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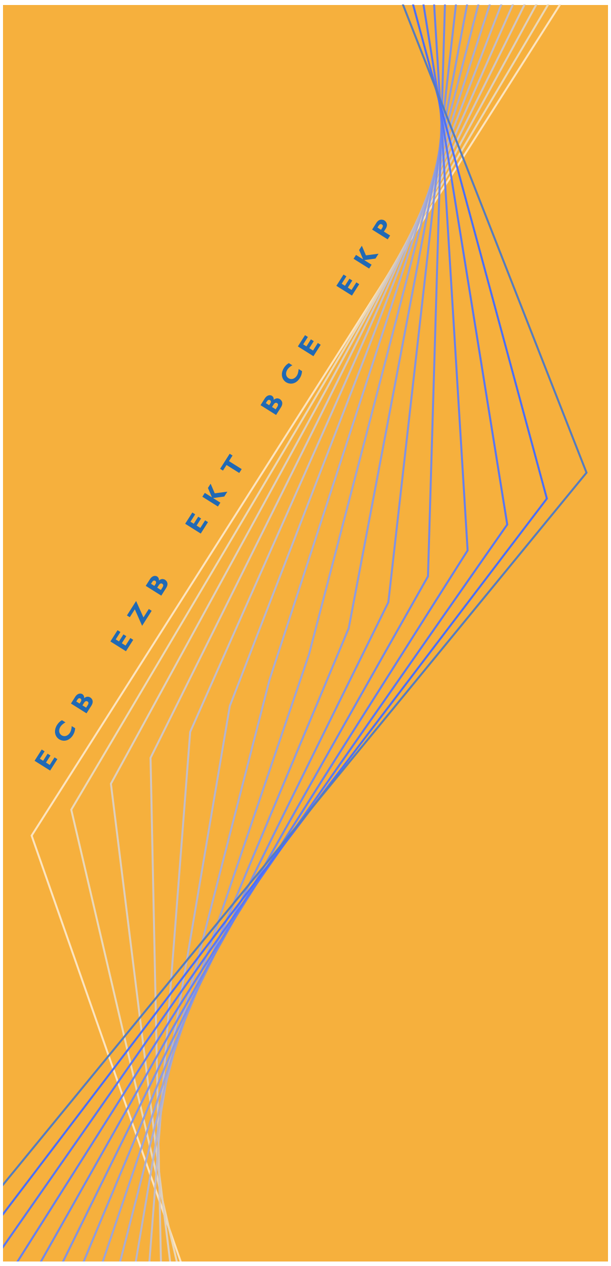


EUROSYSTEM MONETARY TRANSMISSION NETWORK

# WORKING PAPER NO. 96

# THE REACTION OF BANK LENDING TO MONETARY POLICY MEASURES IN GERMANY

BY ANDREAS WORMS

December 2001

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# THE REACTION OF BANK LENDING TO MONETARY POLICY MEASURES IN GERMANY[1]

BY ANDREAS WORMS*

December 2001

* *Deutsche Bundesbank.*

1 *This paper represents the author's personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank.*

**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.


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## Contents

## Abstract

A crucial condition for the existence of a *credit channel* through bank loans is that monetary policy should be able to change bank loan *supply*. This paper contributes to the discussion on this issue by presenting empirical evidence from dynamic panel estimations based on a dataset that comprises individual balance sheet information on all German banks. It shows that the average bank reduces its lending more sharply in reaction to a restrictive monetary policy measure the lower its ratio of short-term interbank deposits to total assets. A dependence on its size can only be found if explicitly controlled for this dominating effect and/or if the very small banks are excluded. Overall, the evidence is compatible with the existence of a *credit channel*.

*JEL classification*: C23, E52, G21

*Keywords:* monetary policy transmission, financial structure, credit channel, dynamic panel data

## Non-technical summary

Based on the assumption of informational imperfections in financial markets, the *credit channel* assigns an active role to the *supply* of bank loans in monetary policy transmission. Due to the fact that the identification of monetary policy induced loan-supply effects is very difficult if based solely on aggregate data, the empirical literature on this issue additionally uses microdata. The studies following this strategy with microdata on banks typically test for a differential reaction of bank lending to monetary policy across banks which can be attributed to a factor that is related to loan supply but not to loan demand. In most of these studies, bank size is chosen as the identifying variable. The underlying idea is based on the assumption that a small bank suffers more from informational problems than a large bank. In case of a restrictive monetary policy measure, therefore, large banks should be better able to maintain their lending because they can more easily attract funds. Hence, based on the *credit channel*, small banks should reduce their lending in reaction to a restrictive monetary policy measure by more than large banks.

The paper at hand tests this hypothesis for the German case. Compared to the existing literature, it basically contains four innovations: (1) It uses a quarterly dataset that covers the entire banking population in Germany on an individual basis. (2) Bank individual seasonal patterns are explicitly taken into account. (3) Bank specific income and risk variables are used to improve the control for differential loan demand effects. And (4) the paper explicitly accounts for the institutional structure of the German banking system.

The dynamic-panel estimations show that the average bank´s response to monetary policy strongly depends on its share of short-term interbank deposits in total assets: The higher this share, the less strongly does the average bank reduce loans in reaction to an interest rate increase. This result is compatible with the hypothesis that banks draw on their short-term interbank deposits in order to (at least partly) shield their loans from restrictive monetary policy measures. The motive for such a behavior could be to maintain close housebank-relationships to loan customers.

A direct dependence of a bank´s reaction to monetary policy on its size cannot be found. The reason is that in Germany almost all the small banks belong to either the cooperative sector or the savings banks´ sector, and that within these two sectors close interbank relationships exist. Among other things, these are characterised by comparatively large volumes of short-term interbank deposits held by small banks with

the large central institutions of their system. The small banks draw on these interbank deposits to cushion the effect of restrictive monetary policy measures on their lending.

As soon as we control for this dominant role of short-term interbank deposits, a significant dependence of a bank´s reaction to monetary policy on its size can indeed be found. Estimations based on a reduced sample that contains only large banks show that short-term interbank deposits are crucial in this respect mainly for the excluded small banks: For the large banks we find a significant size effect even without explicit control for short-term interbank deposits.

In order to interpret these size effects as evidence for the existence of a *credit channel* they have to be attributable to a differential reaction of loan *supply* to monetary policy across banks. This basically amounts to assuming that in reaction to a monetary policy induced interest rate increase, the loan *demand* faced by small (and less liquid) banks should not decrease more strongly than the loan *demand* faced by large (and more liquid) banks.

Based on this assumption, the overall results in this paper are compatible with the existence of a *credit channel* in Germany. This is a comparatively strong outcome if we take into account that the regressions allow – by using the bank-individual income and risk variables, and by explicitly considering bank-individual seasonal patterns – for many more differences in the movements of loans across banks which are not attributable to monetary policy induced supply changes than most of the previous literature did.

# I Introduction*)

Based on the assumption of informational imperfections in financial markets, the *credit channel* assigns an active role to the *supply* of bank loans in monetary transmission via two "subchannels": The *bank lending channel* states that the central bank is able to limit the supply of reservable deposits to banks. This may force them to reduce their supply of loans to non-banks. The *balance sheet channel* does not specifically concentrate on bank loans but refers more generally to the overall supply of funds. It states that a monetary policy induced interest rate increase may worsen the borrowers´ risk characteristics (e.g. by lowering the net worth of potential borrowers by increasing the discount rate applied to future payments and/or by directly reducing these payments) and – as a reaction to this – reduce the supply of funds.

The existence of a *credit channel* has several important implications for monetary policy: One, marginal cost and earning considerations are not the sole factors relevant to investment and funding decisions, but additionally the availability of funds. Second, the overall effect of monetary policy on aggregate expenditure can no longer be completely characterised by a vector of price variables. It depends on additional factors, like e.g. the propensity to supply funds, the average degree of substitution between different forms of funding, and the distribution of these substitution rates among economic agents. Moreover, since the *credit channel* increases the restrictive impact of monetary policy compared to "traditional" transmission channels, the more strongly declining income that comes with it tends c.p. to put a downward pressure on interest rates.[1] As a result, the interest rate level alone may be an insufficient indicator for the effects of monetary policy. Third, the *credit channel* implies that the transmission process of monetary policy depends on the structure of the financial system. This means that structural changes in the financial area may affect monetary transmission. Moreover, this dependence implies that monetary policy may affect economic agents asymmetrically, depending on the degree to which they suffer from

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[1] Bernanke, B.S./Blinder, A.S. (1988) focus on this aspect: Within an IS/LM framework they show that a restrictive monetary policy measure does not only cause a leftward shift of the LM curve (which c.p. causes interest rates to rise) but also – via the *credit channel* – a leftward shift of the IS curve (which c.p. causes interest rates to fall), as investment declines at a given income and a given interest rate level. The net effect of this restrictive measure on the level of interest rates is thus unclear, a priori.

the relevant financial market imperfections.[2] Given the differences in the financial systems across the euro-area countries, this dependence may also imply that the euro-area's monetary policy affects some countries more strongly than others.[3]

So far, the empirical evidence on the *credit channel* in Germany is inconclusive, irrespective of methodology or of type of data used. While Tsatsaronis (1995), Stöß (1996), Guender & Moersch (1997), Küppers (2000) and Favero, Giavazzi & Flabbi (1999) come to the conclusion that a *credit channel* does not exist in Germany, Worms (1998), deBondt (1999a, 1999b), Kakes & Sturm (2001) and Hülsewig, Winker & Worms (2001) find evidence in favor of a *credit channel*.

Some of this inconclusiveness may stem from difficulties in the identification of loan supply versus loan demand effects of monetary policy. The existing literature has shown that this identification is very difficult to achieve on the basis of aggregate data.[4] Therefore, most of the recent empirical literature on the *credit channel* relies on microdata.[5] Here, the identification of supply effects is based on possible differences in monetary policy responses across economic agents that cannot be attributed to demand factors. This strategy does not require control for shifts in (the level of) the demand for funds – which is necessary in the case of aggregate data – but only control for possible *differential* shifts in the demand for funds across economic agents.

Along these lines, the empirical analysis of a *credit channel* in Germany in this paper uses data on individual bank balance sheets and applies panel-econometric techniques to exploit the heterogeneity among banks. Relative to the previous literature the paper contains four innovations: (1) It uses a quarterly dataset that covers the entire banking population in Germany on an individual basis. (2) Bank individual seasonal patterns are explicitly taken into account. (3) Bank specific income and risk variables are used to improve the control for *differential* loan demand effects. And (4) the paper accounts for the network structures that exist among small German banks.

The main findings of the paper are that the average bank´s reaction to monetary policy does not directly depend on its size, but rather on its share of short-term interbank deposits in total assets. Only when controlling for this dominating influence, a

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[2] Such asymmetric effects may also exist at the national level, e.g. with respect to regions (see Carlino, G.A./DeFina, R.H. (1996) and Samolyk, K.A. (1994), which both relate to the US) or sectors (see Hayo, B./Uhlenbrock, B. (1999) for Germany, Ganley, J./Salmon, C. (1996) for the UK and Dedola, L./Lippi, F. (2000) for Germany, France, Italy, the UK and the US).
[3] On this issue, see, e.g., BIS (1995), Favero, C.A./Giavazzi, F./Flabbi, L. (1999), Dornbusch, R./Favero, C.A./Giavazzi, F. (1998), Ramaswamy, R./Sloek, T. (1998) and Guiso, L. et al (1999).
[4] For an overview, see, e.g., Cecchetti, S.G. (1995). See also King, S.R. (1986), Romer, C.D./Romer, D.H. (1990) and Ramey, V. (1993).
[5] See, e.g., Kashyap, A.K./Stein, J.C. (2000, 1995) and Angeloni et al (1995).

significant size effect in line with the *credit channel* can be found. It is argued that this result can be explained by the institutional structure of the German banking system.

This paper is structured as follows: The next section presents descriptive evidence on the importance of bank loans in Germany and on the structure of the German banking system. Section III sketches the estimation methodology and highlights the assumptions underlying the hypothesis tests. After a description of the database (section IV), the estimation results are presented in section V. Section VI concludes.

