D = f(\underset{-}{y^P}, \underset{-}{y^T}, \underset{-}{p}, \underset{+}{i_M}, \underset{?}{X_{t-1}}, \underset{?}{i_M X_{t-1}}, \underset{-}{\rho_{t-1}\Delta i_M}, \underset{-}{\text{costs}}, \underset{+}{\sigma}, \mu_k)$$

Note: the meaning of all the symbols is reported in Table 1.

Fig. A1

Search for mean shift breaks

(monthly data, sequential minimum unit root tests)



Note: The estimated model tests for a shift in the constant. No trend is included. Sequential statistic are computed using the sample 1984:7-2002:12, sequentially incrementing the date of the hypothetical shift. A fraction equal to 15 per cent of the total sample at the beginning and at the end of the sample is not considered for the test. For more details see Banerjee, Lumsdaine and Stock (1992).