Monetary policy effects on bank loans in Germany: A panel-econometric analysis

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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 is. This result is robust against a broad variety of changes in the specification. A dependence on its size can be found only 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*, although it is weakened by the banks´ liquidity management.

JEL-code: C23, E52, G21
Keywords: monetary policy transmission, credit channel, dynamic panel data

Zusammenfassung

Eine wesentliche Bedingung für die Existenz eines durch Bankkredite wirkenden Kreditkanals ist, dass geldpolitische Maßnahmen das Bankkreditangebot verändern. Dieses Papier trägt zur Diskussion über diese Fragestellung bei, in dem es empirische Evidenz aus dynamischen Panelschätzungen präsentiert, die auf Bilanzdaten aller deutschen Banken basieren. Das Papier zeigt, dass die durchschnittliche Bank ihre Kreditvergabe in Reaktion auf eine restriktive geldpolitische Maßnahme um so stärker reduziert, je geringer der Anteil der von ihr gehaltenen kurzfristigen Interbankdepositen an ihrer Aktivsumme ist. Dieses Resultat ist robust hinsichtlich einer Vielzahl von Änderungen in der Schätzspezifikation. Eine Abhängigkeit der Reaktion von der Größe einer Bank kann nur dann festgestellt werden, wenn dieser dominierende Einfluß der kurzfristigen Interbankdepositen explizit berücksichtigt wird und/oder wenn die kleinen Banken von der Untersuchung ausgeschlossen werden. Alles in allem ist diese Evidenz kompatibel mit der Existenz eine Kreditkanals, obwohl dieser durch das Liquiditätsmanagement der Banken geschwächt wird.

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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. The existence of such a transmission channel has major implications for monetary policy. First, 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, such as 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 sharply declining income that accompanies it tends, other things being equal, to put interest rates under downward pressure.[1] As a result, the interest-rate level alone may be an insufficient indicator of 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 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]

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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 ceteris paribus causes interest rates to rise) but also - via the *credit channel* - a leftward shift of the IS curve (which ceteris paribus 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 a priori unclear.

[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, for example, 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).

Given such important practical implications, evidence of the existence of a *credit channel* is, fundamentally, of great interest for the monetary policy making of the Eurosystem. It may have a bearing on, for instance, the choice of possible monetary policy indicators, on the interpretation of the movements of monetary aggregates and, possibly, also on the creation of inflation forecasts.

This paper uses information from individual bank balance sheets and applies panel-econometric techniques to exploit the heterogeneity among banks in order to undertake an empirical analysis of the possible existence of a *credit channel* in Germany. In respect of the previous literature, the present paper contains four innovations: (1) It 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 movements; (4) the paper takes account of the institutional structure of the German banking system.

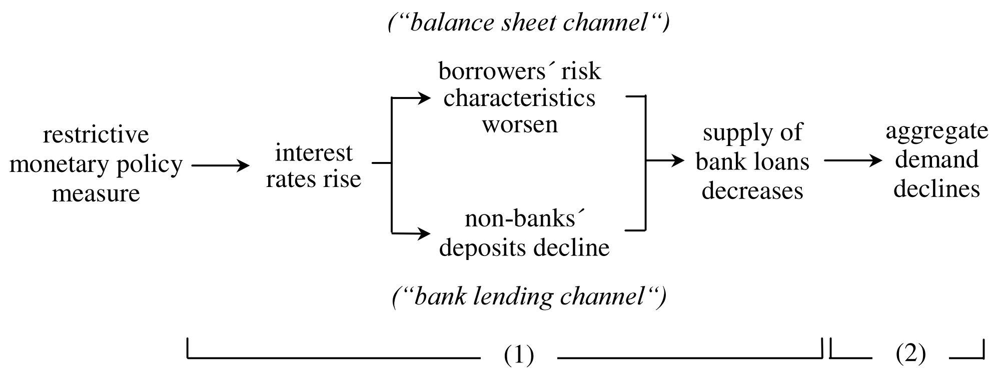
The main findings are that the average bank's reaction to monetary policy does not depend directly on its size, but rather on its share of short-term interbank deposits in total assets. A significant size effect can be found only when controlling for this dominating influence. This result is interpreted as evidence supporting the existence of the *credit channel,* although – given the dominating influence of short-term interbank deposits – it can be described as being only of "second order importance". Therefore, the pattern of divergence in the reaction to monetary policy seems to be more complicated than is usually assumed in large parts of the literature.

The present paper is structured as follows: The following section outlines the *credit channel* theory and reviews the relevant existing literature. Section III presents descriptive evidence of bank loans in Germany and of the structure of the German banking system. Section IV presents the estimation methodology and highlights the assumptions underlying the hypothesis tests. After a description of the database and a discussion of necessary data transformations (section V), the basic estimation results are presented in section VI. Section VII presents the results of some robustness checks. Section VIII presents the conclusions.

II The credit channel theory

Figure 1 shows that – according to the *credit channel* theory – bank loan supply may be affected by monetary policy via two closely related "subchannels": the *"bank* *lending channel"* and the *"balance sheet channel"*. According to the balance sheet channel, an interest-rate increase induced by monetary policy worsens the risk characteristics of potential borrowers by reducing the present value of assets used as collateral.[4] Such a reduction may be caused by an increase in the discount rate applied to expected future payments and/or by a reduction in the expected payments themselves via other transmission channels (e.g. the cost of capital and/or the exchange rate channel). Since this argument relates to all forms of external funding, it also applies to bank loans: Banks may reduce their lending in periods of restrictive monetary policy since their expected losses from defaults increase.[5]

Figure 1: Stylised description of monetary transmission through bank loan supply within the *credit channel* theory



The "pecking-order hypothesis", which is closely linked to the balance sheet channel through the assumption of asymmetric information in financial markets, states that firms initially use up their internally generated funds before they ask for external funding.[6] Since an (unexpected) interest-rate increase brought about by monetary

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[4] An additional way might be by affecting the average probability of default, but this effect is not much emphasised by the relevant literature.

[5] The connection between a company’s balance-sheet appearance and its ability to obtain funds (or to bear the associated costs) also forms the basis of what is known as the "financial-accelerator" approach, according to which (irrespective of monetary policy considerations) cyclical fluctuations in the value of assets eligible as collateral lead to a reinforcement of cyclical upward and downward movements. According to the "financial-accelerator" approach, an economic slowdown tends to result in (i) a deterioration in a company’s balance-sheet position, and thus in its scope for obtaining external funds and (ii) in a weakening of its capacity to generate internal funds. Both factors lead to a reduction in corporate expenditure and thus contribute to reinforcing the economic slowdown (see, for example, Bernanke, B.S./Gertler, M./Gilchrist, S.(1996)).