## II Descriptive Evidence

There are a number of features of the German financial system that may have a bearing when analysing the *credit channel*. One is that the volume of bank loans to firms and households has increased relative to GDP during the 1990s[6], which c.p. indicates a growing potential for a *credit channel* that works through bank loans. Another is that the share of loans from domestic banks in firms´ external financing on average over the years 1991-2000 amounted to around 36 % (securities: 15 %, equity: 21 %)[7], but has decreased substantially over time due to an ongoing securitisation process.[8] This trend has almost exclusively been caused by large firms: While the ratio of bank loans to the balance sheet total has on average decreased for firms with an annual turnover of DM 100 million and more (from 9 % in 1991 to 8 % in 1998), it has *increased* for the other firms.[9] This indicates the growing importance of bank loans as a means of external finance for the large majority of small and medium-sized German firms, which are therefore of special interest for the *credit channel*.

Table 1 presents some key numbers on the structure of the German banking system (as of December 1998). The upper part of the table shows that credit cooperatives make up 70 % of all the institutions, whereas the savings banks make up about 18 % (column 1). The "other banks" – consisting primarily of the big banks ("Gross-banken"), the head institutions of the savings banks´ and the cooperative sector, the foreign banks and the private banks – represent only around 12 %. Despite this comparatively small number of institutions, this latter group accounts for almost three-quarters of all bank assets, while the many credit cooperatives together hold only 10 %

[6] Starting from 50 % for firms and 27 % for households (incl. non-profit organisations) in 1991, these ratios have reached 60 % (firms) and 44 % (households) in 2000.

[7] See Deutsche Bundesbank (2000). Please note that these numbers refer to flows.

[8] From an average of 48 % between 1991 and 1993 it fell to almost 37 % between 1997 and 1999. The mirror image of this development is the movement of the share of financing in the securities market. But overall, this form of external finance has not been of such an importance for German non-financial corporations (average 1991-1993: 22 %, 1997-1999: -1.6 %).

[9] See Deutsche Bundesbank (2001).

(colum 3). In terms of the institutions' importance with respect to lending to domestic private non-banks, the differences are not quite so striking, but still remarkable (column 5).

**Table 1: Structure of the German banking system (December 1998)**[10]

| quantiles of the distribution of total assets used to form size groups | | no of banks | sum of total assets | | loans to domestic firms and individuals | | loans to total assets | total assets per bank mean | total assets per bank std.dev |
|---|---|---|---|---|---|---|---|---|---|
| | | | DM billion | % | DM billion | % | % | DM billion | DM billion |
| | *column* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Total**: | | **3,228** | **10,049** | **100** | **3,689** | **100** | **37** | **3.1** | **20.7** |
| *of which:* | savings banks | 594 | 1,780 | 18 | 997 | 27 | 56 | 3.0 | 4.4 |
| | credit coops | 2,256 | 1,017 | 10 | 599 | 16 | 59 | 0.5 | 1.0 |
| | "other banks" | 378 | 7,252 | 72 | 2,093 | 57 | 29 | 19.2 | 57.7 |
| **> 0 & ≤ 25**: | | **807** | **69** | **1** | **39** | **1** | **57** | **0.1** | **0.0** |
| *of which:* | savings banks | 3 | 0 | 0 | 0 | 0 | 67 | 0.1 | 0.0 |
| | credit coops | 753 | 65 | 1 | 38 | 1 | 58 | 0.1 | 0.0 |
| | "other banks" | 51 | 3 | 0 | 1 | 0 | 39 | 0.1 | 0.0 |
| **> 25 & ≤ 50**: | | **807** | **189** | **2** | **110** | **3** | **58** | **0.2** | **0.1** |
| *of which:* | savings banks | 21 | 7 | 0 | 4 | 0 | 62 | 0.3 | 0.1 |
| | credit coops | 734 | 170 | 2 | 101 | 3 | 60 | 0.2 | 0.1 |
| | "other banks" | 52 | 13 | 0 | 5 | 0 | 38 | 0.2 | 0.1 |
| **> 50 & ≤ 75**: | | **807** | **505** | **5** | **298** | **8** | **59** | **0.6** | **0.2** |
| *of which:* | savings banks | 133 | 99 | 1 | 57 | 2 | 58 | 0.7 | 0.2 |
| | credit coops | 600 | 357 | 4 | 222 | 6 | 62 | 0.6 | 0.2 |
| | "other banks" | 74 | 49 | 1 | 19 | 1 | 39 | 0.7 | 0.2 |
| **> 75 & ≤ 100** | | **807** | **9,286** | **92** | **3,242** | **88** | **35** | **11.5** | **40.3** |
| *of which:* | savings banks | 437 | 1,675 | 17 | 936 | 25 | 56 | 3.8 | 4.9 |
| | credit coops | 169 | 424 | 4 | 238 | 6 | 56 | 2.5 | 2.9 |
| | "other banks" | 201 | 7,188 | 72 | 2,068 | 56 | 29 | 35.8 | 75.4 |
| *>99 & ≤100 (only "other banks")* | | *32* | *5,486* | *55* | *1,495* | *41* | *27* | *171.4* | *114.9* |

The savings banks´ and the cooperative sector could both be described as being relatively closed systems:[11] As concernes their interbank relations, the cooperative banks and – to a lesser degree – the savings banks transact mainly with the central institutions of their own system (the *Landesbanken* in case of the savings banks and the cooperative central banks in case of the credit cooperatives): The savings banks hold almost three quarters of their interbank assets vis-à-vis their central institutions (December 1998). In the case of the credit cooperatives, this share even amounts to 92 %. Accordingly, savings banks and credit cooperatives hold only a small share of their interbank assets vis-à-vis banks outside their own system. Instead, the central institutions hold about 54 % (*Landesbanken*) and about 42 % (cooperative central

[10] These figures differ slightly from the data published in the Supplement to the Bundesbank Monthly Report (Banking Statistics) because a small number of banks was excluded in a data screening process.
[11] See Upper, C./Worms, A. (2001), esp. tables 2a and 2b, and Ehrmann, M./Worms, A. (2001).

banks) vis-à-vis domestic banks that do not belong to their own system. Both systems therefore incorporate some sort of “internal interbank market”, with the central institutions providing the links of their respective system to the “other banks”.

Table 1 additionally contains information on the size structure of the German banking system. The grouping is based on percentiles of the distribution of total assets across all banks so that four (in terms of the number of banks) equally large size groups result. 93 % of the credit cooperatives belong to the three groups of smaller banks and the fourth group mainly consists of savings banks (54 %) and “other banks” (25 %). This group of the largest 807 banks comprises 92 % of the total assets of all banks (column 3), with an average bank size of about DM 11.5 billion (column 7).

Additionally, the quantile from 99 % to 100 % is indicated separately (bottom row). These 32 largest banks – among which there are no credit cooperatives or savings banks – hold a sum of total assets that comprises more than half of the total assets of all banks (column 3). With an average size of more than DM 170 billion, they are more than 50 times bigger than the average over all banks (column 7).

It is interesting, however, that this group´s share of lending in total assets, at an average of 27 % is much lower than that of the smaller banks, even much lower than that of the 25 %-quantile of the largest banks to which it likewise belongs (column 6). More generally, the lending business to domestic private non-banks seems to be of much more importance for the small and medium-sized banks, i.e. for credit cooperatives and for savings banks, than for the large banks: On average, almost 60 % of the total assets of the three groups of smaller banks are loans to domestic private non-banks, while this share amounts to only 35 % in the case of the large banks. This high share in case of the smaller banks is the result of a steady increase during the 1990s. In the same period this ratio has even decreased for the large banks.[12]

Therefore, parallel to the growing importance of bank loans as a means of external finance for small and medium-sized private non-banks during the 1990s, loans became more important as an asset mainly for the small and medium-sized banks. This is compatible with the notion that loans to households and small and medium-sized firms are mainly supplied by the small and medium-sized banks. Unfortunately, the available data do not contain information on individual borrowers so that it is not possible to exactly determine the variation of loan customer size across banks. However, based on the breakdown of loans into borrower groups, it appears that savings banks and credit

[12] See Worms, A. (2001), which is an extended version of the paper at hand. It also contains more regression results and a more detailled discussion of specific methodological issues.

cooperatives give a greater share of their assets in the form of loans to those borrowers that may be assumed to be small or medium-sized on average.[13]

This is consistent with the hypothesis that small and medium-sized firms and households are more likely to obtain loans from savings banks and credit cooperatives than from "other banks" (although this hypothesis cannot be strictly tested with the available data).[14] For that reason, they are of particular interest with regard to the *credit channel*. The large volumes of loans of the large banks are probably mainly due to the fact that they give major individual loans to large enterprises which, however, have a number of other financing instruments available to them as a substitute for bank loans, and are therefore of less interest for the *credit channel*.

## III Estimation methodology

Given the problems of identifying monetary policy induced loan *supply* shifts when using macrodata, the empirical analysis in this paper uses quarterly individual bank data. According to the *credit channel* theory, the informational imperfections in the financial markets that create bank loan supply effects of monetary policy also result in differential loan supply responses across banks. The underlying assumption is that it is the more difficult for a bank to offset the effects of a restrictive monetary policy measure, the higher the degree to which it suffers from asymmetric information vis-à-vis its suppliers of funds. In the literature, bank size is the most commonly used indicator for the ability of banks to generate outside financing: The idea is that small banks have more difficulties in raising funds because they face higher information costs and/or a higher external finance premium than large banks. They are therefore less able to offset contractionary monetary policy measures and have to reduce their loan supply more strongly than large banks.[15]

Another indicator that has been used in the literature is the capitalisation of a bank.[16] The idea is based on the argument that a higher capitalisation makes a bank less prone to moral hazard and asymmetric information problems vis-à-vis its suppliers of funds. Therefore, the external finance premium of a well capitalised bank should be smaller than that of a poorly capitalised one. This implies that less capitalised banks should be

[13] At the end of 1998 more than 42 % of the loans of the saving banks and more than 47 % of the loans of the credit cooperatives were granted to individuals, compared to less than 14 % (savings banks) and 11 % (credit cooperatives) to domestic enterprises. By contrast, the "other banks" on average hold less than 14 % of their loans vis-à-vis domestic individuals and 15 % vis-à-vis domestic enterprises.
[14] For the US, see Hubbard, G.D. (2000).
[15] See, e.g., Kashyap, A.K./Stein, J.C. (2000, 1995).
[16] See, e.g., Kishan, R.P./Opiela, T.P. (2000) and Peek, J./Rosengren, E.S. (1995).

forced to restrict their lending more strongly in reaction to a restrictive monetary policy measure than well capitalised banks.

But, there are fundamental problems with using capitalisation to identify possible loan supply effects of monetary policy. One is that banks may hold higher amounts of capital because they are more risky. Therefore, a bank´s capitalisation (also) mirrors the riskiness of its loan portfolio. As information on risk adjusted capital requirements is not publicly available, the interpretation of results based on capital as it appears on the banks´ balance sheets remains unclear. Moreover, the period under consideration is characterised by a declinig trend in the short-term interest rate which amounts to a more or less steady easing in the stance of monetary policy. In such a period, a well capitalised bank can more easily *expand* its loans compared to one that is restricted by capital requirements. This should show up in a positive dependence of a bank´s re-action to monetary policy on its capitalisation – which is also the result predicted by the *credit channel* theory. But, this argument cannot directly be applied to the case of a *restrictive* monetary policy measure, which is the scenario that usually underlies the *credit channel*.

Therefore, compared to capitalisation, a bank´s size is the preferred indicator for the degree to which it suffers from informational problems, because size is less biased by other factors. Accordingly, the test for the existence of a *credit channel* should be mainly based on bank size and not on capitalisation. Nevertheless, in the following the regression results based on capitalisation are also presented, but without further interpretation. This is done mainly for reasons of comparability to studies that have used such an indicator.

A bank´s liquidity may also play a role in determining its reaction to monetary policy, because a bank should be the more able to shield its loan portfolio from a restrictive monetary policy measure the more liquid assets it can draw on.[17] But, liquidity may be endogenous: Those banks that suffer most from informational imperfections will probably also hold large stocks of liquid assets. In addition, we cannot exclude the possibility that more liquid banks are more risk averse and, hence, also have tighter lending standards. If this is the case and there are differences in loan demand between risky and less risky firms in response to a monetary policy shock, liquidity does also not serve well as the discriminating variable to identify supply effects.

