EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

ECB EZB EKT BCE EKP

WORKING PAPER NO. 104

EUROSYSTEM MONETARY TRANSMISSION NETWORK

IS THERE A BANK LENDING CHANNEL OF MONETARY POLICY IN GREECE? EVIDENCE FROM BANK LEVEL DATA

BY SOPHOCLES N. BRISSIMIS, NICOS C. KAMBEROGLOU AND GEORGE T. SIMIGIANNIS

December 2001

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

EUROSYSTEM MONETARY TRANSMISSION NETWORK

WORKING PAPER NO. 104

IS THERE A BANK LENDING CHANNEL OF MONETARY POLICY IN GREECE? EVIDENCE FROM BANK LEVEL DATA

BY SOPHOCLES N. BRISSIMIS[1,2], NICOS C. KAMBEROGLOU[1] AND GEORGE T. SIMIGIANNIS[1]

December 2001

1 Bank of Greece, Economic Research Department.

2 University of Piraeus. We would like to thank Ignazio Angeloni and Andreas Worms and the other members of the MTN for their useful comments and suggestions. The views expressed in this paper reflect those of the authors and not necessarily those of the Bank of Greece.

The Eurosystem Monetary Transmission Network

This issue of the ECB Working Paper Series contains research presented at a conference on "Monetary Policy Transmission in the Euro Area" held at the European Central Bank on 18 and 19 December 2001. This research was conducted within the Monetary Transmission Network, a group of economists affiliated with the ECB and the National Central Banks of the Eurosystem chaired by Ignazio Angeloni. Anil Kashyap (University of Chicago) acted as external consultant and Benoît Mojon as secretary to the Network.

The papers presented at the conference examine the euro area monetary transmission process using different data and methodologies: structural and VAR macro-models for the euro area and the national economies, panel micro data analyses of the investment behaviour of non-financial firms and panel micro data analyses of the behaviour of commercial banks.

Editorial support on all papers was provided by Briony Rose and Susana Sommaggio.

© **European Central Bank, 2001**

Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

All rights reserved.

Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

The views expressed in this paper are those of the authors and do not necessarily reflect those of the European Central Bank.

ISSN 1561-0810

Contents

Abstract

This paper analyses empirically the role of bank lending in monetary policy transmission on the basis of Greek bank level data. Two approaches have been taken. One employing a reduced form equation linking monetary policy and distributional variables to bank loans in the spirit of Kashyap and Stein's work. The other, which in general yields more satisfactory results, brings together some of the features of the Bernanke-Blinder model with a method for assessing the impact of differential balance-sheet characteristics on banks' ability to supply loans and investigates directly the behaviour of bank loan supply. A loan supply function was estimated with the use of the bank data, and bank-specific characteristics were found to systematically shift this function.

JEL classification: C23, E44, E51, E52, G21

Keywords: Models with panel data, bank lending, monetary policy transmission, differential bank characteristics

Non-technical summary

In contrast to the traditional money view, according to which monetary policy is transmitted through changes in bank liabilities, the credit view emphasises an additional transmission channel, the bank lending channel, which allows central bank actions to affect the supply of credit from banks and, in turn, real spending in the economy. Empirical studies, using mainly US data, have found that bank characteristics, such as asset size, liquidity (or balance sheet strength) and capitalisation, are important in assessing the impact of monetary policy on loan growth and in determining its distributional effects.

This paper examines the role played by Greek banks in the transmission of monetary policy and assesses the importance of cross-sectional differences in bank characteristics for the operation of the bank lending channel, using monthly panel data that cover the second half of the 1990s.

Two approaches have been taken for analysing the role of banks in monetary transmission. One employing a reduced form equation linking monetary policy and distributional variables, as well as their interaction, to bank loans in the spirit of Kashyap and Stein's work. Two indicators of cross-sectional differences were used: a size indicator, differentiating large from small banks, and an indicator of the health of bank balance sheets. The results, while compatible with the existence of a bank lending channel, were in general not satisfactory. In an alternative approach, it was argued that bank heterogeneity, though useful in accounting for loan supply shifts, is not the only element on which to base the analysis of the effectiveness of the lending channel. By bringing together some of the features of the Bernanke - Blinder model with a methodology for assessing the impact of differential balance sheet characteristics on banks' ability to supply loans, we investigated directly the behaviour of bank loan supply.

The empirical results of this second approach show that monetary policy clearly has a significant impact on the supply of bank loans and, through shifts in supply, on aggregate economic activity in Greece. Bank data helped us identify a loan supply function, a task that presents well-known difficulties for researchers. The response of loan supply to the spread between the loan rate and the bond rate is one of the critical parameters in the Bernanke - Blinder model that relates to the degree of substitutability between loans and securities (for banks) and thus to the significance of the lending channel. In addition, bank-specific characteristics were found to systematically shift the loan supply function. The results showed that large banks can, to a certain extent, shield their loan portfolio from monetary policy changes. Similar results hold for the more liquid (healthy) banks.

1. Introduction

Considerable research has recently examined the role played by banks in the transmission of monetary policy. In contrast to the traditional money view, according to which monetary policy is transmitted through changes in bank liabilities, the credit view emphasises an additional transmission channel, the bank lending channel, which allows central bank actions to affect the supply of credit from banks and, in turn, real spending in the economy. However, difficulties in distinguishing shifts in loan supply from shifts in loan demand have complicated the task of uncovering a lending channel at the aggregate level. Thus, the evidence from studies using aggregate data was supplemented by an analysis of the distributional effects of monetary policy changes. The question that empirical studies have sought to answer is whether there are important cross-sectional differences in the way that banks with varying characteristics respond to policy shocks (Kashyap and Stein, 2000). Bank characteristics that were found to be important in assessing the impact of monetary policy on loan growth and in determining its distributional effects were asset size, liquidity (or balance sheet strength) and capitalisation.

This paper examines the implications of differential bank characteristics for the loan supply behaviour of Greek banks, using monthly panel data that cover the second half of the 1990s, and assesses the importance of these cross-sectional differences for the operation of the bank lending channel. It is argued that bank heterogeneity, while useful in accounting for loan supply shifts, is not the only, and indeed not the most important element on which the search for an aggregate bank lending channel could be based.

The paper is divided as follows: Section 2 contains a discussion of the time series evidence on the existence of the lending channel, followed by a brief survey of studies using disaggregated bank data and their usefulness in identifying loan supply shifts. Section 3 presents an overview of recent developments in the Greek banking system and its characteristics that may be pertinent to the operation of the lending channel. Section 4 uses two approaches for analysing the role of banks in monetary transmission. One employing a reduced form equation linking monetary policy and distributional variables to bank loans in the spirit of Kashyap and Stein's work. The other, which in general yields more satisfactory results, brings together some of the features of the Bernanke-Blinder model with a method for assessing the impact of differential balance-sheet characteristics on banks' ability to supply loans and investigates directly the behaviour of bank loan supply. This section also discusses data issues and presents estimation results by applying panel cointegration methods, which indicate the importance of the lending channel for the Greek economy and of bank specific characteristics in accounting for a differentiated response of loans to monetary policy changes. Finally, Section 5 summarises the main conclusions.

2. The bank lending channel: Identification through heterogeneity?

The bank lending channel is a separate channel that reinforces the operation of the money channel for monetary policy transmission. Its existence is predicated on capital market imperfections arising *inter alia* from asymmetric information. To the extent that the bank lending channel operates, monetary policy can influence aggregate demand not only through interest rates as in the traditional money channel, but also through its impact on the supply of bank loans. When monetary policy tightens, bank deposits fall and the loan supply schedule shifts upwards, which enhances the interest rate-induced effect on aggregate demand. This effect on loan supply should be clearly distinguished from loan demand contraction and the inward shift of the loan demand schedule associated with the fall in output that higher interest rates entail.

The bank lending channel has been theoretically analysed by Bernanke and Blinder (1988) in a model that expands the conventional IS-LM framework by taking into account the bank loan market. Loans and bonds are assumed to be imperfect substitutes both for borrowers and banks. This implies that, along with the bond rate, the bank lending rate is also introduced in the analysis, as it influences loan demand and supply and the demand for output. A key result of the Bernanke - Blinder model is that there is no bank lending channel when (i) loan supply is perfectly elastic with respect to the loan rate, i.e. loans and bonds are perfect substitutes in bank portfolios, or (ii) loan demand is perfectly elastic with respect to the loan rate, or output demand does not respond to changes in the loan rate, both cases implying that borrowers view loan and bond financing as perfect substitutes. Note that when these conditions are satisfied, the demand for and the supply of loans cannot be defined separately from the corresponding demand for and supply of bonds.