[6] See Myers, S.C./Majluf, N.S. (1984) and Fazzari, S.M./Hubbard. R.G./Petersen, B.C. (1988). For an overview, see, for example, Myers, S.C. (2001), especially pp. 91-95.

policy may lead to an (unexpected) increase in the interest costs faced by enterprises – where the size and time patterns of this effect depend on the maturity structure of the outstanding debt and the degree of diffusion of interest-rate-related derivatives – their ability for internal funding will, other things being equal, decrease as a result.[7] Ceteris paribus, i.e. given constant expenditures, they will be forced to expand external funding. A *restrictive* monetary policy may thus have a positive effect on loan demand – and thereby *increase* lending. In principle, however, this "perverse" effect should become less important over time since an adaptation of expenditures is then to be expected, resulting in a lower loan demand. This dependence of loan demand on internal funds is known as the "cash-flow effect" and is the most convincing explanation for the often-found positive correlation between the interest-rate level and the rate of growth of the loan volume.[8]

Table 1: Empirical literature on the *credit channel* for Germany

study	method	
Tsatsaronis (1995)	VAR	no evidence in favor of a *credit channel*
Stöß (1996)	descriptive	
Guender/ Moersch (1997)	VAR	
Favero, Giavazzi & Flabbi (1999)	cross-section analysis	
Küppers (2001)	SVAR	
Worms (1998)	SVAR	results consistent with a *credit channel*
DeBondt (1999a)	VECM	
DeBondt (1999b)	panel analysis	
Kakes & Sturm (2001)	VECM	
Hülsewig, Winker & Worms (2001)	VECM	

The *bank lending channel* assumes restrictive monetary policy to reduce the liquidity of the entire commercial banking system or to make the procurement of liquidity associated with lending more costly. Typically, it is assumed that non-banks withdraw reservable deposits from banks because they reorganise their portfolios after a policy-induced interest rate increase (i.e. money demand is assumed to decrease in response to

[7] See, for example, Gertler, M./Gilchrist, S.(1994), esp. p. 311.

[8] See, for example, Müller, M./Worms, A. (1995) for descriptive evidence. Impulse responses with such an intial positive reaction of loans to a restrictive monetary policy shock can be found in Bernanke, B.S./Gertler, M. (1995), particularly page 44, for the US, and in Worms, A. (1998) for Germany.

a restrictive monetary policy). If this reduction in deposits cannot be neutralised by increasing other liabilities vis-à-vis non-banks or by reducing assets other than bank loans, it will decrease a bank's ability to grant loans, i.e. monetary policy will change loan-supply.

So far, empirical evidence of a *credit channel* in Germany is inconclusive, irrespective of methodology or of the type of data used (see table 1). While Tsatsaronis (1995), Stöß (1996), Guender & Moersch (1997), Favero, Giavazzi & Flabbi (1999) and Küppers (2001)[9] do not find a *credit channel* in Germany, Worms (1998), deBondt (1999a, 1999b), Kakes & Sturm (2001) and Hülsewig, Winker & Worms (2001) find evidence in support of a *credit channel.*

This ambiguity in the results reflects the fundamental problem of empirical research on this issue: the identification of monetary-policy-induced shifts in loan supply. To tackle this identification problem, the early empirical studies on the *credit channel* looked at the timing of macroeconomic variables, such as the money stock and/or real GDP. An example is that of testing whether aggregate deposits (monetary aggregates) or aggregate bank loans provide a better forecast of future income. This approach is based on the assumption that, given that bank loan *supply* plays an active role in monetary policy transmission, bank loans should react initially following a monetary policy measure and that only afterwards would (deposits and) GDP move. Conversely, if changes in the volume of bank loans are due mainly to demand effects, (the volume of deposits and) GDP should react initially and only then bank loans.[10]

Nevertheless, the finding that deposits have a higher predictive power for future GDP than loans is also compatible with an active role of bank loan *supply* in monetary transmission: Frictions such as contractual commitments and/or credit lines imply that the supply of bank loans, i.e. an asset position of the bank balance sheet, cannot react as quickly to monetary policy measures as the volume of deposits, i.e. a liability position. Even if there were no structural dependence between deposits (i.e. the money stock) and GDP, but merely between the supply of bank loans and GDP, it would have to be expected for this reason that the predictive value of deposits is higher than that of bank loans solely on account of the lead time of the former.[11]

[9] In his conclusion, Küppers (2001) interprets his own results as being in favor of the credit channel theory. But, this conclusion is based on impulse-response functions with very large confidence intervals.
[10] See, for example, King, S.R. (1986), Romer, C.D./Romer, D.H. (1990) and Ramey, V. (1993).
[11] See Bemanke, B.S. (1993) and Gertler, M./Gilchrist, S. (1994).

The discussion in the past ten years or so has shown that movements in the aggregate volume of loans may essentially be interpreted both as supply and demand induced. For that reason, the empirical *credit channel* literature also analyses microdata – balance-sheet data of individual banks and/or enterprises, for example – or data that were aggregated merely to the level of certain groups of economic agents.[12] This strategy is based on the idea that, if the theoretical foundations of the *credit channel* are valid, certain economic agents should react more strongly to monetary policy measures than others. More specifically: if a bank´s reaction to monetary policy depends on a bank-individual factor that is related to loan supply and not to loan demand, then a differential loan reaction across banks that depends on this factor indicates a loan supply effect of monetary policy.[13] Typically, bank size is used as the identifying variable. This idea is based on the assumption of severe information difficulties implying that small banks have more problems than large banks in attracting funds. Therefore, small banks should be forced to reduce their *supply* of loans more sharply than large banks in periods of restrictive monetary policy. Hence, the empirical result that the volume of loans of small banks reacts more strongly than that of large banks is perceived as an indication of the existence of a loan *supply* effect induced by monetary policy. This empirical test does not require a control for shifts in (the level of) the demand for funds – which is necessary in the case of aggregate data – but only a control for possible *differential* shifts in the demand for funds across banks. Typically, it is therefore assumed that monetary policy does not lead to a differential loan demand reaction across banks.