The general strategy of the subsequent empirical analysis is to test for a differential response of bank loans to monetary policy across banks, depending on the banks´ size,

[17] See Kashyap, A.K./Stein, J.C. (2000).

but also on capitalisation and liquidity. This test will be performed by applying dynamic panel-estimation techniques to the following single equation which can be interpreted as the reduced form of a simple model of the loan market:[18]

$$\begin{aligned}\Delta \log C_{n,t} &= \alpha_n + \sum_{k=1}^{K} \varphi_k \cdot \Delta \log C_{n,t-k} + \sum_{k=1}^{K} \beta_k \cdot \left( bcar_{n,t-k} \cdot \Delta mp_{t-k} \right) \\ &+ \sum_{k=1}^{K} \lambda_k \cdot bcar_{n,t-k} + \sum_{k=1}^{K} \mathbf{\Phi}_k \cdot \Delta \mathbf{X}_{n,t-k} + d_t + \varepsilon_{n,t}\end{aligned} \quad (1)$$

$C_{n,t}$ is the stock of loans to domestic private non-banks of bank $n$ in quarter $t$ ($\Delta$ indicates first differences), $mp_t$ is the indicator of monetary policy and $\varepsilon_{n,t}$ is the error term. $\mathbf{X}_{n,t}$ is a matrix of bank specific variables that serve to capture determinants of loan movements that are not caused by monetary policy induced shifts in loan supply. (1) allows for a bank specific fixed-effect, i.e. a bank specific constant $\alpha_n$ (which amounts to a bank specific trend in $\log C_{n,t}$).

A bank´s loan reaction to monetary policy is assumed to depend linearly on the bank characterising variable *bcar* (which could be size, liquidity or capitalisation, for the definition of these variables, see appendix 1) and is therefore allowed to vary across banks and time. This is captured by the "interaction terms" $\left( bcar_{n,t-k} \cdot \Delta mp_{t-k} \right)$. *bcar* is also included in a non-interacted fashion in order to prevent that possible direct effects of this variable on $\Delta \log C_{n,t}$ are captured by the $\beta$-coefficients.

The long-run coefficient of the interaction term can be used to test for the presence of loan supply effects of monetary policy if all other variables of the estimation equation sufficiently capture (differential) loan movements caused by loan demand or caused by loan supply factors other than monetary policy. If in this case the long-run coefficient of the interaction term is not statistically different from zero, then there is no differential loan reaction to monetary policy across banks, i.e. then this methodology is unable to identify loan supply effects of monetary policy.

Since the hypothesis test consists of looking for *differences* in the loan reaction of banks, it is useful to completely eliminate the overall effect of pure time variables (e.g. the business cycle, the level of interest rates, inflation...) on $\Delta \log C_{n,t}$. This is most effectively done by including a complete set of time dummies $d_t$. While this comes with the drawback that the (average) level effect of monetary policy is also captured by these dummies, i.e. that $\Delta mp_t$ cannot be included as such, it guarantees a perfect control for the time effect on the endogenous variable and therefore enhances the

[18] For more details, see Ehrmann, M. et al (2001) and the discussion in Farinha, L./Marques, R.C. (2001).

power of the hypothesis test.[19] Moreover, (1) can then be interpreted as the reduced form of a broad variety of models that differ only in respect to the number and the choice of included time series variables, because the use of $d_t$ implicitly captures the effect of all of them.

$\mathbf{X}_{n,t}$ consists of (the logarithm of) a bank-individual income variable, $y_{n,t}$, and (the logarithm of) a bank-individual default-risk measure, $risk_{n,t}$. The income of bank *n´*s loan customers $y_n$ is approximated by an average of sectoral real incomes (of nine production sectors and the private households), with sector *j´*s real income $y^j$ being weighted by this sector ´s share in bank *n´*s loan portfolio (for detailed definitions of the variables see appendix 1):

$$y_{n,t} = \sum_{j=1}^{J} \left( \frac{C_{n,t}^{j}}{C_{n,t}} \cdot y_t^j \right). \tag{2}$$

The bank's default-risk is approximated by $risk_{n,t}$, which is a sectoral average of the number of insolvencies. Sector *j´*s insolvencies $ins^j$ are weighted by this sector ´s share in bank *n´*s loan portfolio:[20]

$$risk_{n,t} = \sum_{j=1}^{J} \left( \frac{C_{n,t}^{j}}{C_{n,t}} \cdot ins_t^j \right). \tag{3}$$

A priori, it is unclear how loan growth depends on a change in $risk_{n,t}$ and a change in $y_{n,t}$ in the short-run: If the "cash-flow effect" dominates in the short-run, then the coefficients of the lower-order lags of $y_{n,t}$ should be negative: In this case, a reduced income worsens the ability to finance expenditures internally and thereby leads to an increase in the *demand* for external finance, given expenditures are relatively fixed (which is realistic in the short-run).[21] A similar argument could apply to the risk

[19] While the use of time series instead of a set of time dummies weakens the power of the test for a differential reaction to monetary policy across banks, it allows for assessing the (average) level effect of monetary policy. Estimations of equation (1) with time series are presented in Worms, A. (2001). The long-run coefficient of $\Delta mp$ in these regressions is always significantly negative, as one would expect (see also Ehrmann et al (2001) for a comparable set of results).

[20] Within the *balance sheet channel* a monetary-policy induced interest rate increase may in principle reduce loan supply by (a) (endogenously) increasing the average probability of default and (b) by lowering the amount payed to the bank in case of a (exogenous) default, where typically net worth serves as an indicator for this amount. Including $risk_{n,t}$ as an explanatory variable may capture a possible differential reaction of banks´ loan supply to monetary policy that is caused by (a), which would otherwise be captured by the interaction term in equation (1). Therefore, the inclusion of $risk_{n,t}$ may lead to an underestimation of possible loan-supply effects of monetary policy by the interaction term. But, in accordance with most of the relevant literature, I assume that the effect of monetary policy on $risk_{n,t}$ is only of minor relevance (compared to the influence of exogenous changes in default risk on loans).

[21] The "cash-flow effect" is the most convincing explanation for the often found positive correlation between the interest-rate level and the growth rate of loans. See, e.g., Müller, M./Worms, A. (1995) for descriptive evidence. Impulse responses with such an intial positive reaction of loans to a restrictive monetary policy shock for Germany are presented in Worms, A. (1998), particularly pp. 268-291. For the US, see Bernanke, B.S./Gertler, M. (1995), particularly p. 44.

variable: If the default risk of the loan portfolio increases, then the bank may increase loans in order to enable firms to solve their liquidity problems and in order to meet a possibly increasing demand for loans. In this case, the coefficients of the lower-order lags of $risk_{n,t}$ should be positive. However, despite this ambiguity with respect to the coefficient signs of $risk_{n,t}$ and $y_{n,t}$ in the short-run, the signs of their long-run coefficients are unambigous and can therefore be used as a device to judge the adequacy of the estimations: The long-run coefficient of the income variable should be positive and that of the default-risk variable should be negative.

The bank specific fixed-effect $\alpha_n$ in (1) takes the form of a bank individual constant. In order to be able to estimate an equation with $N$ such varying constants, $\alpha_n$ is removed from the estimation equation by taking first differences of (1).[22] But, due to the dynamic nature of the model, this creates a correlation between the lagged-endogenous variables and the error term, leading to biased and inconsistent OLS-estimates.[23] Therefore, the GMM-method proposed by Arellano & Bond (1991) will be applied subsequently.[24] Here, the lagged levels of the regression variables are used as instrumental variables.

Finally, in order to meet possible endogeneity problems, the right-hand variables enter the regression with at least one lag (see equation (1)).[25] As the maximum lag length $K$ of the variables that enter the regression four lags proved to be sufficient. In order not to have different values for the bank characteristic variable $bcar_{n,t}$ at a given quarter $t$ in equation (1), only one lag of *bcar* instead of four enters the regression at $t$. Therefore, at a given quarter $t$, the four interaction terms consist of $bcar_{n,t-1}$ and the respective lags of $\Delta mp_t$: $(bcar_{n,t-1} \cdot \Delta mp_{t-1})$, $(bcar_{n,t-1} \cdot \Delta mp_{t-2})$, $(bcar_{n,t-1} \cdot \Delta mp_{t-3})$ and $(bcar_{n,t-1} \cdot \Delta mp_{t-4})$. Accordingly, only $bcar_{n,t-1}$ is included in a non-interacted fashion.

[22] Another way of eliminating the fixed-effect is to substract individual means (within-transformation). Usually, taking first difference is preferred in the literature, because the instrumentalisation with lagged variables in case of a within transformation needs a much stronger exogeneity assumption than in case of first differences: If the model is written in first differences, all past values (with more than two lags) of any weakly exogenous variable are valid instruments. In particular, (twice) lagged levels and differences are valid in this context as long as the original disturbance is not serially correlated. If the model is written in deviations from individual means, the new disturbance comprises all past, present and future values of the original disturbances. Then, for a variable to be a valid instrument, it has to be strongly exogenous, which is a stronger assumption that is much less likely to be satisfied.

[23] See Nickell, S. (1981).

[24] See Arellano, M./Bond, S. (1991) and Doornik, J.A./Arellano, M./Bond, S. (1999).

[25] Due to the fact that the individual variables are based on balance sheet data, an endogeneity problem emerges: If bank loans and another position are strongly correlated, it is not clear a priori which position drives the other. The following regressions cope with this problem in two ways: Firstly, based on the Arellano/Bond procedure, all right-hand variables are instrumentalised by their lagged levels (GMM-instruments). Secondly, the right-hand variables enter the regression with at least one lag. The endogeneity/exogeneity-issue then hinges on a timing assumption which leads to a correct identification of the driving forces behind loan growth if "Granger-causality" is the adequate causality concept.

## IV Data

The monthly balance sheet data available for this analysis spans over the period 1992-1998[26] and comprises all German banks (around 4400).[27] As quarterly macrodata and information from the quarterly borrowers statistics of the Deutsche Bundesbank have also been used (e.g. for calculating the income and risk indices), quarterly values were taken by using end of quarter values. Accordingly, there are 28 observations for a bank that has been in the database over the entire period under analysis, and almost 100,000 observations are available.

The balance sheet items of banks that have merged were summed for the time before the merger took place.[28] Applying this procedure to the data leads to a loss of about 10,000 observations, so that 3,296 banks and about 90,000 observations remain in the dataset. After removing those banks that do not have observations in all necessary balance sheet positions, 3,207 banks remain in the sample.

A realisation of a variable is defined as an outlier if it is smaller or larger than prespecified percentiles of the distribution of this variable across all banks and all quarters. The choice of the critical values is made by visual inspection:[29] In the case of $\Delta \log C$ the 2nd and the 98th percentile prove to be adequate, in the case of the *bcar*-variables the 1st and the 99th percentile are sufficient.[30] Every bank that has at least one outlier in either $\Delta \log C$ or the respective *bcar*-variable is removed from the sample. The end result is a reduction of the sample by around 13,000 observations (around 450 banks) so that about 2,800 banks and 75,000 observations remain in the sample.[31]

[26] There has been a change in data definitions created by the harmonisation procedure in the uprun to EMU. The data used in this study therefore ends in 1998 because the additionally available quarters from 1999 to mid-2001 would be too few to appropriately handle this statistical break.

[27] The analysis does not use information on bank individual interest rates, because such information is available only for a sample that comprises about 10 % of all German banks. Moreover, the information contained in this data is insufficient to analyse the question at hand, because it only reports the medians of the distributions of a banks´ interest rates for given categories of loans and deposits.

[28] For a discussion of this procedure and its implications for the individual effect, see Worms, A. (2001). In that paper, the subsequent basic regressions have also been carried out based on two other merger treatments. Due to the fact that the most important results are robust against this variation, only those based on this "backward aggregation"-procedure are presented here.

[29] Given that outliers can very strongly bias the results in panel regressions, the danger of eliminating "too few" observations should be weighted much higher than the danger to eliminate "too many" observations, especially when taking into account the large dataset. Therefore, when in doubt, the thresholds are chosen so that all possible "dubious" observations are removed.

[30] In the case of bank size, the outlier procedure is based on $\Delta siz$ in order not to remove the large banks. In the cases of capitalisation and liquidity it is directly based on *cap* and *liq*, respectively.

[31] The number of observations and banks varies across regressions because the outlier procedure is regression specific in the sense that it is applied only to $\Delta \log C$ and the respective *bcar*-variable(s): If, e.g., size is used, then those banks that have outliers in the liquidity or in the capitalisation variable, but not in size, remain in the sample. This creates samples that are adequate with respect to a specific issue (e.g. "*are there size effects?*"), i.e. that are independent of possible other issues (e.g. "*are there liquidity effects?*").