The implications of the Bernanke - Blinder model are not easy to test empirically, and thus obtaining “sharp measurements of the (channel’s) potency is a challenging task” (Bernanke and Gertler, 1995, p.42). A number of studies over the last decade have indirectly tested for the existence of the bank lending channel by examining timing relationships either between quantity variables (output, loans, money and other bank or firm balance sheet items) or between price variables (interest rates or interest rate differentials). Following the first route, Bernanke and Blinder (1992) have applied VAR analysis to US data to examine the impulse response functions of bank loans, securities and deposits to a positive innovation in the Federal funds rate. Their results showed (i) an immediate decline in the volume of securities and deposits and a delayed decline in the volume of bank loans, and (ii) over a somewhat longer time span , a rebuilding of bank securities holdings and a further decline in loans, essentially matching the decline in deposits. These results were felt to be consistent with a credit channel, but also with a money channel, since loans responded with the same lag as unemployment to the monetary policy shock.

In an attempt to separate the effect of loan demand from loan supply, Kashyap, Stein and Wilcox (KSW, 1993) examined movements in the mix between bank loans and a close substitute (i.e. commercial paper) for bank finance to firms, following changes in monetary policy. According to the authors, the bank lending channel makes the following prediction: a tightening of monetary policy would cause the supply of bank loans to decline by more than the supply of commercial paper, whereas the composition of firms’ external finance would not be affected if monetary policy operated solely through the money channel. KSW found evidence that tight monetary policy leads to an increase in commercial paper issuance while bank loans slowly decline. Oliner and Rudebusch (1995,

1996) questioned the usefulness of changes in the aggregate financing mix as an indicator of the operation of the bank lending channel. They instead proposed an alternative explanation: monetary tightening does not only reduce the demand for all types of external finance but it also redirects all types of credit from small firms to large firms, which rely more heavily on commercial paper financing. In this case, commercial paper issuance may rise relative to bank loans even when the supply of bank loans remains unchanged. Thus, heterogeneity in loan demand rather than shifts in loan supply would explain a change in the mix between bank and non-bank financing. Using data for the US manufacturing sector, Oliner and Rudebusch found almost no evidence that a monetary shock changes the composition of bank and non-bank debt for either small or large firms, which is not consistent with the existence of a bank lending channel. In response to this criticism, Kashyap, Stein and Wilcox (1996) reported that even among large firms there appears to be substitution away from bank loans to commercial paper after a monetary policy contraction. Their statistical results, however, are not very robust; when the federal funds rate is used as the monetary policy indicator, they do not support the existence of the bank lending channel as is also the case with Oliner and Rudebusch's paper. A common limitation of all studies dealing with the issue of the existence of a bank lending channel through the estimation of timing relationships is that they concentrate on relatively short-term responses, which may not be very informative in view of the fact that banks are prevented from adjusting their loans stock quickly after a monetary policy change, due to loan commitments and other contractual agreements (Bernanke and Blinder, 1992, p. 919), and that the observed responses may admit alternative interpretations, not necessarily restricted to supply of credit shifts.

The difficulties in distinguishing shifts in loan demand from shifts in loan supply have prompted researchers to focus on panel data to explore some of the cross-sectional implications of the lending view, namely that the responses of banks and firms to changes in monetary policy may differ, depending on their characteristics. In particular as regards banks, the existing evidence indicates that, due to agency and/or search costs, they may experience increasing costs of non-deposit external finance, which are higher for small banks. Thus, small banks are expected to be affected more from a monetary contraction.

Kashyap and Stein (1995) using US data, tested the hypothesis that, after a monetary contraction, the lending volume of small banks declines more rapidly than that of large banks (i.e. $d^2L_{it}/dM_{it}\, dsize_{it} <0$). Their empirical results are consistent with this hypothesis, as the estimated coefficient on the monetary policy variable, which gives an indication about the operation of the lending channel, declines with size. However, the coefficient for large banks was positive and insignificant, indicating that for this group of banks the lending channel may not be important. Large banks were defined as those representing the top 1% of all banks and their assets accounted for 55% of the total system assets. As estimation results are not presented for another part of the sample (the 99th percentile of bank distribution) accounting for approximately 8% of the system's assets, there is potentially a total of 63% of the system's assets, controlled by banks for which a lending channel for monetary policy transmission may not exist. This in turn would cast doubt on the importance of the lending channel for aggregate economic activity.[1]

One problem with the above test is that banks with a large buffer stock of liquid assets can partly, if not completely, insulate their loans from the effects of monetary policy. For a bank of a given size, a tightening of monetary policy would cause loans to decline less, the more liquid is the bank (i.e. $d^3L_{it} /dM_{it}\, dsize_{it}\, dB_{it} >0$). In this case, the bank would have a

[1] Studies using total loans for the aggregate banking system have generally shown an insignificant effect of monetary policy on loan growth (see, e.g. Becketti and Morris, 1992, and Friedman and Kuttner, 1993).

larger buffer stock of cash and securities, which it can draw down to shield its loan portfolio. Kashyap and Stein (2000) reported that small banks are on average more liquid than large banks and this mitigates the effectiveness of the bank lending channel for these banks. Indeed, by separating banks by asset size and liquidity, Kashyap and Stein found that small banks with the least liquid balance sheet were the most responsive to policy.

Kishan and Opiela's (2000) paper extended the above analysis to include, along with the asset size, an additional differentiating characteristic – a bank's degree of capitalization. The role of bank capital is twofold. It is an indicator of bank health and, therefore, an indicator of a bank's ability to raise funds from alternative sources during contractionary policy. Moreover, prudential supervision, and in particular capital adequacy requirements, may affect the composition of bank asset portfolios, in the sense that well capitalized banks are less constrained during periods of tight monetary policy, since these banks can isolate, to some extent, their loan portfolio from monetary shocks. Kishan and Opiela, using a model of a representative bank, came to the conclusion that the effect of capital on the response of loans to monetary policy changes is positive. Thus, the better capitalized a bank is, the less responsive its loans will be to changes in policy (i.e. $d^2L_{it}/dM_{it}\, dK_{it} > 0$). Their empirical results provide strong evidence that the smallest and least capitalized banks are the most responsive to monetary policy, a finding consistent with loan supply shifts for this category of banks. However, for larger banks, accounting for about 80% of the system's assets, loan responses to monetary policy changes are not statistical significant, suggesting that a bank lending channel may not hold in total.

The tests of the lending channel discussed above that are based on bank characteristics were limited to US data. Favero, Giavazzi and Flabbi (1999) empirically investigated the existence of a lending channel for Europe also using disaggregated bank data. They tested the same hypotheses as Kashyap and Stein (2000) for four European countries (France, Germany, Italy and Spain), with cross-section data for 1992 and bank reserves as the monetary policy variable. Overall, they found no evidence of a lending channel in these countries. For certain size groups, however, their results were counter-intuitive. For example, they found that small banks in Germany, Italy and France use their excess liquidity to expand loans in the presence of monetary policy tightening, contrary to the prediction of the bank lending hypothesis.

A potential problem with studies examining cross section differences in the response to monetary policy is that estimates may be affected by endogeneity bias. For instance, the balance sheet strength variable may be endogenous in that banks which lend to cyclically sensitive customers may hold a larger buffer stock of liquid assets to protect themselves from the greater risk they assume. Other banks which are more conservative may hold a larger stock of liquid assets as a result of a reduction in loans to cyclically sensitive customers. Kashyap and Stein (2000) suggested a two step procedure to remove this bias.

The bottom line of the above review is that heterogeneity bears on the importance of the bank lending channel as differential balance sheet characteristics are tied to banks ability to supply loans (Kishan and Opiela, 2000). Nevertheless, it does not constitute the only element on which the search for a bank lending channel can be based.