Table 2 provides an overview of the major empirical literature on the bank lending channel based on microdata from bank balance sheets.[14] This shows which identifying variables were used in the cited papers to solve the supply-demand identification problem. Besides bank size, the degree of liquidity and capitalisation are also used (see column "identification assumptions with regard to loan supply"): The underlying assumption is that a bank's loan supply reacts all the more strongly to a monetary policy measure, the smaller it is and/or less liquid it is and/or the weaker its capitalisation is.

[12] For an overview, see, for example, Cecchetti, S. (2001).

[13] See, for example, Kashyap, A.K./Stein, J.C./Wilcox, D.W. (1993) and Gertler, M./Gilchrist, S. (1994).

[14] There is another strand of literature, which is based on data on individual enterprises rather than microdata on banks. With regard to Germany, see Kalckreuth, U.v. (2001). See also Kremp, E./Stöss, E./Gerdesmeier, D. (1999), although there is no direct reference to transmission issues.

Table 2: Empirical literature on the bank lending channel, based on microdata from bank balance sheets

paper	coun-try	description of database: sample period, max. number no of periods	description of database: no of banks and observations	estimation method	identification assumptions with regard to: monetary policy	identification assumptions with regard to: loan supply	remarks, drawbacks, data manipulation	does credit channel exist?
Kashyap/ Stein (1995)	USA	Fed-call reports: 76-92 quarterly 66	banks: 14,280 (in 1984:2) observations: 3,360 (balanced)	time-series regression for each category of banks; comparison of the estimated coefficients	Δ**i** or growth in "core deposits" (for size category), **narrative** Romer dates	**small** banks reduce their holdings of securities more sharply than **big** banks	data selection biased towards big banks, data source was designed for regulatory purposes	Yes
Kashyap/ Stein (2000)	USA	Fed-call reports: 76-93 quarterly 70	banks: 11,206 (in 93:2) observations: 96,1530 (unbalanced)	2-stages: (1) cross-sectional analysis for each size category and period, (2) coefficients resulting from (1) as dependent variable in time series regression	**Δi,** Boschen/Mills-**narrative** indicator, **i-shocks** from SVAR	**illiquid** (small) banks reduce their lending more sharply than **liquid** (small) banks.		Yes
Peek/ Rosen-gren (1995)	USA	Fed-call reports: 76-94 quarterly 75	banks: n.a. (no savings banks) observations: n.a.	classification by banks: restricted and unrestricted in capital; time-series regression (OLS, 2SLS) for each category and comparison of the coefficients	**Δ(Federal Funds Target Rate)**	banks not restricted in **capital** reduce their lending less sharply than capital-restricted banks		Yes
Angeloni et al (1995)	IT	87-93 monthly	banks: 40 (no long-term credit banks) observations: 3,360 (balanced)	comparison of VAR impulse response functions for different types of banks	**i–shocks** from VAR	2 classifications: (1) **big/small** banks; (2) banks with **large** and **small loan sizes**	only 2 categories; uses information on bank lending rates; assumes triangular structure to identify VAR; uses information on concentration	Yes
deBondt (1999b)	DE, UK, IT, BE, NL, FR	BankScope: 90-95 annual 6	banks: 55(NL)–1,129(DE) observations: 224(NL)-3,044(DE) (unbalanced)	panel estimation: random and fixed-effects models	ΔΔ**i** or specific policy rule (based on **MCI**)	changes in loan demand are captured by flows in **aggregated income**; apart from that, **liquidity** and **size**	data with low-frequency, selection of data biased towards big banks; bank mergers not taken into account	Yes: DE, BE, NL No: FR, IT, UK

This possibility of identifying supply movements comes with a drawback, however. When using only disaggregated data it is no longer possible to directly measure the level effect of the *credit channel* (or its relative importance to other transmission channels) without making further assumptions. Hence, microdata is mainly used for testing only the first of the two necessary conditions for the existence of the *credit channel*, which are (see (1) and (2) in figure 1):

(1) The central bank is able to influence the *supply* of bank loans, and

(2) *bank loans are not substitutable* (at least for some economic agents).

(1) has the effect that, following a restrictive monetary policy measure, (at least some) borrowers are faced with a reduced *supply* of bank loans. (2) implies that this has an impact on their expenditure behavior. Although (2) is held to be less controversial in the literature[15], when interpreting the results of the present paper it should nevertheless be borne in mind that they cannot be regarded as strict evidence for or against the existence of a *credit channel.* The present paper, instead, concentrates on assumption (1). It is possible, for instance, that the central bank is indeed able to reduce the supply of bank loans by means of a restrictive monetary policy measure, but that (2) does not hold empirically. In that case, economic agents can easily compensate for a reduction in their banks´ supply of loans by increasing the use of other financial resources, say, by expanding trade credit, the issuance of negotiable instruments, or loans from other banks.

It is instructive for the preceding econometric analysis to look more closely at the role of non-banks´ deposits. Figure 1 shows that – according to the *credit channel* theory – bank loan supply is affected by monetary policy in terms of altering the risk characteristics of potential borrowers and/or non-banks' deposits held with banks. Therefore, it is only for one part of the *credit channel*, namely the bank lending channel, that a monetary-policy-induced reduction of deposits is a necessary condition. On the macroeconomic level, such a reduction of non-banks' deposits in reaction to a restrictive monetary policy action is well documented in the empirical money demand literature.[16] While such an aggregate reduction in deposits is necessary for the bank lending channel to work, it is not a necessary condition that deposits react differently across banks. Even if a possible differential reaction with bank loans comes from the bank lending channel (and not the balance sheet channel), it does not have to be caused

[15] See, for example, Freixas, X./Rochet, J.-C., p. 165.

[16] For a general overview and results for the euro-area, see, for example, Deutsche Bundesbank (2001b) and Brand, C./Cassola, N. (2000). Specifically for Germany, see, for example, Scharnagl, M. (1998).

by a differential reduction in deposits: Banks may nevertheless be forced to reduce their lending differently, because they differ in their ability to offset a homogenous reduction in deposits (for example, due to differences in their ability to raise other means of finance or to reduce some of their other assets).

Therefore, this paper does not explicitly analyse whether monetary policy causes differential effects on deposits across banks but concentrates instead on differential effects on bank loans. Such an analysis would go beyond the question analysed in this paper, which looks for loan supply effects of monetary policy. Given the existence of a differential effect of monetary policy on bank loans, such an analysis of deposits could yield additional information on what may cause such an effect. Analysing this question is left to future research.