There are several indications for bank-individual seasonal patterns in the data that – if not properly accounted for – worsen the quality of possible instruments and lead to a low degree of robustness of the results with respect to changes in the specification.[32] Moreover, different seasonal patterns create differences in the loan movements across banks that may falsely be attributed to a differential reaction to monetary policy if not explicitly taken into account. Therefore, in order to cope with this seasonality problem, all bank specific variables ($C_{n,t}$, the $bcar_{n,t}$-variables, $y_{n,t}$ and $risk_{n,t}$) are seasonally adjusted by applying a MA(4)-procedure on a bank individual basis.[33]

# V Estimation results

## V.1 Size, liquidity and capitalisation

In the basic specification, the 3-month interest rate is used as the indicator of monetary policy. Table 2a presents results for the three bank characteristics: In regression 1 size (*siz*), in regression 2 liquidity (*liq*) and in regression 3 capitalisation (*cap*).[34] The long-run coefficients of the respective interaction-term, of the income variable and of the risk variable are reported (the short-run coefficients are reported in appendix 2).

The statistical tests indicate an adequate instrumentalisation in all cases.[35] Moreover, the long-run coefficients of the control variables do in no case show a significantly unexpected sign: Only in regression 2 (liquidity) is the coefficient of the income variable insignificant.

The long-run coefficient of the size-interaction is negative and insignificant (regression 1). This indicates that a bank´s reaction to monetary policy does not

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[32] Preceding regressions based on annual growth rates proved to be better in terms of instrumentalisation and robustness than regressions based on 1st differences. This is also the case when regressions were based on annualised data. Moreover, bank-individual regressions show a broad variety of seasonal patterns.

[33] For more details, see Worms, A. (2001).

[34] All bank characterising variables are demeaned in order to obtain *bcar*-variables with a sum across all included oberservations of zero. This guarantees that the $\beta$´s in (1) are not influenced by the level effect of $\Delta mp$ on $\Delta \log C_{n,t}$. In case of the size variable, the time varying mean across all banks is substracted from the log of total assets of bank *n*. This removes the overall trend in the log of total assets from siz, indicating that the size of a bank relative to the average size across all banks *at a given period* is the relevant measure. This leads to a siz-variable that is on average zero in *every* period *t*. In the case of the capitalisation and the liquidity variable, the overall mean (across time and banks) is substracted. This creates bank characterising variables that are zero across all observations but not necessarily at every single period. This allows the overall degree of liquidity and capitalisation to vary across periods.

[35] Ideally, the instruments should be highly correlated with the variables they serve as instruments for, while they should be uncorrelated with the disturbances. This can be assesed on the basis of auto-correlation (AR)-tests and the Sargan-Test. In order to find the adequate lag length for the instrumental variables, every regression has been carried out several times, starting with lags 2 to 4 of the levels of the regression variables. Typically, a poorer instrumentalisation (only lag 2 or lags 2 and 3) led to an insignificant sum of coefficients of the lagged-endogenous variables, which implies very large standard errors of the long-run coefficients of the other right-hand variables. In most cases, the AR-tests and the Sargan-test pointed to an adequate instrumentalisation for a maximum lag of 6.

directly depend on its size – which is contrary to what the *credit channel* theory would predict and also contrasts the results of the existing empirical literature on the US and on many other countries.[36] In the case of liquidity (regression 2) the long-run coefficient of the interaction-term is significantly positive. This indicates that the long-run effect of an increase in the interest rate on bank lending is the smaller, the more liquid a bank is: The effect of a one percentage point increase in $mp_t$ on $\Delta \log C_{n,t}$ decreases on average by 0.035 percentage points when the liquidity ratio of a bank is increased by one percentage point. This finding implies that, in periods of a restrictive monetary policy, a borrower from a less liquid bank on average tends to suffer from a sharper decline in lending than does a customer of a more liquid bank. According to regression 3, a comparable result also holds in the case of capitalisation: The better capitalised a bank, the less its lending declines in response to a restrictive monetary policy measure.

**Table 2a:**
**Long-run coefficients from basic regression, *mp* = 3-month interest rate**
Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected sign] | | regression 1 *siz* | regression 2 *liq* | regression 3 *cap* |
|---|---|---|---|---|
| $\Delta mp \cdot bcar_{-1}$ | [?] | -0.0448 * (0.0251) | 0.0353 *** (0.0056) | 0.1360 *** (0.0406) |
| $\Delta y$ | [+] | 1.1928 *** (0.4884) | 0.7556 (0.4933) | 0.9602 ** (0.4916) |
| $\Delta risk$ | [–] | -0.6914 *** (0.1186) | -0.7331 *** (0.1222) | -0.5662 *** (0.1189) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.405 | 0.557 | 0.348 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 | 1.000 |
| lags of IVs | | 2-7 | 2-7 | 2-7 |
| No of observations | | 57615 | 58276 | 58374 |
| No of banks | | 2625 | 2654 | 2659 |

See table A1 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.[37]

It is interesting to have a look at the short-run coefficients (see table A1 in appendix 2), because they can give an indication for possible loan *demand* effects. The four coefficients of the income variable in regressions 1-5 are insignificant for lags 1 and 2, but significantly positive either for lag 3 or 4. This is compatible with the "cash-flow effect" of loan *demand*: Given a certain rigidity in expenditures, a reduction in income

[36] See table 2 in Worms, A. (2001) and, e.g., deBondt, G.J. (1999).
[37] Inferences on the coefficients should normally be based on the first step results of the GMM-estimation, but due to computational problems (estimations were carried out with DPD for Ox), the second-step results were used instead. This does not alter the results significantly because the differences between the first and the second step estimates are negligible due to the large number of banks in the sample.

(which could be exogenous or caused by the interest rate and/or the exchange rate channel of monetary policy) causes loan *demand* to increase in the first two quarters at least in some cases. If some loan customers also decrease their loan *demand* and/or some banks decrease loan *supply* in reaction to the decreasing income, then such a mixture of positive and negative effects could explain the insignificance of the income coefficients in the early quarters. Only after some time, the cash-flow effect looses its strenth because expenditures are adapted. As a result, overall loan *demand* decreases and the "income-expectation effect" starts to dominate the movements of the loan aggregate: A higher income may imply or cause the expectation of rising income in the future, thereby increasing investment and loan *demand.* Due to the decreasing importance of this short-run "perverse" *demand* reaction coming from the cash-flow effect, the income coefficient becomes significantly positive not before lag 3 or 4.

Obviously, a similar argument does not apply to the risk variable: Here, the coefficient signs do not change significantly from positive to negative when increasing the lag. Therefore, the hypothesis that a growing default risk of the existing loan portfolio may *increase* loan growth in the very short run due to an increasing *demand* for loans cannot be confirmed by these regressions.

Hence, the results indicate that the impact of monetary policy on bank loans differs only with respect to two of the bank characteristics that have been considered: Liquidity and capitalisation. Possible bank loan supply effects of monetary policy cannot be identified (solely) by bank size as the discriminating variable.

### V.2 Short-term interbank deposits

The result that size is not important for a bank´s reaction to monetary policy can be explained by the structure of the German banking system, which differs considerably from that of other countries, e.g. the US. As shown in table 1, the small banks mainly consist of credit cooperatives and – to a lesser extent – of savings banks. Besides these comparatively small institutions, the savings banks´ sector as well as the cooperative sector also contain large superordinate central institutions.[38] As has been pointed out in section II, these central institutions maintain close relationships with the lower level institutions of their own system and with the "other" domestic banks, while savings banks and credit cooperatives have relationships almost exclusively with the central institutions of their own network. Given these close interbank links within the two systems, it is possible that in case of a restrictive monetary policy measure funds are channelled from the central institutions to their affiliated small institutions, thus

[38] The central institutions of both sectors belong to the 5 % largest banks (Deutsche Bundesbank (2001)).

counteracting potential funding problems otherwise faced by these small banks. Indeed, in a VECM-framework, Ehrmann & Worms (2001) show that after a restrictive monetary policy shock, funds flow from the central institutions to the smaller banks of their respective system.[39] These flows are mainly reductions of short-term deposits held by the small banks with the large banks. This observation is compatible with the hypothesis that small banks reduce their short-term interbank deposits in order to cushion the effect of a restrictive monetary policy on their loans to non-banks.

**Table 2b:**
**Long-run coefficients from basic regression, *mp* = 3-month interest rate**
Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected sign] | | regression 4 *ibk* | regression 5 *oli* |
|---|---|---|---|
| $\Delta mp \cdot bcar_{-1}$ | [?] | 0.0976 *** (0.0116) | -0.0172 *** (0.0064) |
| $\Delta y$ | [+] | 1.1292 ** (0.5072) | 1.2491 ** (0.5547) |
| $\Delta risk$ | [–] | -0.9123 *** (0.1301) | -0.8220 *** (0.1423) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.262 | 0.677 |
| Sargan (p-val, 2nd step) | | 1.000 | 0.998 |
| lags of IVs | | 2-7 | 2-6 |
| No of observations | | 52565 | 57341 |
| No of banks | | 2397 | 2611 |

See table A1 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

This explains two of the regression results presented in table 2a: Firstly, the interbank flows from large to small banks can be the reason for the result that bank size is not a significant determinant of a bank´s reaction to monetary policy, although it is not clear if the monetary policy induced interbank flows described in Ehrmann & Worms (2001) are sufficient to completely offset possible bank-size related effects. Secondly, given that short-term interbank deposits are included in the liquidity variable used in regression 2 (see appendix 1 for the exact definition), it could well be that the significant relationship between the banks´ liquidity and their reaction to monetary policy is mainly driven by short-term interbank deposits. In order to test this hypothesis, the liquidity variable is splitted into two parts: The percentage share of short-term interbank deposits in total assets, *ibk*, and the precentage share of the remaining "other liquid assets" – which mainly consist of securities – to total assets, *oli*.

[39] See Ehrmann, M./Worms, A. (2001).

Repeating the regressions with these two components of liquidity as the *bcar*-variables yields the results presented in table 2b. While the long-run coefficient of the interaction term is significantly positive in case of short-term interbank deposits (regression 4), it is significantly negative in case of the “other liquid assets” (regression 5). Despite the fact that the latter result is difficult to explain, it nevertheless strongly indicates that the significantly positive coefficient of the liquidity-interaction term presented in table 2a (regression 2) is mainly driven by the movements of short-term interbank deposits: Obviously, the average bank does not draw on the assets contained in the liquidity variable other than short-term interbank deposits to cushion the effects of a restrictive monetary policy measure on its loans.[40]

### V.3 Size effects when controlling for short-term interbank deposits

Given the strong evidence in favor of the interbank-variable *ibk*, the weak result especially for bank size leads to the following question: Is there a size effect if we control for the influence of short-term interbank deposits? In order to test for this, the estimation equation is enhanced to include both interaction-terms, size and short-term interbank deposits. Compared to equation (1) this extended equation does not only contain *ibk* and the “single” interaction $\Delta mp \cdot ibk$, but additionally *siz* and $\Delta mp \cdot siz$. Moreover, the respective “double interaction terms” $siz \cdot ibk$ and $\Delta mp \cdot siz \cdot ibk$ are also ncluded in order to allow for possible second-order effects of *siz* and *ibk*.

Table 3 presents the results (regression d1). The coefficients of the control variables $\Delta y$ and $\Delta risk$ are significant and show the expected signs. The coefficient of the *ibk*-interaction is significantly positive like in all previous regressions. This again shows the robustness of this effect. Interestingly, the size-interaction term is now also significantly positive (instead of insignificant in table 2a). Therefore, when controlling for the effect of short-term interbank deposits on a bank´s reaction to monetary policy, a positive size dependence of this reaction cannot be rejected: A bank reacts the less restrictive to a restrictive monetary policy measure the higher its short-term interbank deposits *and* the larger it is, which is in line with the *credit channel* theory. But, given that such a positive coefficient of the size-interaction term does not show up in the single-interaction regression presented in table 2a, it can be interpreted as being dominated by the influence exerted by *ibk*. Hence, the regressions presented in table 2a suffer from an omitted variable bias.

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[40] A possible test for the dominance of the *ibk*- over the *liq*-effect is to include both *bcar*-variables in one regression. This results in a significantly positive interaction term for short-term interbank deposits and an insignificant coefficient for the liquidity interaction. This indicates that the influence of liquidity is already captured by the short-term interbank deposits, i.e. that for the average bank, *liq* does not contain any information which is not already contained in *ibk*. For more details, see Worms, A. (2001).