3. The structure of the Greek banking sector

Banks in Greece have historically played a dominant role in channelling financial savings from surplus to deficit economic units, whereas the relative importance of other financial institutions, such as mutual funds and insurance companies, in financial intermediation was until recently very limited, but is currently increasing. The special role of banks in financial intermediation was further enhanced by the following features of the financial system. First, banks were highly regulated, and detailed selective rules and restrictions governed the distribution of bank credit to economic sectors until the mid- 1980s. Moreover, until December 1990, commercial banks were required to invest 40% of their drachma deposits in government securities, mainly 3-month Treasury bills. This investment requirement was phased out at the margin by end-1993 and banks converted their accumulated Treasury bill holdings into negotiable medium-term government bonds. However, the relatively thin market for government securities did not allow banks to sell a large part of their portfolio of these securities without incurring substantial capital losses. Second, the scope for financing through the capital market was also very limited, as the Stock Exchange was not very developed until the beginning of the 1990s. Third, various restrictions had been imposed on external transactions and in particular on capital flows. Important developments in financial markets abroad, and the need to transpose the relevant EU Directives into domestic law and modernise the Greek financial system led to the gradual liberalisation of financial markets and external transactions, a process that was essentially completed by the mid-1990s. As a result, bank intermediation has relatively declined, whereas the stock market and mutual funds have displayed very rapid growth. Banks have tried to counter this trend through financial innovations. Examples of this are the development of synthetic swaps[2] and the increase in banks' off-balance sheet items,[3] which mainly reflect the fast growth of financial derivatives. To a considerable extent, financial innovations were driven by tax avoidance motives, as well as by the desire of banks to circumvent reserve requirements, given the relatively high reserve requirement ratio (12%, as against the 2% currently applied by the Eurosytem) and the significantly low rates, compared with market rates, at which reserves were remunerated. The response of the Bank of Greece to these developments was to broaden the reserve base, by including all types of bank liabilities to residents and non-residents, arising from deposits or credits or, in general, associated with asset management agreements. This system of reserve requirements remained in place until June 2000, when it was harmonised with that of the Eurosystem, with transitory arrangements for the release of the accumulated reserves in excess of the new requirement. It should be also noted that a special regime applied to the bulk of deposits in foreign currencies, for which the reserve requirement ratio was effectively 100%. Again, a gradual harmonisation brought the reserve requirement ratio for these deposits down to that applied by the Eurosystem.

The above discussion suggests that, prior to the recent harmonisation of the reserve requirement system, banks operating in Greece had only very limited possibilities to isolate their fund raising activities from the effects of monetary policy shocks and thus to maintain their loan supply unchanged. The only possibility open to them was to resort to the stock market for raising share capital, but this procedure could not be used flexibly, given the institutional procedures that have to be followed for increasing share capital. On

---

[2] Synthetic swaps were developed in the early 1990s mainly for tax avoidance reasons. A synthetic swap involved the transfer of an amount of funds to a term deposit account denominated in a foreign currency with a bank abroad and the simultaneous forward selling of the principal and the interest for drachmas. The difference between the spot and the forward exchange rates is treated as capital gains by tax authorities and is not taxed.

[3] Greek commercial banks' off-balance sheet items as a percentage of total assets: 1993: 53%, 2000: 154%.

the other hand, the scope for substituting loans for securities appears to have been minimal until the mid-1990s, but it has increased considerably after financial liberalisation was completed. Thus, the bank lending channel is expected to have been especially potent in the period before the liberalisation of the banking system, but to have weakened thereafter. Indeed, the available time series evidence based on the relationship between output, money and credit for the period 1972-1996 indicates that a strong lending channel existed in the earlier part of that period but its importance subsequently diminished with the financial liberalisation (Brissimis and Kastrissianakis, 1997).

Kashyap and Stein (1997), on the basis of four indicators of the relative importance of the bank lending channel in the EU countries (EU-12), classified Greece as a country where the bank lending channel is more likely to work. The first indicator refers to the concentration of the banking system: the more concentrated the system, the less sensitive is expected to be its responsiveness to monetary policy shocks, given that large banks can more easily substitute other liabilities that are not subject to reserve requirements and/or are uninsured, for deposits. The second indicator is the rate of return on bank assets: other things being equal, the more capitalised a bank, the higher its expected profitability, since the cost its funds is relatively lower.[4] On the other hand, well capitalised banks should have an easier access to capital markets to raise funds in the event of a deposit shock, implying that monetary policy would have less of an impact on those banks. The third indicator relates to the size of firms: smaller firms are more dependent on bank financing than larger firms, as monitoring costs for small firms are so high that they would have difficulties in securing non-bank financing. Thus, for a given contraction of bank credit, these firms will be affected more. Finally, the fourth indicator refers to the importance of non-bank financing, in particular equity and bond financing. Where the availability of non-bank financing is greater, the efficacy of the bank lending channel is likely to be less.

Table 1 provides information on the structure of the Greek banking system according to various characteristics at the end of 1998. Commercial banks constitute the most important segment of the Greek banking sector, their share in total bank assets being 88.2%, while the share of specialised credit institutions is a little above 10%. Cooperative banks hold a very low percentage (0.3%) of total bank assets, although their number has been increasing in recent years.

The degree of concentration of the Greek banking system is relatively high, given that the share of the three larger banks in total bank assets is almost 50%, while that of the banks at the bottom 50 per cent of the distribution of their total assets is only 3.8%. However, Greek banks are rather small according to an absolute size criterion as only 5 fall into the "large bank" category, i.e. total assets larger than € 6 billion, while there are 14 banks, each with total assets not exceeding € 50 million, which make up almost all of the bottom quartile. As shown in Table 1, loans to the non-MFI private sector as a percentage of total assets is higher in the case of small banks according to both absolute and relative size criteria. On the contrary, holdings of securities represent a smaller percentage of the total assets in smaller banks rather than in larger banks, indicating that the latter are relatively more liquid. Furthermore, the share of deposits in total liabilities is higher in the case of larger banks, but smaller banks are better capitalised.

As regards capitalisation, poorly capitalised banks rely on deposits more than well capitalised banks. However, the ratio of loans to the non-MFI private sector to total assets of well capitalised banks is higher, indicating that capital adequacy considerations may have been more binding for poorly capitalised banks.

[4] For a given level of total assets, the more capitalised a bank is, the lower will be the amount and cost of borrowed funds, making the return on assets (ROA) higher.

4. Empirical evidence

The role of banks in the transmission process and the importance of differential bank characteristics as regards the response of bank loans to a monetary tightening can be empirically investigated by using the following specification based on Kashyap and Stein (1995):

$$\Delta L_{it} = \sum_j a_j \Delta L_{i,t-j} + \sum_j b_j \Delta r_{t-j} + \sum_j c_j Z_{i,t-1} \Delta r_{t-j} + dZ_{i,t-1} + \sum_j e_j \Delta W_{t-j} + v_i + \varepsilon_{it} \quad (1)$$

where $L_{i,t}$ are real loans (in logs), r_t is a monetary policy interest rate, Z_{it} is a bank specific characteristic, W_t is a vector of control variables, v_i represents individual bank effects, and ε_{it} is the error term. Subscripts i and t refer to specific banks and time period, respectively.