III Descriptive Evidence

There are specific features of the German financial system that may be important when analysing the *credit channel.* One is that the volume of bank loans to firms and households increased relative to GDP during the 1990s: Starting from 50 % for firms and 27 % for households (incl. non-profit organisations) in 1991, these ratios reached 60 % (firms) and 44 % (households) in 2000. Other things being equal, this indicates a growing potential for a *credit channel* that works through bank loans.

Another key feature is that bank loans are a very important means of finance in Germany: households raise funds to finance consumption exclusively in the form of loans, with bank loans making up nearly 94 % as at the end of 1998.[17] Moreover, 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 %).[18] But, this share has decreased substantially over time: from an average of 48 % between 1991 and 1993 it fell to almost 37 % between 1997 and 1999.

This overall declining trend is the result of an ongoing securitisation process. However, it is important to mention that this trend is almost entirely due to the financing behavior of the very large firms: Figure 2 shows the ratio of bank loans to the balance-sheet total for firms of different size groups.[19] This ratio has increased for small and medium-sized firms. The only group for which this ratio has not increased is the group of very

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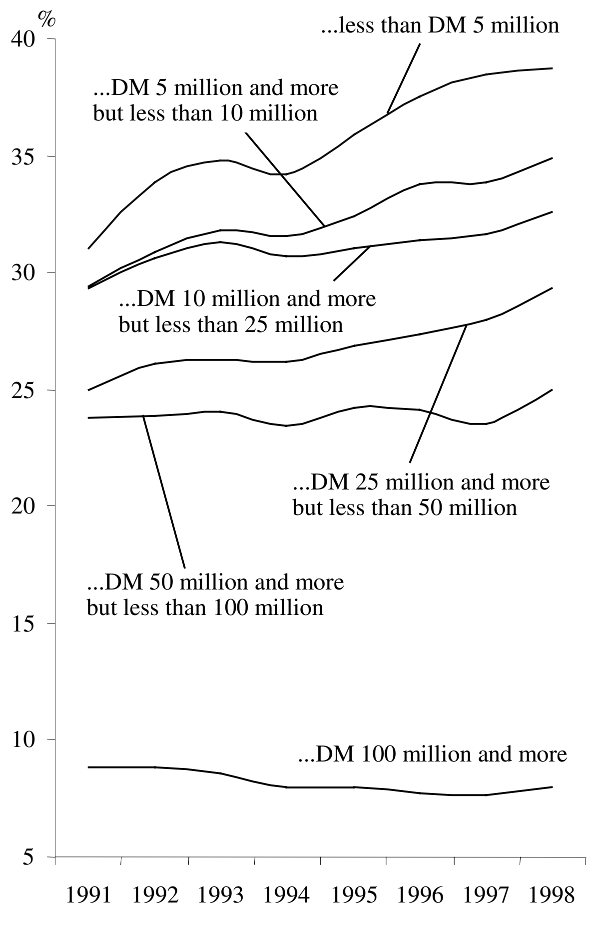
[17] See, for example, Deutsche Bundesbank (2000), p. 34.
[18] See, for example, Deutsche Bundesbank (2000). Note that these numbers are based on flow data.
[19] See Deutsche Bundesbank (2001c).

large firms: Here, the ratio decreased from 9 % in 1991 to 8 % in 1998. 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 3 presents some key numbers on the structure of the German banking system. 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 ("Grossbanken"), the head institutions of the savings bank sector and of the cooperative sector, the foreign banks and the private banks – represent only around 12 %. Despite this comparatively small number of institutions, this latter group holds almost three-quarters of all bank assets, while the many credit cooperatives together hold only 10 % (column 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).

Figure 2: Bank lending by size of enterprise*
as % of balance sheet total

Enterprises with an annual turnover of...



* A comparable group of enterprises from the producing sector, wholesale and retail trade and transport.
Source: Deutsche Bundesbank, Monthly Report, September 2001.

Table 3: Structure of the German banking system (December 1998)[20]

quartiles 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	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 bank´s sector and the cooperative sector could both be described as being relatively closed systems:[21] As far as their interbank relationships are concerned, the cooperative banks and – to a lesser degree – the savings banks transact mainly with the central institutions of their own system (which are the *Landesbanken* in case of the savings banks and the cooperative central banks in case of the 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 banks) vis-à-vis domestic banks that do not belong to their own system. Both

[20] 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.

[21] For a description, see Upper, C./Worms, A. (2001a), especially tables 2a and 2b, and Ehrmann, M./Worms, A. (2001).

systems therefore incorporate some sort of "internal interbank market", with the central institutions providing their respective systems' links to the outside.

Table 3 additionally contains information on the size structure of the German banking system. The grouping is based on quartiles of the distribution of total assets across all banks, resulting in four groups of equally large size (in terms of the number of banks). 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 percentile 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 which 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 their share of lending in total assets, at an average of 27 % is much lower than that of the smaller banks, and even much lower than that of the top quartile of the largest banks to which they likewise belong (column 6).

More generally, lending business to domestic private non-banks seems to be of much greater importance for the small and medium-sized banks, i.e. for credit cooperatives and for savings banks, than it is 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 the case of the smaller banks is the result of a steady increase during the 1990s (1991: 53 %), while, in fact, this ratio decreased for the large banks during the same period (1991: 41 %).

Therefore, parallel to the growing importance of bank loans as a means of 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. These observations are 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 certain borrower groups, it appears that savings banks and credit cooperatives give a greater share of their assets in the form of loans to those borrowers that can be assumed to be small or medium-sized on average: 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 with 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.

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 the "other banks" (although this hypothesis cannot be strictly tested with the available data).[22] 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* (see condition (2) in figure 1).

IV Estimation methodology

Given the problems of identifying monetary-policy-induced loan *supply* shifts with macrodata, the empirical analysis in this paper is based on 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 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 of a bank's ability to generate outside financing: The idea is that small banks have more difficulties in raising funds because they face higher information costs, and therefore a higher external finance premium, than large banks. Hence, they are less able to offset contractionary monetary policy measures and have to reduce their loan supply more strongly than large banks in this case.[23]

Another indicator that has been used in the literature is a bank´s capitalisation.[24] The idea is based on the argument that a higher capitalisation makes a bank less prone to

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[22] For the US, see Hubbard, G.D. (2000).
[23] See, for example, Kashyap, A.K./Stein, J.C. (2000, 1995).
[24] See, for example, Kishan, R.P./Opiela, T.P. (2000) and Peek, J./Rosengren, E.S. (1995).