**Table 3:**
**Long-run coefficients from regressions with double interactions,**
***mp* = 3-month interest rate**

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected signs]: | bcar1: / bcar2: | regression d1 *siz* / *ibk* | regression d2 *cap* / *ibk* |
|---|---|---|---|
| $\Delta mp \cdot bcar1_{-1}$ | [?] | 0.1011 *** (0.0258) | 0.1221 *** (0.0464) |
| $\Delta mp \cdot ibk_{-1}$ | [?] | 0.0988 *** (0.0093) | 0.0775 *** (0.0112) |
| $\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$ | [?] | 0.0088 * (0.0049) | 0.0157 * 0.0090 |
| $\Delta y$ | [+] | 0.9958 ** (0.4218) | 0.7762 (0.7109) |
| $\Delta risk$ | [–] | -0.7778 *** (0.1028) | -0.3950 *** (0.1604) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.263 | 0.559 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 |
| lags of IVs | | 2-6 | 2-5 |
| No of observations | | 51597 | 52334 |
| No of banks | | 2353 | 2386 |

See table A2 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

Another interesting result is the insignificant coefficient of the double interaction with $\Delta mp$. It means that the strength of the effect of short-term interbank deposits on the reaction of a bank to monetary policy does not depend on its size and vice-versa. Stated differently: Assume a certain combination of *siz* and *ibk* which implies a specific reaction to a change in *mp,* i.e. a specific long-run reaction coefficient to monetary policy. Given an increase in size, this long-run coefficient remains constant if short-term interbank deposits decrease accordingly. The zero long-run coefficient of the double interaction implies that this substitution relation between *siz* and *ibk* is constant, i.e. independent of (the level of) *siz* and *ibk*.

Table 3 also contains the results of using *ibk* and *cap* simultaneously (regression d2). Here again, the interaction term with short-term interbank deposits is positive. Additionally, the coefficient of the *cap*-interaction term is significantly positive (as in table 2a): C.p., loans of well capitalised banks decline less strongly than loans of less capitalised banks if interest rates are increased.

## V.4 Robustness with respect to a change in the monetary policy indicator

Besides the supply-demand identification problem, the empirical analysis of the *credit channel* – like the empirical literature on monetary transmission in general – has a further key problem of identification: That between endogenous and exogenous monetary policy measures. It stems from the fact that a central bank *re*acts with the short-term interest rate $i_t$ to observed and/or expected changes of other relevant variables. $\Delta i_t$ thus contains an endogenous component that causes a measurement problem with regard to the effects of monetary policy. If it is possible to extract the *exogenous* component from $\Delta i_t$, then – according to the respective literature[41] – it may be used to measure the effects of monetary policy measures more accurately.

Therefore, in order to check robustness of the results presented in table 3 with regard to the choice of *mp*, the estimations are carried out anew using a VAR-shock as the monetary policy indicator. The VAR contains a world commodity price index, US real GDP, US short-term interest rate and a linear trend as exogenous variables. Endogenous variables are German real GDP, consumer prices, the 3-month interest rate and the real effective exchange rate.[42] The VAR allows for a contemporaneous response of the interest rate to the real effective exchange rate and is therefore much more realistic than many of the VARs for Germany existing in the literature. Moreover, it is able to generate impulse response functions that do not entail a “price puzzle”.[43]

The residuals of the short-term interest rate equation are interpreted as the exogenous interest rate component: $mp_t = i_t - \hat{i}_t^{VAR} = \hat{u}(i)_t^{VAR}$.[44] The results confirm the dominance of short-term interbank deposits – the coefficients of the *ibk*-interaction term are significantly positive in both regressions (table 4).[45] But, contrasting regression d1, there is no significant influence of size (and also the coefficient of the *cap*-interaction becomes insignificant).

Therefore, the significantly positive size effect found when controlling for short-term interbank deposits (table 3) is not robust against this change in the monetary policy indicator. But, when interpreting these results it should be borne in mind that the use of the VAR-shock as the monetary policy indicator hinges on a number of important

[41] See, e.g., Sims, C. (1996), Uhlig, H. (1998) and Bernanke, B.S./Mihov, I. (1995). The Bundesbank's policy is analysed in Bernanke, B.S./Mihov, I. (1996) and Clarida, R./Gertler, M. (1997).

[42] The VAR was estimated by F. Smets and R. Wouters whom I would like to thank for supplying me with their data and results. See Smets, F./Wouters, R. (1999) for more information on the regression. The sample period is 1980 - 1998.

[43] See, e.g., Worms, A. (1998), esp. pp. 278-291. In order to solve the identification problem, the reaction coefficient on the exchange rate is estimated using the Japanese interest rate and US-Dollar/Yen exchange rate as instruments. See Smets, F./Wouters, R. (1999).

[44] The VAR-shocks are only available up to the second quarter of 1998, so that the number of observations used in the regressions presented in table 3 is smaller than the number of observations used in those presented in table 4.

[45] The coefficient of the *ibk*-interaction term in a single interaction regression is also significantly positive when the VAR-shock is used. See Worms, A. (2001).

assumptions.[46] One of the most critical is probably that the estimated exogenous changes in the interest rate should have the same effects as the endogenous changes. Only then can the estimated effect be used to describe the overall effects of monetary policy. Given this problem and given that the interest rate shocks may change with a change in the specification of the VAR, the lack of robustness with respect to the monetary policy indicator may not be of great concern.

**Table 4:**
**Long-run coefficients from regressions with double interactions,**
***mp* = VAR-shock**

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected sign] | | | regression d3 | regression d4 |
|---|---|---|---|---|
| | | *bcar1:* | *siz* | *cap* |
| | | *bcar2:* | *ibk* | *ibk* |
| $\Delta mp \cdot bcar1_{-1}$ (muliplied by 100) | [?] | | -0.0225 (0.0000) | -0.0327 (0.0357) |
| $\Delta mp \cdot ibk_{-1}$ (muliplied by 100) | [?] | | 0.0196 *** (0.0000) | 0.0227 *** (0.0085) |
| $\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$ (muliplied by 100) | [?] | | 0.0063 ** (0.0000) | -0.0006 (0.0067) |
| $\Delta y$ | [+] | | 0.5799 (0.4327) | -1.7642 (4.6819) |
| $\Delta risk$ | [–] | | -0.8107 *** (0.1029) | 0.5760 (0.5889) |
| AR1 (p-val,1st step) | | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | | 0.622 | 0.462 |
| Sargan (p-val, 2nd step) | | | 1.000 | 1.000 |
| lags of IVs | | | 2-7 | 2-3 |
| No of observations | | | 49258 | 49962 |
| No of banks | | | 2353 | 2386 |

See table A3 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

In order to determine the "adequate" method of measuring monetary policy, these drawbacks have to be weighted against the endogeneity/exogeneity-problem that comes with using the short-term interest rate as such. Given that the regressions are based on bank individual information (which probably does not lead to monetary policy induced interest rate changes) and that $\Delta mp$ does not enter the regressions contemporaneously, this endogeneity/exogeneity-issue is probably less severe. Hence, in the following all further results are presented using our preferred measure of monetary policy, the 3-month interest rate.[47]

[46] For a critique of VAR approaches to measure monetary policy effects, see, e.g., McCallum, B.T. (1999), Faust, J. (1998) and Rudebusch, G.D. (1996).

[47] The literature discusses several methods of determining the exogenous component in the interest rate, like using financial market data to extract expected changes of the short-term interest rate, the "narrative approach", the use of a specific reaction function of the central bank aso. All of these alternatives have their own specific problems. For a discussion, see, e.g., Worms, A. (2001).

## V.5 Restricting the sample to large banks

Table 5 presents information on four groups of banks. They have been formed by first ranking the banks according to their individual loan-market share and subsequently sorting them into four groups that each hold (around) 25 % of the loan market (see also table 1). The group of the largest banks that together holds around 25 % loan market share consists of only 4 banks, whereas the group of the smallest banks consists of 2188 banks.

**Table 5: Bank groups based on loan-market share (1992-1998)**
(based on the sample used for estimating regression 4, i.e. corrected for outliers in $\Delta \log C$ and *ibk*)

| group: | *very large* | *large* | *small* | *very small* |
|---|---|---|---|---|
| number of banks | 4 | 22 | 195 | 2188 |
| *of which: savings banks* | *0* | *5* | *34* | *269* |
| *credit cooperatives* | *0* | *1* | *148* | *1894* |
| *other banks* | *4* | *16* | *13* | *25* |
| loan market share in % | 26.3 | 24.1 | 24.6 | 25.0 |
| average of *ibk* in % | 14.9 | 10.9 | 7.6 | 10.0 |
| average of *liq* in % | 30.1 | 25.4 | 31.4 | 33.5 |
| average of *cap* in % | 5.5 | 3.2 | 4.0 | 4.4 |
| average of *siz* (log of total assets) | 19.4 | 17.6 | 15.2 | 12.4 |

Given that all banks enter the regression with the same weight, i.e. independent of their size, it could well be that the previous results are solely driven by the many very small banks in the sample. In order to test if the results obtained so far hold even if the least important banks in terms of the loan-market share are excluded, the regressions presented in tables 2a and 2b are repeated with only those larger banks that together constitute 75 % of the loan market, i.e. the "very small" banks are excluded and the estimations are carried out anew with the remaining banks, which are around 220-270.

Table 6 presents the results: Like in all preceding regressions the long-run coefficients of the risk variable are significantly negative in all cases. Those of the income variable are significantly positive in all cases, except in the regression with the *ibk*-interaction. Interestingly, all the coefficients of the interaction terms are significantly positive now: This shows that the results for liquidity, capitalisation and short-term interbank deposits presented in tables 2a and 2b hold qualitatively even if the sample is reduced to contain the larger banks only. Moreover, even those interaction terms that were either insignificant (size) or had an implausible sign ("other liquid assets") when using the whole sample, now show significantly the expected signs.[48]

[48] The qualitative results presented in table 6 are robust against using the VAR-shock in all cases but in the case of the "other liquid assets".

**Table 6:**
**Long-run coefficients from regressions with reduced sample,**
***mp* = 3-month interest rate (sample of banks covers 75% of loan market)**
Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected sign] | | regression 6 *siz* | regression 7 *liq* | regression 8 *cap* | regression 9 *ibk* | regression 10 *oli* |
|---|---|---|---|---|---|---|
| $\Delta mp \cdot bcar_{-1}$ | [?] | 0.1257 ** | 0.0455 *** | 0.3242 *** | 0.0351 *** | 0.0372 *** |
| | | (0.0524) | (0.0054) | (0.0263) | (0.0124) | (0.0064) |
| $\Delta y$ | [+] | 5.1608 *** | 5.4195 *** | 5.9016 *** | 2.4208 | 3.0885 * |
| | | (1.3142) | (1.7871) | (1.8431) | (2.6355) | (1.6653) |
| $\Delta risk$ | [–] | -0.3521 *** | -0.3679 *** | -0.3483 *** | -0.5487 *** | -0.2441 *** |
| | | (0.0485) | (0.0580) | (0.0697) | (0.1505) | (0.0729) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.307 | 0.444 | 0.349 | 0.651 | 0.523 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| lags of IVs | | 2-7 | 2-7 | 2-7 | 2-7 | 2-7 |
| no of obs | | 5434 | 6006 | 5434 | 4859 | 5522 |
| no of banks | | 247 | 273 | 247 | 221 | 251 |

See table A4 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

This is especially interesting in the case of the size interaction (regression 6): If the very small banks are excluded from the sample, a significant size effect can be found even in the single-interaction regression. Obviously, the insignificance of the coefficient of the size interaction in table 2a has been caused by those "very small" banks – indicating that they do not behave in the way predicted by the *credit channel* theory. As has already been pointed out, the reason is that these banks are mainly credit cooperatives and savings banks (see tables 1 and 5) which use their short-term interbank deposits to cushion the effects of monetary policy on their loan portfolio. This is in line with the fact that these banks hold relatively large buffers of short-term interbank deposits.[49] While the share of short-term interbank assets in total assets amounts to an average of 10 % for the "very small" banks, it amounts to only 8 % for all other banks. The motive for this higher share could well be that the "very small" banks want to put themselves in a position to cushion possible shocks which would otherwise force them to more strongly adapt their loan portfolio. This would be also in line with the hypothesis that these "very small" banks maintain housebank relationships with their loan customers (see above, section II).[50]

[49] See Deutsche Bundesbank (2001), esp. p. 57 and Upper, C./Worms, A. (2001).
[50] The high share of short-term interbank deposits in total assets of the group of the "very large" and "large" banks (see table 5) is probably not due to this motive, but rather to their more intensive overall activity in interbank borrowing and lending. For a more detailled description, see Upper, C./Worms, A. (2001).