Equation (1) is the typical reduced form equation of a bank that is compatible with the existence of a bank lending channel and in which differential bank characteristics play an important role in shifting the banks' loan supply function. The parameters of interest in this equation are the b_j's and c_j's, which are assumed to be the same across banks. A monetary tightening is expected to reduce lending, hence $\sum_j b_j$ should be negative. Large and liquid banks are expected to be able to better shield their loans from monetary shocks by using their buffer of liquid assets and/or by attracting funds from non-deposit sources. Thus, $\sum_j c_j$ is expected to be positive. Individual bank characteristics other than those represented by Z_i are captured by the fixed effect term $v_{i.}$

Panel data on balance sheet items for Greek banks have been used to estimate equation (1). The sample includes monthly observations covering the period January 1995 to December 1999 for 12 commercial banks representing all sizes. Although the sample contains only 20% of all banks operating in Greece, at end-1999 the share of these banks in total assets, loans, and deposits of the banking system was 57%, 59%, and 68%, respectively. Bank data had to be adjusted for two mergers that occurred in the later part of 1999. Merged banks were assumed to remain independent and the relevant data after the merger were allocated to each of the banks according to the pattern observed immediately prior to their merging.[5] All balance sheet variables were deflated by the consumer price index, seasonally adjusted and expressed in logs. The 3-month money market rate (Athibor) is used as the monetary policy variable. As a control variable we used an index of real GDP constructed on the basis of annual national accounts data and available monthly indicators of economic activity for the main sectors of the economy.[6]

The effects of bank specific characteristics are examined by using a balance sheet strength (liquidity) and a size variable. Liquidity is defined as the ratio of liquid assets $LQ_{i,t}$ (cash, deposits held with other banks and securities) to total assets $A_{i,t}$. Bank size is measured by total assets. The bank characteristic variables are defined as deviations from the cross-sectional mean at each time period in the case of the size variable, so as to remove its trend, or the overall mean in the case of the bank strength variable, which does not have a trend:

[5] This treatment of mergers was adopted as a backward aggregation of merging banks would have resulted in a considerable loss of information, while the bias introduced by allocating data to the particular banks after their merging is small since, as mentioned above, the two mergers occurred only in the second half of the last year of the sample period.

[6] See Brissimis *et al* (2001).

$$B_{i,t} = LQ_{i,t} / A_{i,t} - \sum_t [(\sum_i LQ_{i,t} / A_{i,t})/N]/T \quad (2)$$
$$S_{i,t} = \ln A_{i,t} - (\sum_i \ln A_{i,t})/N \quad (3)$$

The system of equations (1) was estimated by using SUR weighted least squares (sometimes referred to as the Parks estimator) which is appropriate when residuals are both cross section heteroscedastic and contemporaneously correlated.[7] Furthermore, in order to reduce possible multicolliniarity problems, we discarded the inflation rate and the interaction terms with inflation which were much less significant. We ended up retaining three lags for the other variables. Also, we included the 12th lag of the rate of growth of loans in order to capture any seasonality that had not been removed. Finally, a dummy variable was included to account for the impact of the turbulence in the foreign exchange market in November 1997 that followed the financial crisis in Russia.

The estimation results are shown in Table 2. The direct impact of monetary policy on loans has the correct sign but is not significant in either equation. The effect of the interaction of the monetary policy variable with each bank characteristic also has the correct sign and is significant only in the case of the liquidity variable, indicating that more liquid banks can better shield their loan portfolio from monetary policy changes.

Empirical work based on equation (1) above appears in our view to have two limitations: first, it relies on a reduced form relating loans to a monetary policy variable, which does not allow the identification of the parameters of the structural model-the Bernanke and Blinder model- that are relevant to the existence of the lending channel. Moreover, measurement biases may be introduced from the use of explanatory variables, such as GDP, data on which have only a time dimension. Second, variables are expressed in first difference form, not taking into account possible equilibrium relationships.

An alternative approach would consist in trying to estimate directly the banks' loan supply function. The discussion in Section 2 above has shown that the identification of this function is critical to the empirical investigation of the bank lending channel and panel data can be useful in uncovering certain aspects of bank behaviour which may be related to its existence.

Assuming that the loan market is competitive, we can specify the following equilibrium loan supply function for the individual bank i:

$$L_{it} = \alpha + \beta (\rho_t - i_t) + \gamma D_{it} \qquad \beta>0, \quad \gamma>0 \qquad (4)$$

where L_{it} and D_{it} are real loans and deposits (in logs) of bank i in period t, and ρ_t and i_t are the lending rate and the bond rate in period t.

[7] This is the analogue to the Seemingly Unrelated Regression- GLS using estimated cross-section residual covariance matrix, with the appropriate across equation restrictions.

Equation (4) is consistent with the aggregate loan supply function in the Bernanke - Blinder's model discussed above. In this specification, loans depend on the interest rate spread, assuming that there is rate of return homogeneity of degree zero which implies that, when all interest rates rise by the same amount, banks do not change the composition of their portfolios. Furthermore, the lending rate variable only has a time dimension, since in a competitive market the individual bank takes the price (interest rate) as given.[8] The sensitivity of loan supply to the interest rate spread (i.e. the parameter β) is one of the three parameters in the Bernanke and Blinder's model which determine the lending channel's potency. When $\beta \rightarrow \infty$, loans and bonds are perfect substitutes for banks ($\rho = i$) and there is no bank lending channel. Deposits are the scale variable in (4).

The effect of bank characteristics can be introduced *via* the coefficient on $(\rho_t - i_t)$ or D_{it}. Assuming that bank characteristics affect loan supply by differentiating the loan response to changes in deposits, we can assume that:

$$\gamma_i = \gamma_0 + \gamma_1 Z_{it} \qquad (5)$$

where Z_{it} is a bank specific characteristic, for example its balance sheet strength. In terms of the Bernanke - Blinder's model, this is translated into shifts of the loan supply function and, consequently, of the CC curve according to cross-sectional differences.[9] Substituting equation (5) into equation (4) we obtain:

$$L_{it} = \alpha + \beta\,(\rho_t - i_t) + \gamma_0 D_{it} + \gamma_1 D_{it} Z_{it} \qquad (6)$$

As in the previous model, distributional effects will be explored by using the same balance sheet and size variables. The effect of asset size on the sensitivity of loan supply to policy-induced shifts in deposits is expected to be negative (γ_1<0): larger banks may find it easier to raise non-deposit finance and thus partly offset the effects of contractionary policy on loans. This makes the shift parameter γ_i smaller, implying a weakened lending channel. Similarly, banks which hold higher ratios of liquid to total assets can better insulate their loan portfolio against monetary shocks. This means that the response of loans to monetary policy would be smaller for these banks and, as a result, the lending channel would be less important. As noted in Section 3, for a bank of a given size, the tightening of monetary policy would cause loans to decline less, the more liquid is the bank. To capture this effect, the interaction term $Z_{it}B_{it}$ will be introduced in equation (5) with an expected positive coefficient.

Equation (6) can be considered as a loan supply function incorporating the effects of differential bank characteristics and will be the basis for the empirical analysis. To deal with the issue of non-stationarity of the variables involved and the possible existence of a cointegrating relationship between them we estimated a linear single equation error correction model.[10]

[8] This implies that for the estimation of the loan supply function of the individual bank the simultaneity problem arising from the interaction of loan demand and loan supply, and the identification problem do not exist. Of course, to the extent that the bank loan market is imperfectly competitive the results will suffer from estimation biases. However, the perfect competition assumption is commonly made in all studies of the bank lending channel.

[9] Had we introduced the effect of differentiated bank characteristics through the coefficient on the interest rate spread, this would have affected both the slope and the position of the CC curve.

[10] Alternatively, the non-linear least squares (NLS) single equation estimation method for the simple ECM specification, suggested by Phillips and Loretan (1991), could be used, which gives asymptotically efficient and median unbiased estimates of long-run equilibrium relationships. For an application of this method, see Chinn (1997) and Chinn and Johnston (1997).

$$\Delta L_{i,t} = \varphi_{i,0} - \varphi_1 ECT_{i,t-1} + \varphi_3 \Delta L_{i,t-1} + \Gamma \Delta X_{i,t-1} + u_{i,t} \qquad \varphi_1 > 0 \qquad (7)$$

where $\varphi_{i,0}$ is a bank specific constant capturing the effect of bank specific variables not included in the cointegrating relationship, ECT is the residual of the cointegrating equation and X is the vector of the right hand side variables in equation (6). In order to have a parsimonious representation of the error correction model, the lag length was restricted to one,[11] which was sufficient to ensure that residuals were not autocorrelated. We estimated the cointegrating relationship without bank specific effects in the constant term and with homogeneity imposed across the slope coefficients. The cointegrating vector defines residuals that are stationary. To test for stationarity, the differenced residual is regressed on the lagged residual and bank dummies:

$$\Delta ECT_{i,t} = \delta ECT_{i,t-1} + \text{bank dummies} + u_{i,t} \qquad \delta > 0 \qquad (8)$$

The t-statistic on the δ coefficient is then compared to the critical value given in Table 5 of Levin and Lin (1992). If the t-statistic is significant, then the null hypothesis of non-stationarity and hence of no cointegration can be rejected.