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 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 (1992-1998) is characterised by a declining 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 lead to a positive dependence of a bank's reaction to monetary policy on its capitalisation – which is also the result predicted by the *credit channel*. However, this argument cannot be applied directly to the case of a *restrictive* monetary policy measure, which is the scenario usually underlying the *credit channel.*

Therefore, rather than capitalisation, bank size is the preferred indicator of the degree to which a bank suffers from informational problems, since 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, some regression results based on capitalisation are also presented below, but without further interpretation. This is done mainly to create comparability with studies that have used such an indicator for the identification of monetary policy's loan supply effects.

A bank's degree of liquidity may also play a role in determining its reaction to monetary policy measures, because a bank should be more able to shield its loan portfolio from a restrictive monetary policy measure, the more liquid assets it can draw on.[25] However, liquidity (like capitalisation) may be endogenous with respect to the factors for which it should serve as an indicator: 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

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

and, therefore, 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 also does not serve well as the discriminating variable for identifying supply effects.

Therefore, the general strategy of the subsequent empirical analysis is to test for a differential response of bank loans to monetary policy across banks of different size. Despite the above-listed problems with using capitalisation and liquidity as indicators to identify loan supply effects, we do not exclude the possibility that these variables have an influence on a bank´s reaction to monetary policy. The 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 loan market model:[26]

$$\begin{aligned} \Delta \log C_{n,t} &= \alpha_n + \sum_{k=0}^{K_1} \varphi_k \cdot \Delta \log C_{n,t-k} + \sum_{k=0}^{K_2} \beta_k \cdot \left(bcar_{n,t-k} \cdot \Delta mp_{t-k} \right) \\ &+ \sum_{k=0}^{K_3} \lambda_k \cdot bcar_{n,t-k} + \sum_{k=0}^{K_4} \mathbf{\Phi}_k \cdot \Delta \mathbf{X}_{n,t-k} + d_t + \varepsilon_{n,t} \end{aligned} . \qquad (1)$$

$C_{n,t}$ is the stock of loans to domestic private non-banks of bank n in quarter t (Δ 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. Equation (1) allows for a bank specific fixed-effect, i.e. a bank-specific constant α_n (which amounts to a bank-specific trend in $C_{n,t}$).

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) and is therefore allowed to vary across banks and over time. This linear dependence 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 possible direct effects of this variable on $\Delta \log C_{n,t}$ being captured by the β 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

[26] For more details, see Ehrmann, M. et.al (2001).

of the interaction term is not statistically different from zero, then there is no differential loan reaction to monetary policy across banks, i.e. the proposed 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 (for example, the business cycle, the level of interest rates, inflation, etc.) on $\Delta \log C_{n,t}$. This is most effectively done by including a complete set of time dummies d_t. While this is accompanied by the drawback that the (average) level effect of monetary policy is also captured by these dummies, i.e. that mp_t cannot be included as such, it guarantees a perfect control for the time effect on the endogenous variable and thereby enhances the power of our hypothesis test.[27] Moreover, (1) can then be interpreted as the reduced form of a broad variety of structural 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 (combinations) 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:

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

[27] 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 with time series are presented below, in section VII (see also Ehrmann et al. (2001) for a comparable set of results).

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 paid to the bank in case of a (exogenous) default, where, typically, net worth serves as the indicator for this amount (see figure 1). Including $risk_{n,t}$ as an explanatory variable may capture a possible differential reaction of banks´ loan supply to monetary policy 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. However, in accordance with most of the relevant literature, I assume below that the effect of monetary policy on $risk_{n,t}$ is only of minor relevance (in comparison with the influence of exogenous changes in default risk on loans).

A priori, it is unclear how loan growth depends on changes in $risk_{n,t}$ and $y_{n,t}$ in the short run: If the "cash-flow effect" dominates in the short-run, 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 that expenditures are relatively fixed (which is realistic in the short-run). A similar argument could apply to the risk variable: If the default risk of the loan portfolio increases, 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. The coefficients of the lower-order lags of $risk_{n,t}$ should be positive in this case. 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 unambiguous and can therefore be used as a device to judge the adequacy of the estimation results: 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 α_n in equation (1) takes the form of a bank individual constant. In order to be able to estimate an equation with N such varying constants, α_n is removed from the estimation equation by taking first differences of (1).[28] Owing to

[28] Another way of eliminating the fixed effect is to substract individual means ("within-transformation"). Usually, taking first differences is preferred in the literature, because the instrumentalisation with lagged variables in a within transformation needs a much stronger exogeneity assumption than is the case for 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

the dynamic nature of the model, however, this creates a correlation between the lagged-endogenous variables and the error term, leading to biased and inconsistent OLS estimates.[29] Therefore, the GMM method proposed by Arellano & Bond (1991) will be applied subsequently.[30] Here, the lagged levels of the regression variables are used as instrumental variables.

Liquidity is defined as the ratio of liquid assets $la_{n,t}$ to total assets $A_{n,t}$ (in percent, see appendix 1):

$$liq_{n,t} = 100 \cdot \frac{la_{n,t}}{A_{n,t}} - \left[\frac{1}{T} \cdot \sum_{t=1}^{T} \frac{1}{N_t} \cdot \sum_{n=1}^{N_t} 100 \cdot \frac{la_{n,t}}{A_{n,t}} \right]. \tag{4}$$

$la_{n,t}$ is the sum of those assets that can easily be liquidated by the bank and mainly consists of cash and balances with the central bank (7 % on average across all banks and periods), short-term interbank deposits (32 %), debt securities (58 %) and shares (3 %, for more information, see also appendix 1).The capitalisation variable is constructed in the same way, using the bank´s capital $cp_{n,t}$ instead of liquid assets:

$$cap_{n,t} = 100 \cdot \frac{cp_{n,t}}{A_{n,t}} - \left[\frac{1}{T} \cdot \sum_{t=1}^{T} \frac{1}{N_t} \cdot \sum_{n=1}^{N_t} 100 \cdot \frac{cp_{n,t}}{A_{n,t}} \right]. \tag{5}$$

The size variable is the sum of total assets $A_{n,t}$ taken as a logarithm:

$$siz_{n,t} = \log A_{n,t} - \left[\frac{1}{N_t} \cdot \sum_{n=1}^{N_t} \log A_{n,t} \right]. \tag{6}$$

All three bank characteristics are demeaned in order to obtain *bcar* variables with a sum across all included observations of zero. This guarantees that the *ß*´s in equation (1) are not influenced by the level effect of *mp* on loan growth. In case of the size variable (equation (6)), 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

original disturbances. Then, for a variable to be a valid instrument, it has to be strongly exogenous, which is a stronger assumption which is much less likely to be satisfied.