**Table 7:**
**Long-run coefficients from regressions with reduced sample, double interactions, *mp* = 3-month interest rate (sample of banks covers 75% of loan market)**
Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
*, **, *** = significance at the 10%-, 5%,- 1%-level (standard errors in parenthesis).

| variable [expected sign] | bcar1: / bcar2: | regression d5 | regression d6 <br> *cap* <br> *q* |
|---|---|---|---|
| $\Delta mp \cdot bcar1_{-1}$ | [?] | 0.0640 ** <br> (0.0263) | 0.2849 *** <br> (0.0282) |
| $\Delta mp \cdot liq_{-1}$ | [?] | 0.0370 *** <br> (0.0047) | 0.0360 *** <br> (0.0048) |
| $\Delta mp \cdot bcar1_{-1} \cdot liq_{-1}$ | [?] | 0.0274 *** <br> (0.0024) | -0.0170 *** <br> (0.0032) |
| $\Delta y$ | [+] | 4.5994 *** <br> (1.3403) | 1.5238 <br> (1.5652) |
| $\Delta risk$ | [–] | -0.0544 <br> (0.1386) | -0.1045 <br> (0.1848) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.602 | 0.970 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 |
| lags of IVs | | 2-5 | 2-5 |
| No of observations | | 5698 | 6622 |
| No of banks | | 259 | 301 |

See table A5 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

The long-run coefficient of the interaction with the "other liquid assets" is now significantly positive (regression 10). This is compatible with the idea that – while the "very small" banks do not seem to use the "other liquid assets" to shield their loans to private non-banks from restrictive monetary policy measures – the larger banks do so. Given that the "other liquid assets" mainly consist of securities, this is compatible with the idea that (opposite to the small banks) the larger banks sell securities to partly shield their loan portfolios from restrictive monetary policy measures. But, this effect is comparatively small: While the influence of short-term interbank deposits in the single-interaction estimations is strong enough to completely dominate the size effect in the case of the whole sample (regression 1), the influence of the liquidity variable(s) is obviously too weak to completely offset the size effect in the case of the larger banks (regression 6).

Moreover, the size of the coefficients of the *ibk*- and of the *oli*-interaction, as well as of the *liq*-interaction are comparatively similar. This and the fact that they all are significant shows that splitting the liquidity variable into short-term interbank deposits and "other liquid assets" may not be appropriate in the case of the larger banks. Indeed, repeating the double-interaction regressions with *ibk* on the one side and alternatively *siz* and *cap* on the other (like in table 3) yields unsatisfactory results (i.e.

almost no significant interaction coefficients).[51] But, using liquidity instead of short-term interbank deposits in all regressions basically confirms the results presented in table 6 (see table 7):[52] The coefficients of the liquidity interaction are significantly positive in both cases, and there is also a positive dependence of the banks´ reaction to monetary policy on size and on capitalisation (the significantly positive coefficient of the interaction terms with liquidity and size remain even if the VAR-shock is used in the double-interaction regressions).

## VI Summary and conclusions

A crucial condition for the existence of a *credit channel* that works through bank loans is that monetary policy should be able to change the *supply* of bank loans. This paper contributes to the discussion on this issue by presenting empirical evidence from dynamic-panel estimations based on a dataset that comprises individual balance sheet information on all German banks. It shows that the average bank´s response to monetary policy mainly depends on its share of short-term interbank deposits in total assets (and therefore on its liquidity): The higher this share, the less strongly does the average bank reduce its loans in reaction to an interest rate increase. This is compatible with the hypothesis that small banks – which are almost exclusively organised in either the cooperative or the savings banks´ sector – draw on their short-term interbank deposits to (at least partly) shield their loans to private non-banks from restrictive monetary policy measures. The motive for such a behavior could be to maintain close housebank-relationships to loan customers.

A significant dependence of a bank´s reaction to monetary policy on its size can only be found if at the same time there is appropriate control for short-term interbank deposits. Otherwise, a strong omitted variable bias results.

Reducing the sample to those largest banks that together cover 75 % of the loan market (only about 10 % of all banks) – which excludes most of the (small) savings banks and credit cooperatives – reveals that the lack of a size effect in the basic regressions was mainly due to the behavior of the small banks which hold a comparatively large share of short-term interbank deposits on which they can draw. Moreover, for the larger banks not only short-term interbank deposits but rather their overall liquidity seems to determine their reaction to monetary policy.

[51] See Worms, A. (2001).
[52] The results of the double-interaction regressions based on the reduced sample have to be interpreted more cautiously than those based on the complete sample: Relative to the number of coefficients to be estimated, the sample consists of comparatively few banks only. Moreover, the long-run coefficients of the control variables are insignificant in most cases.

These results are based on the 3-month interest rate as the monetary policy indicator. Given the discussion in the literature of how to adequately measure monetary policy in an empirical anlysis, the regressions have also been carried out on the basis of a VAR-shock. In this robustness check, neither a positive dependence on size nor on capitalisation could be found for the complete sample, independently of controlling for short-term interbank deposits or not. Only the dependence on short-term interbank deposits is robust against this change in the policy indicator.

Therefore, there is very robust evidence in favor of a differential reaction to monetary policy across all banks that depends on short-term interbank deposits: Due to the fact that (smaller) banks draw on their interbank deposits in reaction to a restrictive monetary policy measure, small banks do not reduce loans more strongly than large ones. Moreover, as soon as we control for the effect of short-term interbank deposits (or of liquidity) and/or we exclude the very small banks from the sample, there is evidence for a differential reaction to monetary policy across banks that depends on size.

The key assumption that must hold in order to interpret these results as evidence for the existence of a *credit channel* is that these effects have to be attributable to a differential reaction of the banks´ loan *supply* to monetary policy. Put differently: The differences in the loan response across banks should not be due to differences in loan demand or to differences in loan supply that are not caused by monetary policy. Given the results of this paper, this basically amounts to assuming that in reaction to a monetary policy induced interest rate increase, the loan *demand* faced by small (and less liquid) banks should not decrease more strongly than loan *demand* faced by large (and more liquid) banks.

Overall, the results in this paper are compatible with the existence of a *credit channel* in Germany. This is a comparatively strong outcome if we take into account that the regressions allow – by using the bank-individual income and risk variables, and by explicitly considering bank-individual seasonal patterns – for many more differences in the movements of loans across banks which are not attributable to monetary policy induced supply changes than most of the previous literature did.

## Appendix 1: Definition of variables

$n$ = bank index
$t$ = period (quarter) index
$j$ = sector index

$i_t$ = short-term market rate (3-month interest rate) .

$A_{n,t}$ = sum of total assets of bank *n*.

$C_{n,t}$ = volume of loans of bank *n* to domestic firms, private persons and non-profit organisations

$risk_{n,t}$ = bank-specific risk-variable: weighted average of the number of insolvencies

$y_{n,t}$ = bank-specific income-variable: weighted average of the real output

$y_t^j$ = real output of sector j (in the case of private households: consumption expenditure).

$C_{n,t}^j$ = volume of loans of bank *n* to sector *j* (or to private households).

$ins_t^j$ = number of insolvent firms from sector *j* (individuals are generally assumed to be solvent).

$siz_{n,t}$ = log of total assets of bank *n*

$cap_{n,t}$ = capital of bank *n* in percent of total assets of bank *n* (in

$liq_{n,t}$ = liquid assets of bank *n* in percent of total assets of bank *n*; liquid assets consist of:

cash
+ balances with the central bank
+ treasury bills, treasury certificates and similar debt instruments issued by public bodies (eligible for refinancing)
+ debt securities
+ shares and other variable-yield securities
+ asset items constituting claims on credit institutions with an agreed maturity or redeemable at notice of one year or less.

$ibk_{n,t}$ = short-term interbank deposits of bank *n* as a percentage of total assets of bank *n*: short-term interbank deposits are:

asset items constituting claims on credit institutions with an agreed maturity or redeemable at notice of one year or less

$oli_{n,t}$ = “other liquid assets” of bank *n* in percent of total assets of bank *n*; “other liquid assets” consist of:

cash
+ balances with the central bank
+ treasury bills, treasury certificates and similar debt instruments issued by public bodies (eligible for refinancing)
+ debt securities
+ shares and other variable-yield securities

## Appendix 2: Tables

### Table A1: Estimation results, single interaction, *mp* = 3-month interest rate

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
Standard errors in parenthesis (coefficients and standard deviations taken from 2nd step results).
*** Significance on 1%-level, ** Significance on 5%-level , * Significance on 10%-level.
**Time dummies included.**

| variable: | lag: | regression 1 *siz* | regression 2 *liq* | regression 3 *cap* | regression 4 *ibk* | regression 5 *oli* |
|---|---|---|---|---|---|---|
| $\Delta mp \cdot bcar_{-1}$ | lag 1 | -0.0599 *** (0.0087) | 0.0102 *** (0.0019) | 0.0737 *** (0.0154) | 0.0198 *** (0.0038) | -0.0056 ** (0.0024) |
| | lag 2 | -0.0072 (0.0046) | 0.0082 *** (0.0014) | 0.0224 * (0.0118) | 0.0281 *** (0.0036) | -0.0027 (0.0019) |
| | lag 3 | -0.0381 *** (0.0101) | 0.0033 * (0.0019) | 0.0434 ** (0.0174) | 0.0245 *** (0.0040) | -0.0100 *** (0.0025) |
| | lag 4 | 0.0684 *** (0.0111) | 0.0071 *** (0.0020) | -0.0263 (0.0185) | 0.0066 (0.0041) | 0.0041 * (0.0024) |
| $\Delta cr$ | lag 1 | 0.1254 *** (0.0064) | 0.1199 *** (0.0051) | 0.1176 *** (0.0053) | 0.1265 *** (0.0056) | 0.1252 *** (0.0062) |
| | lag 2 | 0.1112 *** (0.0054) | 0.1175 *** (0.0047) | 0.1115 *** (0.0048) | 0.1189 *** (0.0051) | 0.1106 *** (0.0056) |
| | lag 3 | 0.0633 *** (0.0045) | 0.0663 *** (0.0043) | 0.0624 *** (0.0043) | 0.0669 *** (0.0046) | 0.0586 *** (0.0049) |
| | lag 4 | -0.1216 *** (0.0041) | -0.1186 *** (0.0040) | -0.1237 *** (0.0040) | -0.1220 *** (0.0042) | -0.1276 *** (0.0044) |
| $\Delta y$ | lag 1 | 0.2346 (0.1634) | 0.0755 (0.1690) | 0.1547 (0.1683) | 0.2503 (0.1743) | 0.1806 (0.1809) |
| | lag 2 | 0.1090 (0.1625) | 0.0191 (0.1649) | -0.0223 (0.1683) | -0.0171 (0.1713) | 0.1658 (0.1779) |
| | lag 3 | 0.3626 ** (0.1560) | 0.2497 (0.1525) | 0.2949 * (0.1540) | 0.3254 ** (0.1535) | 0.3391 ** (0.1688) |
| | lag 4 | 0.2739 * (0.1536) | 0.2714 * (0.1520) | 0.3717 ** (0.1533) | 0.3557 ** (0.1573) | 0.3554 ** (0.1684) |
| $\Delta risk$ | lag 1 | -0.2799 *** (0.0357) | -0.2685 *** (0.0359) | -0.2563 *** (0.0359) | -0.3618 *** (0.0445) | -0.3087 *** (0.0415) |
| | lag 2 | -0.1639 *** (0.0317) | -0.1781 *** (0.0319) | -0.1366 *** (0.0327) | -0.1657 *** (0.0352) | -0.1751 *** (0.0362) |
| | lag 3 | -0.0265 (0.0272) | -0.0497 * (0.0290) | -0.0026 (0.0290) | -0.0890 *** (0.0304) | -0.0594 * (0.0344) |
| | lag 4 | -0.0977 *** (0.0228) | -0.1010 *** (0.0236) | -0.0755 *** (0.0234) | -0.1221 *** (0.0250) | -0.1417 *** (0.0281) |
| $bcar$ | lag 1 | 0.0069 (0.0084) | 0.0005 *** (0.0001) | 0.0026 (0.0020) | 0.0003 *** (0.0001) | -0.0001 (0.0001) |
| constant | | -0.0005 (0.0004) | -0.0008 * (0.0005) | -0.0006 (0.0005) | 0.0000 (0.0005) | -0.0006 (0.0005) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.405 | 0.557 | 0.348 | 0.262 | 0.677 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 | 1.000 | 1.000 | 0.998 |
| lags of IVs | | 2-7 | 2-7 | 2-7 | 2-7 | 2-6 |
| No of observations | | 57615 | 58276 | 58374 | 52565 | 57341 |
| No of banks | | 2625 | 2654 | 2659 | 2397 | 2611 |