The estimated cointegrating relationships with distributional effects are shown in Table 3. As with the previous model, SUR weighted least squares were used in all estimations. The t statistic for testing for cointegration is given at the bottom of this Table. It indicates that the null hypothesis of no-cointegration can be rejected in all cases. As already mentioned, bank characteristics included in the regressions are the bank size (S_{it}) and the balance sheet strength (B_{it}). The interaction terms of these variables with deposits (D_{it}) give an indication of the importance of distributional effects in shifting the loan supply function. Interaction terms always have the expected sign and in most of the cases are significant. Equation 1 in Table 3 shows that large banks are able to partly insulate their loan portfolio from a monetary policy tightening. Similar results are found for the more liquid banks (Table 3, equation 2). Furthermore, the equations which use both the size and balance sheet strength variables confirm the hypothesis that the sensitivity of lending volume to monetary policy is greater for smaller banks with weaker balance sheets.

In all estimated equations, the coefficient of the spread variable is positive and significant (at the 5 percent level[12]), providing evidence of imperfect substitutability between loans and securities in bank portfolios.[13] Thus, the panel data allow the identification of the loan supply function, which is critical to the operation of the lending channel. Finally, the estimated coefficient of reversion (φ_1) is statistically significant and implies that the half-life of a deviation from equilibrium is about two years. This is a plausible result given that during the sample period about 40 percent of total bank loans to the private sector were long-term with an estimated average maturity of about 8 years.

A second issue on which we focus is the possible bias due to the endogeneity of the deposits variable. To correct for such bias, we used an instrumental variable estimator for deposits. The instruments used were lagged values of loans and deposits and the contemporaneous and lagged values of the interest rate spread and GDP. Correcting for endogeneity bias does not essentially alter the basic conclusions derived from the above estimation, although the importance of the bank lending channel appears to have

[11] With the exception of the dependant variable for which the lag length was three. Also the 12th lag was added to capture any seasonality that had not been removed.
[12] At the 10 percent level in equation 4.
[13] This would imply the existence of a bank lending channel, provided that there is also imperfect substitutability between loans and bonds on the part of borrowers.

strengthened somewhat, as judged by the size of the estimated coefficient of the spread and the significance of shift factors represented by bank differential characteristics.[14]

5. Conclusions

The use of bank level data has recently supplemented the empirical analysis of the role of bank lending in monetary transmission with aggregate data. Moving away from the aggregate data, a number of studies have addressed the issue that monetary policy actions may affect banks' loan supply function, by testing the cross-sectional implications of the lending view.

In this paper two approaches have been taken. One employing a reduced form equation linking monetary policy and distributional variables, as well as their interaction, to bank loans in the spirit of Kashyap and Stein's work. This equation was estimated by using panel data for Greek banks covering the second half of the 1990s and two indicators of cross-sectional differences: a size indicator, differentiating large from small banks, and an indicator of the health of bank balance sheets. The results, while compatible with the existence of a bank lending channel, were in general not satisfactory. In an alternative approach, it was argued that bank heterogeneity, though useful in interpreting loan supply shifts, is not the only element on which to base the analysis of the effectiveness of the lending channel. By bringing together some of the features of the Bernanke - Blinder model with a methodology for assessing the impact of differential balance sheet characteristics on banks' ability to supply loans, we investigated directly the behaviour of bank loan supply.

The empirical results of this second approach show that monetary policy clearly has a significant impact on the supply of bank loans and, through shifts in supply, on aggregate economic activity in Greece. Bank data helped us identify a loan supply function, a task that presents well-known difficulties for researchers. The response of loan supply to the interest rate spread is one of the critical parameters in the Bernanke-Blinder model that relates to the degree of substitutability between loans and securities (for banks) and thus to the significance of the lending channel. In addition, bank-specific characteristics were found to systematically shift the loan supply function. The results showed that large banks can, to a certain extent, shield their loan portfolio from monetary policy changes. Similar results hold for the more liquid (healthy) banks.

[14] The relevant results are available on request.

References

Becketti, S. and C. Morris (1992), "Are Bank Loans Still Special?" Federal Reserve Bank of Kansas City Economic Review, 77, No3, 71-84.

Bernanke, B.S. and A.S. Blinder (1988), "Credit, Money, and Aggregate Demand", American Economic Review, Papers and Proceedings, vol 78, pp. 435-9.

Bernanke, B.S. and A.S. Blinder (1992), "The Federal Funds Rate and the Channels of Monetary Transmission", American Economic Review, vol 82, pp. 901-21.

Bernanke, B.S. and M. Gertler (1995), "Inside the Black Box: The Credit Channel of Monetary Policy Transmission", Journal of Economic Perspectives, vol 9, pp. 27-48.

Brissimis, S. N. and E.C. Kastrissianakis (1997), "Is There a Credit Channel in the Greek Economy?" (in Greek), Bank of Greece Economic Bulletin, 10, pp. 91-111.

Brissimis, S. N., N. S. Magginas, G. T. Simigiannis and G. S. Tavlas (2001), "Issues in the Transmission of Monetary Policy" in Bank of Greece and The Brookings Institution Eds "Greece's Economic Performance and Prospects", Athens.

Chinn, M. D. (1997), "Sectoral Productivity, Government Spending and Real Exchange Rates: Empirical Evidence for OECD Countries", NBER, Working Paper No 6017.

Chinn, M. and L. Johnston (1997), "Real Exchange Rate Levels, Productivity and Demand Shocks: Evidence from a Panel of 14 Countries", IMF Working Paper No 66.

Favero, C.A., F. Giavazzi and L. Flabbi (1999), "The Transmission Mechanism of Monetary Policy in Europe: Evidence from Banks' Balance Sheets" NBER Working Paper No 7231.

Friedman, B. M. and K. N. Kuttner (1993), "Economic Activity and the Short-Term Credit Markets: An Analysis of Prices and Quantities", Brookings Papers on Economic Activity, No 2, pp. 193-283.

Kashyap, A.K. and J.C. Stein (1995), "The Impact of Monetary Policy on Bank Balance Sheets", Carnegie Rockester Conference Series on Public Policy, vol. 42, pp. 151-95.

Kashyap, A.K. and J.C. Stein 1997), "The Role of Banks in Monetary Policy: A Survey with Implications for the European Monetary Union", Federal Reserve Bank of Chicago Economic Perspectives, September/October, pp. 2-18.

Kashyap, A.K., and J.C. Stein (2000), "What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?", American Economic Review, vol 90, pp. 407-28.

Kashyap, A.K., J.C. Stein and D. W. Wilcox (1993), "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance", American Economic Review, vol 83, pp. 78-98.

Kashyap, A.K., J.C. Stein and D. W. Wilcox (1996), "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance: A Reply", American Economic Review, vol 86, pp. 310-4.

Kishan, R. P. and T. P. Opiela (2000), "Bank Size, Bank Capital, and the Bank Lending Channel", Journal of Money, Credit, and Banking, vol 32, pp. 121-41.

Levin, A. and C. Lin (1992), "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties", University of California, San Diego, Department of Economics, Discussion Paper No 23.

Oliner, S.D. and G.D. Rudebusch (1995), "Is There a Bank Lending Channel for Monetary Policy?", Federal Reserve Bank of San Francisco Economic Review, No 2, pp. 3-20.

Oliner, S.D. and G.D. Rudebusch (1996), "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance: Comment", American Economic Review, vol 86, pp. 300-9.

Phillips, P.C.B. and M. Loretan (1991), "Estimating Long-run Economic Equilibria", Review of Economic Studies, 58, pp. 407-36.