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

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

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 (equations (4) and (5)). This creates bank characteristics that are zero across all observations, but not necessarily at every single period t. This allows the overall degree of liquidity and capitalisation to vary across t.

V Data

The monthly balance-sheet data available for this analysis spans the period 1992-1998[31] and comprises all German banks (around 4400).[32] As quarterly macrodata and information from the quarterly borrowers statistics of the Deutsche Bundesbank have also been used (for calculating the income and risk indices, for example), quarterly values were taken by using end-of-quarter values. Accordingly, there are 28 observations for a bank that is in the database over the entire period under analysis, and almost 100,000 observations are available.

V.1 The nature of balance-sheet data

Owing to the fact that the individual variables are based on balance-sheet data, a specific endogeneity problem emerges: If bank loans and other balance-sheet positions 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 (1991) 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:

$$\begin{aligned} \Delta \log C_{n,t} &= \alpha_n + \sum_{k=1}^{4} \varphi_k \cdot \Delta \log C_{n,t-k} + bcar_{n,t-1} \cdot \sum_{k=1}^{4} \beta_k \cdot \Delta mp_{t-k} \\ &+ \lambda \cdot bcar_{n,t-1} + \sum_{k=1}^{4} \mathbf{\Phi}_k \cdot \Delta \mathbf{X}_{n,t-k} + d_t + \varepsilon_{n,t} \end{aligned} . \qquad (1a)$$

[31] There was a change in data definitions created by the harmonisation procedure in the run-up 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.

[32] The analysis does not use information on bank-individual interest rates, because such information is available only for a comparatively small number of banks (only 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 the banks' interest rates for given categories of loans and deposits.

The endogeneity/exogeneity-issue then hinges on a timing assumption: The driving forces behind loan growth are correctly identified if loans are "Granger-caused" by those factors.

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 the estimation equation, only one lag of $bcar$ instead of four enters the regression at t (see equation (1a)) Therefore, at a given quarter t, the four interaction terms consist of $bcar_{n,t-1}$ and the respective lags of Δmp_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 additionally included in a non-interacted fashion.

V.2 Bank mergers

A potential problem is posed by the large number of bank mergers that took place during the observation period. Table 4 shows that this phenomenon was a major factor chiefly in the cooperative sector, where over 80 % of all bank takeovers occured.

Table 4: Take-overs and liquidations of German banks within the sample period (January 1992 and December 1998, based on monthly data)

	total no of banks		taken over		liquidated	
savings banks	735	(17 %)	150	(14 %)	0	(0 %)
credit cooperatives	3,151	(72 %)	**906**	**(82 %)**	4	(4 %)
“other banks”	505	(12 %)	54	(5 %)	107	(96 %)
Total	4,391	(100 %)	**1,110**	**(100 %)**	111	(100 %)

Within the systematic of the banking statistics of the Bundesbank, a merger of two banks generally leads – among other things – to two changes: (a) one bank drops out of the sample and (b) the second bank remains in the sample and the balance sheet positions of the excluded bank are added to this bank. Hence, the balance sheet positions of the remaining bank “jump” to the new level in the month after the merger.

Basically, three methods of treating bank mergers in the context of this paper exist:

(1) *Ignoring the existence of bank mergers, i.e. leaving the sample as it is.* This may be adequate with regard to the data if the variables are defined as ratios (e.g. percent of total assets) rather than as stocks or changes in stocks.

(2) *The bank merger is notionally transferred to the start of the sample period* by summing the balance-sheet items of the merging parties also for the time before the merger.

(3) The merging banks are eliminated from the sample following the bank merger and *the merged bank is considered as a newly created one,* i.e. as being completely independent of its predecessors.

Table 5: Assumption structure for dealing with bank mergers[33]

		(b) Is the receiving bank´s individual effect allowed to change after the merger? No	Yes
(a) Have the individual effects of the merging banks been identical before the merger?	Yes	**Procedure 2:** *"Bank mergers already occured in t_0"*	
	No	**Procedure 1:** *"Bank mergers ignored"*	**Procedure 3:** *"A new bank emerges from the bank merger"*

Each of these three methods entails an implicit assumption with regard to the unobservable characteristic of the individual banks (such as the quality of the management, the bank strategy, etc.) which in the panel estimation is reflected by the "bank-individual effect" α_n (see equation (1a)). For example, procedure 2 restricts the individual effects of the merging banks to the same value over the entire observation period. In terms of the unobservable individual characteristics, they are thus assumed to be identical. This contrasts with procedure 3 where each of the merging banks is allowed to have its own individual effect, i.e. its own (unobservable) characteristic. Another implication of procedure 3 is that the new bank is given its own individual effect, which may be different from the individual effects of one of the preceding banks (as is the case in procedure 1) or from the average of the preceding banks (as is the case in procedure 2).

These considerations indicate that procedures 1 to 3 can be categorised in terms of the answers to two questions on the bank-individual effects α_n:

[33] The fourth box of the table is characterised by the following combination: the individual effects of the merging banks are identical before the merger and the individual effect of the newly created bank is different from these. This combination could imply that two identical banks merge in order to reach a size that allows them to change their (unobservable) characteristics afterwards. This motive does not seem to be very realistic, at least not in the German case. It will therefore not be considered below.

(a) Have the individual effects of the merging banks been identical before the merger?
(b) Is the receiving bank's individual effect allowed to change after the merger?

The resulting categorisation shows that procedures 2 and 3 are diametrically opposed to each other in terms of their assumption structure (see table 5). This is interesting, because the structure of assumptions listed in table 5 may follow from the specific motives for the observed bank mergers: It is compatible with procedure 2 if the mergers were mainly carried out to achieve economies of scale, since approximately identical banks (i.e. banks with the same individual effect α_n) merge to reduce the average costs per unit of output, i.e. they merge in order to increase their size. By contrast, procedure 3 is the adequate treatment of mergers if the main motive for the merger was to achieve economies of scope, since different banks (i.e. banks with different individual effects) merge in order to broaden their spectrum of activities in order to realise advantages of combining these different characteristics.