## Table A2: Estimation results, double interaction, *mp* = 3-month interest rate

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
Standard errors in parenthesis (coefficients and standard deviations taken from 2nd step results).
*** Significance on 1%-level, ** Significance on 5%-level , * Significance on 10%-level.
**Time dummies included.**

| variable: | bcar1:<br>bcar2: | regression d1<br>*siz*<br>*ibk* | regression d2<br>*cap*<br>*ibk* |
|---|---|---|---|
| $\Delta mp \cdot bcar1_{-1}$ | lag 1 | -0.0320 ***<br>(0.0089) | 0.0473 ***<br>(0.0169) |
| | lag 2 | 0.0335 ***<br>(0.0062) | -0.0003<br>(0.0152) |
| | lag 3 | -0.0115<br>(0.0098) | 0.0623 ***<br>(0.0191) |
| | lag 4 | 0.0977 ***<br>(0.0104) | -0.0056<br>(0.0193) |
| $\Delta mp \cdot ibk_{-1}$ | lag 1 | 0.0204 ***<br>(0.0033) | 0.0170 ***<br>(0.0038) |
| | lag 2 | 0.0313 ***<br>(0.0032) | 0.0224 ***<br>(0.0037) |
| | lag 3 | 0.0227 ***<br>(0.0037) | 0.0237 ***<br>(0.0040) |
| | lag 4 | 0.0113 ***<br>(0.0035) | 0.0026 ***<br>(0.0040) |
| $\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$ | lag 1 | 0.0000<br>0.0013<br>(0.0018) | -0.0026<br>(0.0031) |
| | lag 2 | 0.0011<br>(0.0016) | 0.0023<br>(0.0030) |
| | lag 3 | 0.0046 ***<br>(0.0017) | -0.0007<br>(0.0032) |
| | lag 4 | 0.0005<br>(0.0018) | 0.0143 ***<br>(0.0032) |
| $\Delta cr$ | lag 1 | 0.1024 ***<br>(0.0060) | 0.1206 ***<br>(0.0058) |
| | lag 2 | 0.0955 ***<br>(0.0049) | 0.1119 ***<br>(0.0057) |
| | lag 3 | 0.0584 ***<br>(0.0041) | 0.0535 ***<br>(0.0056) |
| | lag 4 | -0.1239 ***<br>(0.0037) | -0.1346 ***<br>(0.0050) |
| $\Delta y$ | lag 1 | 0.3782 **<br>(0.1523) | -0.0011<br>(0.2004) |
| | lag 2 | -0.1254<br>(0.1493) | 0.0350<br>(0.2117) |
| | lag 3 | 0.3548 **<br>(0.1406) | 0.2544<br>(0.2082) |
| | lag 4 | 0.2565 *<br>(0.1376) | 0.3706 **<br>(0.1887) |
| $\Delta risk$ | lag 1 | -0.3403 ***<br>(0.0373) | -0.2686 ***<br>(0.0571) |
| | lag 2 | -0.1357 ***<br>(0.0295) | -0.0745 *<br>(0.0435) |
| | lag 3 | -0.0792 ***<br>(0.0254) | 0.0287<br>(0.0399) |
| | lag 4 | -0.1197 ***<br>(0.0218) | -0.0207<br>(0.0326) |
| *bcar1* | lag 1 | -0.0487 ***<br>(0.0084) | -0.0051 **<br>(0.0023) |
| *ibk* | lag 1 | 0.0005 ***<br>(0.0001) | 0.0002 **<br>(0.0001) |
| *bcar1·ibk* | lag 1 | 0.0002 ***<br>(0.0000) | 0.0001<br>(0.0001) |
| constant | | -0.0003<br>(0.0004) | 0.0003<br>(0.0005) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.263 | 0.559 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 |
| lags of IVs | | 2-6 | 2-5 |
| No of observations | | 51597 | 52334 |
| No of banks | | 2353 | 2386 |

## Table A3: Estimation results, double interaction, *mp* = VAR-shock

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
Standard errors in parenthesis (coefficients and standard deviations taken from 2nd step results).
*** Significance on 1%-level, ** Significance on 5%-level , * Significance on 10%-level.
**Time dummies included.**

| variable: | *bcar1:* / *bcar2:* | regression d3 *siz* *ibk* | regression d4 *cap* *ibk* |
|---|---|---|---|
| $\Delta mp \cdot bcar1_{-1}$ | lag 1 | -0.0076 ** (0.0030) | -0.0075 (0.0071) |
| (muliplied by 100) | lag 2 | -0.0075 ** (0.0036) | -0.0122 (0.0097) |
| | lag 3 | 0.0027 (0.0041) | -0.0094 (0.0110) |
| | lag 4 | -0.0078 ** (0.0037) | 0.0005 (0.0086) |
| $\Delta mp \cdot ibk_{-1}$ | lag 1 | 0.0052 *** (0.0011) | 0.0054 *** (0.0017) |
| (muliplied by 100) | lag 2 | 0.0048 *** (0.0016) | 0.0047 ** (0.0024) |
| | lag 3 | 0.0043 *** (0.0018) | 0.0050 * (0.0027) |
| | lag 4 | 0.0033 ** (0.0013) | 0.0047 *** (0.0018) |
| $\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$ | lag 1 | 0.0010 * (0.0006) | 0.0004 (0.0013) |
| (muliplied by 100) | lag 2 | 0.0020 *** (0.0008) | -0.0018 (0.0019) |
| | lag 3 | 0.0015 * (0.0008) | 0.0001 (0.0021) |
| | lag 4 | 0.0010 * (0.0006) | 0.0007 (0.0014) |
| $\Delta cr$ | lag 1 | 0.0866 *** (0.0061) | 0.1064 *** (0.0225) |
| | lag 2 | 0.0938 *** (0.0051) | 0.1033 *** (0.0215) |
| | lag 3 | 0.0565 *** (0.0042) | 0.0464 ** (0.0220) |
| | lag 4 | -0.1338 *** (0.0038) | -0.1295 *** (0.0448) |
| $\Delta y$ | lag 1 | 0.1454 (0.1601) | -1.2880 (1.1310) |
| | lag 2 | -0.2523 (0.1580) | -1.2034 (1.1630) |
| | lag 3 | 0.2783 * (0.1448) | -0.8713 (1.1350) |
| | lag 4 | 0.3487 ** (0.1441) | 1.8218 (1.2870) |
| $\Delta risk$ | lag 1 | -0.3625 *** (0.0383) | -0.3706 ** (0.1531) |
| | lag 2 | -0.1531 *** (0.0307) | -0.0049 (0.1430) |
| | lag 3 | -0.1032 *** (0.0259) | 0.2584 * (0.1429) |
| | lag 4 | -0.1084 *** (0.0217) | 0.6202 *** (0.1580) |
| *bcar1* | lag 1 | -0.0708 *** (0.0088) | -0.0065 (0.0040) |
| *bcar2* | lag 1 | -0.0001 (0.0001) | -0.0006 *** (0.0002) |
| *bcar1·bcar2* | lag 1 | 0.0002 *** (0.0000) | -0.0002 ** (0.0001) |
| constant | | -0.0006 (0.0004) | 0.0006 (0.0007) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.622 | 0.462 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 |
| lags of IVs | | 2-7 | 2-3 |
| No of observations | | 49258 | 49962 |
| No of banks | | 2353 | 2386 |

**Table A4: Estimation results, reduced sample (75 % of loan market), *mp* = 3-month interest rate**

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
Standard errors in parenthesis (coefficients and standard deviations taken from 2nd step results).
*** Significance on 1%-level, ** Significance on 5%-level , * Significance on 10%-level.
**Time dummies included.**

| variable: | bcar: | regression 6 *siz* | regression 7 *liq* | regression 8 *cap* | regression 9 *ibk* | regression 10 *oli* |
|---|---|---|---|---|---|---|
| $\Delta mp \cdot bcar_{-1}$ | lag 1 | -0.1491 *** | 0.0213 *** | 0.1826 *** | 0.0138 *** | 0.0158 *** |
| | | (0.0156) | (0.0015) | (0.0089) | (0.0037) | (0.0021) |
| | lag 2 | 0.0686 *** | 0.0182 *** | 0.0509 *** | 0.0227 *** | 0.0089 *** |
| | | (0.0095) | (0.0012) | (0.0061) | (0.0032) | (0.0015) |
| | lag 3 | 0.1009 *** | -0.0049 *** | -0.1332 *** | -0.0081 ** | -0.0017 |
| | | (0.0177) | (0.0015) | (0.0096) | (0.0035) | (0.0017) |
| | lag 4 | 0.0824 *** | -0.0019 | 0.1623 *** | -0.0037 | 0.0060 *** |
| | | (0.0171) | (0.0011) | (0.0110) | (0.0036) | (0.0020) |
| $\Delta cr$ | lag 1 | 0.1246 *** | 0.0933 *** | 0.1062 *** | 0.1120 *** | 0.0888 *** |
| | | (0.0163) | (0.0153) | (0.0115) | (0.0235) | (0.0195) |
| | lag 2 | 0.1034 *** | 0.1249 *** | 0.1130 *** | 0.1318 *** | 0.1282 *** |
| | | (0.0152) | (0.0120) | (0.0117) | (0.0193) | (0.0165) |
| | lag 3 | 0.0768 *** | 0.1208 *** | 0.0717 *** | 0.1145 *** | 0.0863 *** |
| | | (0.0139) | (0.0126) | (0.0107) | (0.0197) | (0.0142) |
| | lag 4 | -0.1215 *** | -0.0583 *** | -0.1014 *** | -0.0628 *** | -0.0843 *** |
| | | (0.0134) | (0.0113) | (0.0095) | (0.0182) | (0.0148) |
| $\Delta y$ | lag 1 | 2.1565 *** | 1.1949 *** | 1.8844 *** | 1.6383 ** | 1.1712 *** |
| | | (0.2999) | (0.3707) | (0.4971) | (0.6629) | (0.4300) |
| | lag 2 | 1.4783 *** | 1.2366 *** | 1.5419 *** | 0.7637 | 0.9348 ** |
| | | (0.3406) | (0.3882) | (0.4742) | (0.6240) | (0.4269) |
| | lag 3 | 1.2957 *** | 1.8665 *** | 1.6252 *** | 0.5960 | 1.0064 *** |
| | | (0.3023) | (0.3786) | (0.4496) | (0.6386) | (0.3625) |
| | lag 4 | -0.7158 *** | -0.3996 | -0.2686 | -1.2926 *** | -0.7001 ** |
| | | (0.2312) | (0.2952) | (0.2737) | (0.4561) | (0.2986) |
| $\Delta risk$ | lag 1 | -0.3046 *** | -0.2133 *** | -0.2822 *** | -0.2772 *** | -0.1963 *** |
| | | (0.0164) | (0.0143) | (0.0225) | (0.0331) | (0.0188) |
| | lag 2 | -0.0985 *** | -0.0764 *** | -0.1014 *** | -0.1232 *** | -0.0589 *** |
| | | (0.0122) | (0.0117) | (0.0161) | (0.0314) | (0.0165) |
| | lag 3 | 0.0070 | -0.0256 *** | 0.0017 | -0.0342 | -0.0055 |
| | | (0.0101) | (0.0100) | (0.0134) | (0.0252) | (0.0138) |
| | lag 4 | 0.1087 *** | 0.0508 *** | 0.0996 *** | 0.0480 *** | 0.0700 *** |
| | | (0.0073) | (0.0063) | (0.0097) | (0.0173) | (0.0101) |
| *bcar* | lag 1 | 0.0012 | 0.0013 *** | 0.0044 *** | 0.0003 *** | 0.0009 *** |
| | | (0.0064) | (0.0001) | (0.0011) | (0.0001) | (0.0001) |
| constant | - | -0.0012 *** | -0.0004 | -0.0005 | 0.0007 | -0.0003 |
| | | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0004) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.307 | 0.444 | 0.349 | 0.651 | 0.523 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| lags of IVs | | 2-7 | 2-7 | 2-7 | 2-7 | 2-7 |
| no of observations | | 5434 | 6006 | 5434 | 4859 | 5522 |
| no of banks | | 247 | 273 | 247 | 221 | 251 |

**Table A5: Estimation results from regressions with double interactions, reduced sample (75 % of loan market), *mp* = 3-month interest rate**