Table 1. Structure of the banking sector in Greece, December 1998

	All banks	Type			Size			
		Commercial	Cooperative	Other	Absolute		Relative	
					Small	Large	Small	Large
Size indicators								
Number of institutions	60	43	12	5	14	5	30	3
Number of bank branches	2757	2562	31	164	24	1732	119	1249
Number of bank employees	57898	55112	244	2542	204	34751	2423	25789
Average total assets (millions of euros)	2198	2704	29,4	3052	19	16620,2	166,6	21321,3
Median total assets (millions of euros)	593,5	795	12	1852	17,5	12600	593,5	10045,5
Market share (percentage of total assets)	100	88,2	0,3	11,6	0,2	63,0	3,8	48,5
Asset structure (percentage of year-end total assets)								
Cash	0,8	0,8	1,1	0,7	1,0	0,8	0,4	0,9
Loans to general government	2,6	2,2	0,3	6,0	0,5	3,1	0,7	3,7
Loans to non-MFI private sector	31,4	32,6	71,3	22,0	49,8	29,2	35,9	30,4
Loans to non-financial corporations	29,4	30,7	71,3	18,2	49,8	27,6	32,3	29,1
Loans to households	7,6	7,0	27,2	12,0	10,9	7,2	8,0	6,9
of which:								
House purchase	5,3	4,4	6,1	11,9	2,2	5,8	4,2	5,8
Securities	23,8	21,3	2,5	42,8	0,0	29,0	7,7	25,0
of which :								
Money market paper	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other securities issued by MFIs	0,2	0,3	0,0	0,0	0,0	0,3	0,0	0,4
Securities issued by general government	23,3	20,8	2,5	42,7	0,0	28,5	7,5	24,4
Securities issued by non-financial corporations	0,3	0,3	0,0	0,1	0,0	0,2	0,1	0,3
of which :								
Maturity of less than 2 years	3,1	3,3	0,0	1,1	0,0	3,8	1,1	4,1
Maturity of more than 2 years	20,7	18,0	2,5	41,7	0,0	25,2	6,5	20,9
Shares and other equity	3,3	3,1	1,0	4,9	0,5	3,4	0,4	3,3
Assets denominated in foreign currencies	26,8	29,7	0,1	5,6	23,5	20,4	45,6	22,6
Assets denominated in non-euro area currencies	18,2	20,2	0,0	2,8	19,2	11,6	28,5	12,8
Liabilities structure (percentage of year-end total assets)								
Overnight deposits	7,8	8,4	4,6	3,3	5,0	6,7	7,6	7,1
Time deposits								
Maturity of less than 2 years	62,4	63,3	59,2	55,7	37,9	71,2	38,5	70,5
Maturity of more than 2 years	1,0	0,3	1,2	6,5	0,3	0,1	1,8	0,2
Debt securities	0,4	0,4	0,0	0,0	1,3	0,6	0,1	0,8
of which :								
Money market paper	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other	0,4	0,4	0,0	0,0	1,3	0,6	0,1	0,8
Denominated in non-EMU currencies								
Liabilities denominated in foreign currencies	32,5	35,7	0,5	8,4	17,3	25,7	47,7	29,8
Liabilities denominated in non-euro area currencies	23,5	25,8	0,0	6,6	13,5	16,1	34,3	18,8
Capital and reserves	8,3	6,6	29,5	20,2	29,1	6,7	7,7	5,5

Table 1 (continued). Structure of the banking sector in Greece, December 1998

	Capitalisation		Deposit share		Credit share		Liquidity	
	Low	High	Low	High	Low	High	Low	High
Size indicators								
Number of institutions	6	6	6	6	6	6	6	6
Number of bank branches	52	18	18	908	6	21	22	144
Number of bank employees	1729	508	546	20469	241	185	1007	1580
Average total assets (millions of euros)	916,5	315,3	373,5	8562,8	245	54,5	654,5	1902,8
Median total assets (millions of euros)	360,5	3,5	46,5	2576	30	41	42	520
Market share (percentage of total assets)	4,2	1,4	1,7	39,0	1,1	0,2	3,0	8,6
Asset structure (percentage of year-end total assets)								
Cash	0,4	0,0	0,0	0,8	0,1	1,1	2,7	0,0
Loans to general government	0,2	26,4	23,4	1,1	0,0	0,4	8,4	0,6
Loans to non-MFI private sector	27,3	41,3	40,4	23,5	4,8	73,8	49,0	8,6
Loans to non-financial corporations	24,4	37,6	36,4	22,1	4,8	73,8	44,7	6,2
Loans to households	8,9	0,9	2,2	8,4	2,3	30,5	30,4	5,0
of which:								
House purchase	0,8	0,8	0,6	7,2	0,2	6,3	29,1	5,0
Securities	8,8	12,9	11,1	35,0	0,3	2,7	3,6	54,7
of which :								
Money market paper	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other securities issued by MFIs	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0
Securities issued by general government	8,2	12,1	10,4	34,2	0,3	2,7	3,6	54,7
Securities issued by non-financial corporations	0,6	0,8	0,7	0,3	0,0	0,0	0,0	0,0
of which :								
Maturity of less than 2 years	1,5	0,3	0,3	0,9	0,2	0,0	1,5	1,0
Maturity of more than 2 years	7,3	12,6	10,8	34,1	0,1	2,7	2,1	53,7
Shares and other equity	0,2	9,0	7,6	2,8	0,0	1,1	9,2	1,2
Assets denominated in foreign currencies	59,5	32,0	35,1	22,5	83,8	0,0	14,5	9,1
Assets denominated in non-euro area currencies	56,3	19,3	22,9	13,3	64,0	0,0	9,9	7,7
Liabilities structure (percentage of year-end total assets)								
Overnight deposits	5,8	0,0	0,6	6,7	6,2	3,8	13,1	0,4
Time deposits								
Maturity of less than 2 years	55,4	0,6	0,5	76,4	31,0	54,4	19,7	73,2
Maturity of more than 2 years	0,1	0,0	0,0	0,1	3,6	1,3	25,3	0,0
Debt securities	0,0	0,2	0,2	1,0	0,2	0,0	0,0	0,0
of which :								
Money market paper	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Other	0,0	0,2	0,2	1,0	0,2	0,0	0,0	0,0
Denominated in non-EMU currencies								
Liabilities denominated in foreign currencies	67,1	35,0	35,8	26,1	76,9	0,6	15,2	15,3
Liabilities denominated in non-euro area currencies	59,7	22,9	24,8	15,8	75,1	0,0	11,1	13,8
Capital and reserves	0,8	56,1	47,1	7,7	5,7	24,7	17,1	12,0

Table 2: Reduced form loan equation

Variable	Equation (1) Bank characteristic: size Coefficient	t-statistic	Probability	Equation (1) Bank characteristic: balance sheet strength Coefficient	t-statistic	Probability
ΔL_{t-1}	-0,134	-3,20	0,0014	-0,130	-3,14	0,0018
ΔL_{t-2}	-0,057	-1,38	0,1686	-0,047	-1,17	0,2426
ΔL_{t-3}	0,159	3,89	0,0001	0,176	4,38	0,0000
ΔL_{t-12}	-0,156	-4,26	0,0000	-0,148	-4,05	0,0001
$\Delta r_{t-1}+\Delta r_{t-2}+\Delta r_{t-3}$	-0,034	-0,65	0,5129	-0,064	-1,24	0,2134
S_{t-1}	-0,031	-0,44	0,6612			
B_{t-1}				-0,031	-0,63	0,5301
$\Delta \log Y_{t-1}+\Delta \log Y_{t-2}+\Delta \log Y_{t-3}$	0,000	0,38	0,7039	0,000	0,29	0,7735
$S_{t-1}*\Delta r_{t-1}$	1,706	0,44	0,6614			
$S_{t-1}*\Delta r_{t-2}$	-5,981	-1,40	0,1620			
$S_{t-1}*\Delta r_{t-3}$	-2,409	-0,62	0,5386			
$B_{t-1}*\Delta r_{t-1}$				23,546	0,81	0,4193
$B_{t-1}*\Delta r_{t-2}$				42,320	1,30	0,1953
$B_{t-1}*\Delta r_{t-3}$				97,221	3,37	0,0008
$S_{t-1}*\Delta \log Y_{t-1}$	0,000	0,00	0,9967			
$S_{t-1}*\Delta \log Y_{t-2}$	-0,092	-1,28	0,2009			
$S_{t-1}*\Delta \log Y_{t-3}$	-0,031	-0,40	0,6901			
$B_{t-1}*\Delta \log Y_{t-1}$				0,000	0,47	0,6393
$B_{t-1}*\Delta \log Y_{t-2}$				-0,022	-0,43	0,6674
$B_{t-1}*\Delta \log Y_{t-3}$				-0,078	-1,44	0,1496
Dummy for 11/97	0,004	0,84	0,4002	0,026	2,69	0,0073
Sample	Feb. 96 - Dec. 99			Feb. 96 - Dec. 99		
Total panel observations	564			564		
Adjusted R^2	0,129			0,140		