Which of these two motives was likely to be more responsible for the bank mergers that took place in Germany is not evident *a priori.*[34] Nevertheless, despite the fact that much attention was given to a number of mergers which, according to official pronouncements, were intended to combine different areas of operation – especially mergers of large banks – most mergers, namely those between small and comparatively homogeneous credit cooperatives were probably carried out for reasons of economies of scale. This is also in line with the view of the Banking Supervision Committee (BSC) which comes to the conclusion that economies of scale are the main rationale for mergers among smaller banks (to which many of the savings banks and almost all cooperative banks belong), whereas the comparatively few large-bank M&As often reflect a repositioning of the institutions involved.[35] Therefore, the following estimations will be based on data to which procedure 2 has been applied. In order to check the robustness of the main results with respect to the merger procedure, the main regressions will be repeated on the basis of procedures 1 and 3 (see section VII.2).

Applying procedure 2 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.

[34] For an analysis of the reasons for mergers among German cooperative banks, see Lang, G./Welzel, P. (1999) and also European Central Bank (2000).
[35] For the report of the the BSC, see European Central Bank (2000), especially p. 21.

V.3 Outliers

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 periods. 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 of eliminating "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.

The choice of the critical values is made by visual inspection: In the case of $\Delta \log C$ the 2nd and the 98th percentile prove to be adequate; in the case of all *bcar* variables the 1st and the 99th percentile are sufficient. In the case of bank size, the outlier procedure is based on Δsiz (rather than on *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. Every bank that has at least one outlier in either $\Delta \log C$ or the respective *bcar*-variable is eliminated from the sample. The number of observations and banks varies across regressions due to the fact that the outlier procedure is regression-specific in the sense that it has only been applied to $\Delta \log C$ and the respective *bcar* variable(s): if, for example, we test for size effects, 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. "*Is a bank´s reaction determined by its size?*"), i.e. that are independent of possible other issues (e.g. "*Is a bank´s reaction determined by its degree of liquidity?*").

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.

V.4 Bank-specific seasonal patterns

There are several indications of the existence of strong bank-specific individual seasonal patterns: First, regressions based on annual growth rates prove to be better in terms of instrumentalisation and robustness than regressions based on first differences; Second, this is also true when regressions are based on annualised data. Third, estimating equation (1a) including seasonal dummies for every single bank individually, results in a broad variety of different seasonal patterns.

If these bank-individual seasonal patterns are not properly accounted for, they tend to worsen the quality of possible instruments and lead to a low degree of robustness of the results with respect to changes in the specification. More importantly, 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 problem, all bank-specific variables that enter the regressions are seasonally adjusted on an individual basis by applying the following simple MA procedure:

(a) for every quarter q, quarterly indices $s_{n,q}$ are computed as the centered moving average of the respective variable $x_{n,t}$ ($T_{n,q}$ is the number of observations of bank n in quarter q, q = 1...4):

$$\tilde{s}_{n,q} = \frac{1}{T_{n,q}} \cdot \sum_{t_{n,q}=1}^{T_{n,q}} \frac{4 \cdot x_{n,t}}{0.5 \cdot x_{n,t+2} + x_{n,t+1} + x_{n,t} + x_{n,t-1} + 0.5 \cdot x_{n,t-2}}; \quad (7)$$

(b) these quarterly indices are adjusted so that they multiply to one:

$$s_{n,q} = \frac{\tilde{s}_{n,q}}{\sqrt[4]{\tilde{s}_{n,1} \cdot \tilde{s}_{n,2} \cdot \tilde{s}_{n,3} \cdot \tilde{s}_{n,4}}}; \quad (8)$$

(c) the original values of variable $x_{n,t}$ are divided by $s_{n,q}$ to obtain the seasonally adjusted series.

This procedure has been applied bank-individually to $\Delta \log C_{n,t}$, $risk_{n,t}$, $y_{n,t}$ and all $bcar_{n,t}$ variables.The resulting seasonal-adjusted values are used in the subsequent regressions.

VI Estimation results

VI.l Size, liquidity and capitalisation

In the basic specification, the three-month interest rate is used as the indicator of monetary policy. Table 6a presents the results for each of the three bank characteristics: In regression 1 size (*siz*), in regression 2 liquidity *(liq)* and in regression 3 capitalisation *(cap)* are used. The long-run coefficients of the respective interaction term, of the income variable and of the risk variable are reported (all short-run coefficients are reported in appendix 2).

The statistical tests indicate an adequate instrumentalisation in all cases.[36,37] Moreover, in no case do the long-run coefficients of the control variables show a significantly

[36] Ideally, the instruments should be highly correlated with the variables for which they serve as instruments, while they should be uncorrelated with the disturbances. This can be assessed on the basis of autocorrelation (AR) tests and the Sargan Test. In order to find the adequate lag length for the instrumental

unexpected sign: Only in regression 2 (liquidity) is the coefficient of the income variable insignificant.

Table 6a:
Long-run coefficients from basic regression, *mp* = three-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)
Δy	[+]	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.[38]

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 directly depend on its size – which is contrary to what the *credit channel* theory would predict and also contrasts with the results of the existing empirical literature on the US and on many

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 (for example, 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.

[37] In almost all of the following regressions, the p-value of the Sargan test is one or close to one. This is probably due to the comparatively large set of instrument variables used in the GMM estimations. Reducing the number of instruments generally produces unsatisfactory results, such as a negative sum of the coefficients of the lagged endogenous variable or insignificance (or wrong signs) of the coefficients of the control variables. Obviously, the dynamic structure of the model is relatively complex (which is – among other things – due to the quarterly frequency of the data) and can therefore only be adequately captured by a very rich set of instruments. Further regressions show that this problem is exacerbated by the inclusion of a set of time dummies. Nevertheless, the AR tests do not indicate a misspecification.

[38] Inferences on the coefficients should normally be based on the first step results of the GMM-estimation, but, owing 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 owing to the large number of banks in the sample.

other countries.[39] 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 decrease of the volume of loans in reaction to a one percentage-point increase in *mp* will on average be 0.035 percentage-points smaller if the liquidity ratio of a bank increases by one unit. 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.

It is also interesting to take a look at the short-run coefficients (see table Al in appendix 2), because they can give an indication of the control of possible loan *demand effects.* In all regressions reported in table A1, the four coefficients of the income variable 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 (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, such a mixture of positive and negative effects could explain the insignificance of the income coefficients in the early quarters. It is only after some time that the cash-flow effect loses its strength 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.*.Owing to the decreasing importance of this short-run "perverse" *demand* reaction coming from the cash-flow effect, the income coefficient does not become significantly positive 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 owing to an increasing *demand* for loans cannot be confirmed by these regressions.