Coefficients and standard errors of the bank individual income and risk variable multiplied by 100.
Standard errors in parenthesis (coefficients and standard deviations taken from 2nd step results).
*** Significance on 1%-level, ** Significance on 5%-level , * Significance on 10%-level.
**Time dummies included.**

| variable: | bcar1: / bcar2: | regression d5 (*siz* / *liq*) | regression d6 (*cap* / *liq*) |
|---|---|---|---|
| $\Delta mp \cdot bcar1_{-1}$ | lag 1 | -0.1521 *** (0.0070) | 0.0595 *** (0.0067) |
| | lag 2 | 0.0773 *** (0.0060) | -0.0043 (0.0062) |
| | lag 3 | 0.0521 *** (0.0102) | -0.0529 *** (0.0074) |
| | lag 4 | 0.0743 *** (0.0104) | 0.1796 *** (0.0081) |
| $\Delta mp \cdot liq_{-1}$ | lag 1 | 0.0108 *** (0.0016) | 0.0125 *** (0.0013) |
| | lag 2 | 0.0142 *** (0.0013) | 0.0161 *** (0.0011) |
| | lag 3 | 0.0046 *** (0.0018) | -0.0126 *** (0.0016) |
| | lag 4 | 0.0002 ** (0.0017) | 0.0069 *** (0.0011) |
| $\Delta mp \cdot bcar1_{-1} \cdot liq_{-1}$ | lag 1 | 0.0124 *** (0.0008) | -0.0241 *** (0.0011) |
| | lag 2 | 0.0105 *** (0.0007) | 0.0026 *** (0.0009) |
| | lag 3 | -0.0058 *** (0.0009) | -0.0095 *** (0.0011) |
| | lag 4 | 0.0050 *** (0.0009) | 0.0202 *** (0.0011) |
| $\Delta cr$ | lag 1 | 0.0564 *** (0.0076) | 0.0967 *** (0.0087) |
| | lag 2 | 0.1045 *** (0.0067) | 0.1605 *** (0.0073) |
| | lag 3 | 0.1064 *** (0.0077) | 0.1343 *** (0.0075) |
| | lag 4 | -0.0734 *** (0.0068) | -0.0300 *** (0.0074) |
| $\Delta y$ | lag 1 | 1.0265 *** (0.3664) | 0.5070 (0.3945) |
| | lag 2 | 1.0745 *** (0.3707) | -0.0263 (0.3530) |
| | lag 3 | 1.6280 *** (0.3382) | 0.8273 *** (0.3225) |
| | lag 4 | -0.0211 (0.2414) | -0.3351 (0.2482) |
| $\Delta risk$ | lag 1 | -0.1168 *** (0.0389) | -0.1770 *** (0.0442) |
| | lag 2 | -0.0201 (0.0315) | 0.0264 (0.0342) |
| | lag 3 | 0.0078 (0.0264) | 0.0489 * (0.0270) |
| | lag 4 | 0.0853 *** (0.0188) | 0.0350 * (0.0197) |
| *bcar1* | lag 1 | -0.0195 *** (0.0041) | 0.0130 *** (0.0008) |
| *liq* | lag 1 | 0.0020 *** (0.0001) | 0.0011 *** (0.0001) |
| *bcar1·liq* | lag 1 | -0.0001 *** (0.0000) | 0.0003 *** (0.0000) |
| constant | | -0.0015 *** (0.0003) | -0.0017 *** (0.0003) |
| AR1 (p-val,1st step) | | 0.000 *** | 0.000 *** |
| AR2 (p-val,1st step) | | 0.602 | 0.970 |
| Sargan (p-val, 2nd step) | | 1.000 | 1.000 |
| lags of IVs | | 2-5 | 2-5 |
| No of observations | | 5698 | 6622 |
| No of banks | | 259 | 301 |

## Bibliography

**Angeloni, I/Buttiglione, L/Ferri, G/Gaiotti, E (1995):** The *Credit channel* of Monetary Policy across Heterogenous Banks: The Case of Italy; in: *Temi di discussione de Servizio Studi* 256, Banca d´Italia.

**Arellano, M/Bond, S (1991):** Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations; in: *The Review of Economic Studies* 58, 277-297.

**BIS (1995)**: Financial Structure and the Monetary Policy Transmission Mechanism; Bank for International Settlements - Monetary and Economic Department, C.B. 394, March 1995.

**Bernanke, B S/Blinder, A S (1988)**: Credit, Money, and Aggregate Demand; in: *American Economic Review* 78/2, May 1988, 435-439.

**Bernanke, B S/Gertler, M (1995)**: Inside the Black Box: The *Credit channel* of Monetary Policy Transmission; in: *Journal of Economic Perspectives* 9/4, 27-48.

**Bernanke, B S/Mihov, I (1995)**: Measuring Monetary Policy; in: NBER Working Paper No. 5145, June 1995.

**Bernanke, B S/Mihov, I (1996):** What does the Bundesbank target?; in: NBER Working Paper No. 5764, September 1996.

**Carlino, G A/DeFina, R H (1996):** Does Monetary Policy Have Differential Regional Effects?; in: *Federal Reserve Bank of Philadelphia Business Review*, March/April 1996, 17-27.

**Cecchetti, S G (1995):** Distinguishing Theories of the Monetary Transmission Mechanism; in: Federal Reserve Bank of St. Louis Review, May/June 1995, 83 - 100.

**Clarida, R /Gertler, M (1997):** How The Bundesbank Conducts Monetary Policy; in: Romer/ Romer (eds.): Reducing Inflation; University of Chicago Press, Chicago.

**deBondt, G J (1999):** Financial Structure and Monetary Transmission in Europe – A Cross-Country Study; Doctoral Dissertation, Universiteit van Amsterdam.

**Dedola, L/Lippi, F (2000):** The Monetary Transmission Mechanism: Evidence from the Industry Data of Five OECD Countries; mimeo, Banca d´Italia.

**Deutsche Bundesbank (2001):** Bank balance sheets, bank competition and monetary policy transmission; in: *Monthly Report the Deutsche Bundesbank*, September 2001.

**____________(2000):** The relationship between bank lending and the bond market in Germany; in: *Monthly Report the Deutsche Bundesbank*, January 2000, 33-47.

**Doornik, J A/Arellano, M/Bond, S (1999):** Panel Data Estimation using DPD for Ox; mimeo.

**Dornbusch, R/Favero, C A/Giavazzi, F (1998):** Immediate Challenges for the ECB: Issues in Formulating a Single Monetary Policy; in: *Economic Policy* 26, 15-64.

**Ehrmann, M/Gambacorta, L/Martinez-Pages, J/Sevestre, P/ Worms, A (2001)**: Financial systems and the role of banks in monetary policy transmission in the euro area; in: European Central Bank Working Paper Series, forthcoming.

**Ehrmann, M/Worms, A (2001)**: Interbank lending and monetary policy transmission: Evidence for Germany; European Central Bank Working Paper No. 73, July 2001.

**Faust, J (1998):** The robustness of identified VAR conclusions about money; in: *Carnegie-Rochester Conference Series on Public Policy*, December 1998, 207-244.

**Farinha, L/Marques, R C (2001)**: The bank lending channel of monetary policy: identification and estimation using Portuguese micro bank data; in: European Central Bank Working Paper Series, forthcoming.

**Favero, C A/Giavazzi, F/Flabbi, L (1999):** The Transmission Mechanism of Monetary Policy in Europe: Evidence from Bank´s Balance Sheets; in: NBER working paper No. 7231.

**Ganley, J/Salmon, C (1996):** The industrial impact of monetary policy; in: *Bank of England Quarterly Bulletin*, August 1996, 288-298.

**Guender, A/Moersch, M (1997)**: On the Existence of a *Credit channel* of Monetary Policy in Germany; in: *Kredit und Kapital* 30, 173-185.

**Guiso, L/Kashyap, A K/Panetta, F/Terlizzese, D (1999):** Will a common European monetary policy have asymmetric effects? in: *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. 23, 56-75.

**Hayo, B/Uhlenbrock, B (1999):** Industry effects of monetary policy in Germany; in: ZEI Working Paper No B14/1999, University of Bonn.

**Hubbard, H G (2000):** Capital-market imperfections, investment, and the monetary transmission mechanism; paper presented at the Bundesbank spring conference „Investing Today for the World of Tomorrow“, 28/29 April 2000.

**Hülsewig, O/Winker, P/Worms, A (2001):** Bank lending in the transmission of monetary policy: A VECM analysis for Germany; in: International University in Germany Working Paper 08/2001, Bruchsal.

**Kakes, J/Sturm, J-E (2001):** Monetary policy and bank lending – Evidence from German banking groups; mimeo. De Nederlandsche Bank, January 2001.

**Kashyap, A K/Stein, J C (2000):** What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?; in: *American Economic Review* 90/3 (June 2000), 407-428.

____________ **(1995):** The Impact of Monetary Policy on Bank Balance Sheets; in: *Carnegie-Rochester Conference Series on Public Policy* 42 (June 1995), pp. 151-195.

**King, S R (1986)**: Monetary Transmission: Through Bank Loans, or Bank Liabilities?; in: *Journal of Money, Credit, and Banking* 18/3, August 1986, 290-303.

**Kishan, R P/Opiela, T P (2000):** Bank Size, Bank Capital, and the Bank Lending Channel; in: *Journal of Money, Credit, and Banking* 32/1, 121-141.

**Küppers, M (2000)**: Banken in der geldpolitischen Transmission; Schriften zur angewandten Wirtschaftsforschung 86, Mohr-Siebeck, Tuebingen.

**McCallum, B T (1999):** Analysis of the Monetary Transmission Mechanism: Methodological Issues; CEPR/European Summer Institute Conference, Sept. 1999.

**Müller, M/Worms, A (1995)**: Targeting Monetary Aggregates, Interest Rate Movements, and Credit Demand; in: Geld - Währung - Kapitalmarkt Working Papers No. 38; University of Frankfurt/M., February 1995.

**Nickell, S (1981)**: Biases in Dynamic Models with Fixed Effects; in: *Econometrica* 49, 1417-1426.

**Peek, J/Rosengren, E S (1995):** Bank Lending and the Transmission of Monetary Policy; in: Peek/Rosengren (eds): Is Bank Lending Important for the Transmission of Monetary Policy?; Federal Reserve Bank of Boston Conference Series No 39 (June 1995), 47-68.

**Ramaswamy, R/Sloek, T (1998):** The Real Effects of Monetary Policy in the European Union: What are the differences? in: *IMF Staff Papers* 45/2, June 1998, 374-391.

**Ramey, V (1993)**: How important is the *credit channel* in the transmission of monetary policy?; in: *Carnegie-Rochester Conference Series on Public Policy* 39, 1-45.

**Romer, C D/Romer, D H (1990)**: New Evidence on the Monetary Transmission Mechanism; in: *Brookings Papers on Economic Activity* 1/1990, 149-213.

**Rudebusch, G D (1996):** Do measures of monetary policy in a VAR make sense?; in: *Temi di discussione de Servizio Studi* 269, Banca d´Italia.

**Samolyk, K A (1994):** Banking conditions and regional economic performance – Evidence of a regional *credit channel*; in: *Journal of Monetary Economics* 34, 259-278.

**Sims, C A (1996):** Macroeconomics and Methodology; in: *Journal of Economic Perspectives* 10/1, 105-120.

**Smets, F/Wouters, R (1999):** The exchange rate and the monetary transmission mechanism in Germany; in: *De Economist* 147 (4), pp. 489-521.

**Stöß, E (1996):** Enterprises´ financial structure and their response to monetary policy stimuli – An analysis based on the Deutsche Bundesbank´s corporate balance sheet statistics, Deutsche Bundesbank Discussion Papier No. 9.

**Tsatsaronis, C (1995):** Is there a credit channel in the transmission of monetary policy? Evidence from four countries; in: BIS(ed): Financial Structure and the Monetary Policy Transmission Mechanism, Basle, pp. 154-187.

**Uhlig, H (1998):** The robustness of identified VAR conclusions about money – A comment; in: *Carnegie-Rochester Conference Series on Public Policy*, December 1998, 245-263.

**Upper, C/Worms, A (2001)**: Estimating bilateral exposures in the German interbank market: is there a danger of contagion?; in BIS (ed.): Marrying the macro- and micro-prudential dimensions of financial stability, BIS papers No 1, pp.211-229.

**Worms, A (1998):** Bankkredite an Unternehmen und ihre Rolle in der geldpolitischen Transmission in Deutschland; Peter Lang-Verlag, Reihe Europäische Hochschulschriften, Reihe V: Volks- und Betriebswirtschaft, No. 2244.

**Worms, A (2001):** Monetary policy effects on bank loans in Germany: A panel-econometric analysis; Economic Research Centre of the Deutsche Bundesbank Discussion Paper, forthcoming.

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