Table 3. Loan supply function with distributional effects: panel estimation results

Variable	Equation				
	(1)	(2)	(3)	(4)	(5)
Constant	0,124 (0.47)	0,804 (6.63)	0,201 (0.77)	0,891 (7.23)	0,281 (1.08)
ρ_t-i_t	3,478 (2.65)	2,735 (2.21)	2,779 (2.15)	2,161 (1.74)	3,027 (2.37)
D_{it}	0,880 (34.35)	0,807 (108.21)	0,876 (34.95)	0,801 (104.90)	0,865 (34.49)
S_{it}*D_{it}	-0,010 (-3.42)		-0,010 (-3.53)		-0,008 (-2.67)
B_{it}*D_{it}		-0,051 (-6.37)		-0,038 (-4.21)	-0,032 (-3.51)
S_{it}*B_{it}*D_{it}			0,038 (5.83)	0,024 (3.26)	0,026 (3.55)
Short-run dynamics with fixed effects					
$ECT_{i,t-1}$	-0,021 (-2.75)	-0,018 (-2.17)	-0,019 (-2.56)	-0,020 (-2.38)	-0,018 (-2.23)
$\Delta L_{i,t-1}$	-0,120 (-2.88)	-0,124 (-2.96)	-0,124 (-3.00)	-0,132 (-3.17)	-0,132 (-3.15)
$\Delta L_{i,t-2}$	-0,061 (-1.47)	-0,057 (-1.39)	-0,062 (-1.52)	-0,054 (-1.31)	-0,059 (-1.43)
$\Delta L_{i,t-3}$	0,158 (3.89)	0,159 (4.53)	0,152 (3.75)	0,151 (3.73)	0,147 (3.61)
$\Delta L_{i,t-12}$	-0,163 (-4.51)	-0,164 (-4.53)	-0,154 (-4.24)	-0,151 (-4.17)	-0,149 (-4.11)
$\Delta(\rho_{t-1}$-$i_{t-1})$	0,038 (0.25)	0,030 (0.20)	0,088 (0.58)	0,064 (0.42)	0,077 (0.50)
$\Delta D_{i,t-1}$	-0,020 (-1.47)	-0,012 (-0.89)	-0,019 (-1.38)	-0,010 (-0.79)	-0,019 (-1.36)
$\Delta(S_{i,t-1}$*$D_{i,t-1})$	0,003 (1.81)		0,003 (2.29)		0,003 (2.23)
$\Delta(B_{i,t-1}$*$D_{i,t-1})$		-0,001 (-0.49)		-0,003 (-1.66)	-0,003 (-1.60)
$\Delta(S_{i,t-1}$*$B_{i,t-1}$*$D_{i,t-1})$			0,003 (2.41)	0,004 (2.63)	0,004 (2.98)
Adjusted R^2	0,133	0,136	0,131	0,132	0,128
N	564	564	564	564	564
t statistic for co-integration test	-7.07*	-6.87*	-7.11*	-6.76*	-7.03*

Notes: Numbers in parenthesis are t statistics.

* indicates rejection of hypothesis of no co-integration at the 1% significance level.

European Central Bank Working Paper Series

1 "A global hazard index for the world foreign exchange markets" by V. Brousseau and F. Scacciavillani, May 1999.

2 "What does the single monetary policy do? A SVAR benchmark for the European Central Bank" by C. Monticelli and O. Tristani, May 1999.

3 "Fiscal policy effectiveness and neutrality results in a non-Ricardian world" by C. Detken, May 1999.

4 "From the ERM to the euro: new evidence on economic and policy convergence among EU countries" by I. Angeloni and L. Dedola, May 1999.

5 "Core inflation: a review of some conceptual issues" by M. Wynne, May 1999.

6 "The demand for M3 in the euro area" by G. Coenen and J.-L. Vega, September 1999.

7 "A cross-country comparison of market structures in European banking" by O. de Bandt and E. P. Davis, September 1999.

8 "Inflation zone targeting" by A. Orphanides and V. Wieland, October 1999.

9 "Asymptotic confidence bands for the estimated autocovariance and autocorrelation functions of vector autoregressive models" by G. Coenen, January 2000.

10 "On the effectiveness of sterilized foreign exchange intervention" by R. Fatum, February 2000.

11 "Is the yield curve a useful information variable for the Eurosystem?" by J. M. Berk and P. van Bergeijk, February 2000.

12 "Indicator variables for optimal policy" by L. E. O. Svensson and M. Woodford, February 2000.

13 "Monetary policy with uncertain parameters" by U. Söderström, February 2000.

14 "Assessing nominal income rules for monetary policy with model and data uncertainty" by G. D. Rudebusch, February 2000.

15 "The quest for prosperity without inflation" by A. Orphanides, March 2000.

16 "Estimating the implied distribution of the future short term interest rate using the Longstaff-Schwartz model" by P. Hördahl, March 2000.

17 "Alternative measures of the NAIRU in the euro area: estimates and assessment" by S. Fabiani and R. Mestre, March 2000.

18 "House prices and the macroeconomy in Europe: Results from a structural VAR analysis" by M. Iacoviello, April 2000.

19 "The euro and international capital markets" by C. Detken and P. Hartmann, April 2000.

20 "Convergence of fiscal policies in the euro area" by O. De Bandt and F. P. Mongelli, May 2000.

21 "Firm size and monetary policy transmission: evidence from German business survey data" by M. Ehrmann, May 2000.

22 "Regulating access to international large value payment systems" by C. Holthausen and T. Rønde, June 2000.

23 "Escaping Nash inflation" by In-Koo Cho and T. J. Sargent, June 2000.

24 "What horizon for price stability" by F. Smets, July 2000.

25 "Caution and conservatism in the making of monetary policy" by P. Schellekens, July 2000.

26 "Which kind of transparency? On the need for clarity in monetary policy-making" by B. Winkler, August 2000.

27 "This is what the US leading indicators lead" by M. Camacho and G. Perez-Quiros, August 2000.

28 "Learning, uncertainty and central bank activism in an economy with strategic interactions" by M. Ellison and N. Valla, August 2000.

29 "The sources of unemployment fluctuations: an empirical application to the Italian case" by S. Fabiani, A. Locarno, G. Oneto and P. Sestito, September 2000.

30 "A small estimated euro area model with rational expectations and nominal rigidities" by G. Coenen and V. Wieland, September 2000.

31 "The disappearing tax base: Is foreign direct investment eroding corporate income taxes?" by R. Gropp and K. Kostial, September 2000.

32 "Can indeterminacy explain the short-run non-neutrality of money?" by F. De Fiore, September 2000.

33 "The information content of M3 for future inflation" by C. Trecroci and J. L. Vega, October 2000.

34 "Capital market development, corporate governance and the credibility of exchange rate pegs" by O. Castrén and T. Takalo, October 2000.

35 "Systemic risk: A survey" by O. De Bandt and P. Hartmann, November 2000.

36 "Measuring core inflation in the euro area" by C. Morana, November 2000.

37 "Business fixed investment: Evidence of a financial accelerator in Europe" by P. Vermeulen, November 2000.

38 "The optimal inflation tax when taxes are costly to collect" by F. De Fiore, November 2000.

39 "A money demand system for euro area M3" by C. Brand and N. Cassola, November 2000.

40 "Financial structure and the interest rate channel of ECB monetary policy" by B. Mojon, November 2000.

41 "Why adopt transparency? The publication of central bank forecasts" by P. M. Geraats, January 2001.

42 "An area-wide model (AWM) for the euro area" by G. Fagan, J. Henry and R. Mestre, January 2001.

43 "Sources of economic renewal: from the traditional firm to the knowledge firm" by D. R. Palenzuela, February 2001.

44 "The supply and demand for eurosystem deposits – The first 18 months" by U. Bindseil and F. Seitz, February 2001.

45 "Testing the Rank of the Hankel matrix: a statistical approach" by G. Camba-Mendez and G. Kapetanios, February 2001.

46 "A two-factor model of the German term structure of interest rates" by N. Cassola and J. B. Luís, February 2001.

47 "Deposit insurance and moral hazard: does the counterfactual matter?" by R. Gropp and J. Vesala, February 2001.

48 "Financial market integration in Europe: on the effects of EMU on stock markets" by M. Fratzscher, March 2001.

49 "Business cycle and monetary policy analysis in a structural sticky-price model of the euro area" by M. Casares, March 2001.

50 "Employment and productivity growth in service and manufacturing sectors in France, Germany and the US" by T. von Wachter, March 2001.

51 "The functional form of the demand for euro area M1" by L. Stracca, March 2001.

52 "Are the effects of monetary policy in the euro area greater in recessions than in booms?" by G. Peersman and F. Smets, March 2001.

53 "An evaluation of some measures of core inflation for the euro area" by J.-L. Vega and M. A. Wynne, April 2001.

54 "Assessment criteria for output gap estimates" by G. Camba-Méndez and D. R. Palenzuela, April 2001.

55 "Modelling the demand for loans to the private sector in the euro area" by A. Calza, G. Gartner and J. Sousa, April 2001.

56 "Stabilization policy in a two country model and the role of financial frictions" by E. Faia, April 2001.

57 "Model-based indicators of labour market rigidity" by S. Fabiani and D. Rodriguez-Palenzuela, April 2001.

58 "Business cycle asymmetries in stock returns: evidence from higher order moments and conditional densities" by G. Perez-Quiros and A. Timmermann, April 2001.

59 "Uncertain potential output: implications for monetary policy" by M. Ehrmann and F. Smets, April 2001.

60 "A multi-country trend indicator for euro area inflation: computation and properties" by E. Angelini, J. Henry and R. Mestre, April 2001.

61 "Diffusion index-based inflation forecasts for the euro area" by E. Angelini, J. Henry and R. Mestre, April 2001.

62 "Spectral based methods to identify common trends and common cycles" by G. C. Mendez and G. Kapetanios, April 2001.

63 "Does money lead inflation in the euro area?" by S. N. Altimari, May 2001.

64 "Exchange rate volatility and euro area imports" by R. Anderton and F. Skudelny, May 2001.

65 "A system approach for measuring the euro area NAIRU" by S. Fabiani and R. Mestre, May 2001.

66 "Can short-term foreign exchange volatility be predicted by the Global Hazard Index?" by V. Brousseau and F. Scacciavillani, June 2001.

67 "The daily market for funds in Europe: Has something changed with the EMU?" by G. P. Quiros and H. R. Mendizabal, June 2001.

68 "The performance of forecast-based monetary policy rules under model uncertainty" by A. Levin, V. Wieland and J. C.Williams, July 2001.

69 "The ECB monetary policy strategy and the money market" by V. Gaspar, G. Perez-Quiros and J. Sicilia, July 2001.

70 "Central Bank forecasts of liquidity factors: Quality, publication and the control of the overnight rate" by U. Bindseil, July 2001.

71 "Asset market linkages in crisis periods" by P. Hartmann, S. Straetmans and C. G. de Vries, July 2001.

72 "Bank concentration and retail interest rates" by S. Corvoisier and R. Gropp, July 2001.

73 "Interbank lending and monetary policy transmission – evidence for Germany" by M. Ehrmann and A. Worms, July 2001.

74 "Interbank market integration under asymmetric information" by X. Freixas and C. Holthausen, August 2001.

75 "Value at risk models in finance" by S. Manganelli and R. F. Engle, August 2001.

76 "Rating agency actions and the pricing of debt and equity of European banks: What can we infer about private sector monitoring of bank soundness?" by R. Gropp and A. J. Richards, August 2001.

77 "Cyclically adjusted budget balances: An alternative approach" by C. Bouthevillain, P. Cour-Thimann, G. van den Dool, P. Hernández de Cos, G. Langenus, M. Mohr, S. Momigliano and M. Tujula, September 2001.

78 "Investment and monetary policy in the euro area" by B. Mojon, F. Smets and P. Vermeulen, September 2001.

79 "Does liquidity matter? Properties of a synthetic divisia monetary aggregate in the euro area" by L. Stracca, October 2001.

80 "The microstructure of the euro money market" by P. Hartmann, M. Manna and A. Manzanares, October 2001.

81 "What can changes in structural factors tell us about unemployment in Europe?" by J. Morgan and A. Mourougane, October 2001.

82 "Economic forecasting: some lessons from recent research" by D. Hendry and M. Clements, October 2001.

83 "Chi-squared tests of interval and density forecasts, and the Bank of England's fan charts" by K. F. Wallis, November 2001.

84 "Data uncertainty and the role of money as an information variable for monetary policy" by G. Coenen, A. Levin and V. Wieland, November 2001.

85 "Determinants of the euro real effective exchange rate: a BEER/PEER approach" by F. Maeso-Fernandez, C. Osbat and B. Schnatz, November 2001.

86 "Rational expectations and near rational alternatives: how best to form expecations" by M. Beeby, S. G. Hall and S. B. Henry, November 2001.

87 "Credit rationing, output gap and business cycles" by F. Boissay, November 2001.

88 "Why is it so difficult to beat the random walk forecast of exchange rates?" by L. Kilian and M. P. Taylor, November 2001.

89 "Monetary policy and fears of instability" by V. Brousseau and Carsten Detken, November 2001.

90 "Public pensions and growth" by S. Lambrecht, P. Michel and J. -P. Vidal, November 2001.

91 "The monetary transmission mechanism in the euro area: more evidence from VAR analysis" by G. Peersman and F. Smets, December 2001.

92 "A VAR description of the effects of the monetary policy in the individual countries of the euro area" by B. Mojon and G. Peersman, December 2001.

93 "The monetary transmission mechanism at the euro-area level: issues and results using structural macroeconomic models" by P. McAdam and J. Morgan, December 2001.

94 "Monetary policy transmission in the euro area: What do aggregate and national structural models tell us?" by P. van Els, A. Locarno, J. Morgan and J.-P. Villetelle, December 2001.

95 "Some stylised facts on the euro area business cycle" by A.-M. Agresti and B. Mojon, December 2001.

96 "The reaction of bank lending to monetary policy measures in Germany" by A.Worms, December 2001.

97 "Asymmetries in bank lending behaviour. Austria during the 1990s." by S. Kaufmann, December 2001.

98 "The credit channel in the Netherlands: evidence from bank balance sheets" by L. De Haan, December 2001.

99 "Is there a bank lending channel of monetary policy in Spain?" by I. Hernando and J. Martínez-Pagés, December 2001.

100 "Transmission of monetary policy shocks in Finland: evidence from bank level data on loans" by J. Topi and J. Vilmunen, December 2001.

101 "Monetary policy and bank lending in France: are there asymmetries?" by C. Loupias, F. Savignac and P. Sevestre, December 2001.

102 "The bank lending channel of monetary policy: identification and estimation using Portuguese micro bank data" by L. Farinha and C. Robalo Marques, December 2001.

103 "Bank-specific characteristics and monetary policy transmission: the case of Italy" by L. Gambacorta, December 2001.

104 "Is there a bank lending channel of monetary policy in Greece? Evidence from bank level data" by S. N. Brissimis, N. C. Kamberoglou and G. T. Simigiannis, December 2001.

105 "Financial systems and the role of banks in monetary policy transmission in the euro area" by M. Ehrmann, L. Gambacorta, J. Martínez-Pagés, P. Sevestre, A. Worms, December 2001.

106 "Investment, the cost of capital, and monetary policy in the nineties in France: a panel data investigation" by J. B. Chatelain and A. Tiomo, December 2001.

107 "The interest rate and credit channel in Belgium: an investigation with micro-level firm data" by P. Butzen, C. Fuss and P. Vermeulen, December 2001.

108 "Credit channel and investment behaviour in Austria: a micro-econometric approach" by M. Valderrama, December 2001.

109 "Monetary transmission in Germany: new perspectives on financial constraints and investment spending" by U. von Kalckreuth, December 2001.

110 "Does monetary policy have asymmetric effects? A look at the investment decisions of Italian firms" by E. Gaiotti and A. Generale, December 2001.

111 "Monetary transmission: empirical evidence from Luxembourg firm level data" by P. Lünnemann and T. Mathä, December 2001.

112 "Firm investment and monetary transmission in the euro area" by J. B. Chatelain, A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen, December 2001.