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[39] See table 2 and, for example, deBondt, G.J. (1999).

The results therefore 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.

VI.2 Short-term interbank deposits

The result that size is not crucial 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 3, the small banks mainly consist of credit cooperatives and – to a lesser extent – savings banks. Besides these comparatively small institutions, the savings banks sector as well as the cooperative sector also contain large superordinate central institutions.[40]

As pointed out in section III, these central institutions maintain close relationships with the lower-level institutions of their own system and with the "other" 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, if monetary policy is restrictive, funds are channelled from the central institutions to their affiliated small institutions, thus 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 systems.[41] 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.

This feature explains two of the regression results presented in table 6a: Firstly, the interbank flows from large to small banks can be the reason for bank size not being 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 offset possible bank-size related effects completely. Secondly, given that the liquidity variable used in regression 2 contains short-term interbank deposits (see appendix 1 for the exact definition), it could well be that the significant

[40] The central institutions of both sectors belong to the 5 % largest banks (Deutsche Bundesbank (2001 c)).
[41] See Ehrmann, M./Worms, A. (2001).

relationship between the banks' liquidity and their reaction to monetary policy is mainly driven by short-term interbank deposits.

Table 6b:
Long-run coefficients from basic regression, *mp* = three-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)
Δy	[+]	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.

In order to test this hypothesis, the liquidity variable is split 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 – in total assets, *oli:*[42]

$$ibk_{n,t} = 100 \cdot \frac{sid_{n,t}}{A_{n,t}} - \left[\frac{1}{T} \cdot \sum_{t=1}^{T} \frac{1}{N_t} \cdot \sum_{n=1}^{N_t} 100 \cdot \frac{sid_{n,t}}{A_{n,t}} \right], \tag{9}$$

$$oli_{n,t} = 100 \cdot \frac{la_{n,t} - sid_{n,t}}{A_{n,t}} - \left[\frac{1}{T} \cdot \sum_{t=1}^{T} \frac{1}{N_t} \cdot \sum_{n=1}^{N_t} 100 \cdot \frac{la_{n,t} - sid_{n,t}}{A_{n,t}} \right]. \tag{10}$$

Repeating the regressions with these two components as the bank characteristic variables yields the results presented in table 6b. Again, the control variables show

[42] *ibk* and *oli* are deviations from the overall mean (as is the case for the liquidity variable).

significantly the expected signs. While the long-run coefficient of the interaction term is significantly positive in case of the interbank variable (regression 4), it is significantly negative in the case of the "other liquid assets" (regression 5). Despite the fact that the latter result is difficult to explain at first glance[43], it nevertheless strongly indicates that the significantly positive coefficient of the liquidity-interaction term presented in table 6a (regression 2) is mainly driven by the movements of short-term interbank deposits. Obviously, on average, banks do 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 loans.

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

Given the strong evidence in favor of short-term interbank deposits, the weak result especially for bank size leads to the following question: Is there a size effect if we control for the influence of *ibk*? In order to test for this, the estimation equation is enhanced to include both interaction terms, size and short-term interbank deposits. In contrast to equation (1a) this extended equation therefore does not only contain one "single-interaction" term but two, *mp·siz* and *mp·ibk.* Moreover, the respective "double-interaction term" *mp·siz·ibk* has to be included additionally to allow for possible second order effects. Furthermore, *siz*, *ibk* and *siz·ibk* are also included:

$$\begin{aligned}\Delta\log C_{n,t} &= \alpha_n + \sum_{k=1}^{4}\varphi_k \cdot \Delta\log C_{n,t-k} + siz_{n,t-1} \cdot \sum_{k=1}^{4}\beta_{1,k} \cdot \Delta mp_{t-k} \\ &+ ibk_{n,t-1} \cdot \sum_{k=1}^{4}\beta_{2,k} \cdot \Delta mp_{t-k} + \left(siz_{n,t-1} \cdot ibk_{n,t-1}\right) \cdot \sum_{k=1}^{4}\beta_{3,k} \cdot \Delta mp_{t-k} \\ &+ \lambda_1 \cdot siz_{n,t-1} + \lambda_2 \cdot ibk_{n,t-1} + \lambda_3 \cdot \left(siz_{n,t-1} \cdot ibk_{n,t-1}\right) + \sum_{k=1}^{4}\mathbf{\Phi}_k \cdot \Delta\mathbf{X}_{n,t-k} + d_t + \varepsilon_{n,t}\end{aligned} \quad . \quad (1b)$$

Table 7 presents the results of estimating this “double-interaction” equation (regression dl). The coefficients of the control variables *Δy* and *Δrisk* are significant and show the expected signs. The coefficient of the *ibk*-interaction is significantly positive as in all previous regressions. This again shows the strength of this effect.

[43] Splitting *oli* into its components reveils that the negative coefficient is mainly driven by debt securities which make up more than 80 % of the assets contained in *oli*. One factor behind the negative sign could be that some of the debt securities on the balance sheet of a bank have already been pledged as collateral in repo-operations with other banks and are therefore no longer available for a further procurement of funds. See Upper, C./Worms, A. (2001b).

Table 7:
Long-run coefficients from regressions with double interactions,
***mp* = three-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	regression d2	regression d3
	bcar1:	*siz*	*cap*	*liq*
	bcar2:	*ibk*	*ibk*	*ibk*
$\Delta mp \cdot bcar1_{-1}$	[?]	0.1011 *** (0.0258)	0.1221 *** (0.0464)	0.0091 (0.0383)
$\Delta mp \cdot ibk_{-1}$	[?]	0.0988 *** (0.0093)	0.0775 *** (0.0112)	0.1814 *** (0.0059)
$\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$	[?]	0.0088 * (0.0049)	0.0157 * 0.0090	-0.0026 *** (0.0009)
Δy	[+]	0.9958 ** (0.4218)	0.7762 (0.7109)	0.3738 (0.6291)
$\Delta risk$	[–]	-0.7778 *** (0.1028)	-0.3950 *** (0.1604)	-0.3703 ** (0.1594)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.263	0.559	0.619
Sargan (p-val, 2nd step)		1.000	1.000	1.000
lags of IVs		2-6	2-5	2-5
No of observations		51597	52334	52422
No of banks		2353	2386	2390

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

Interestingly, the size-interaction term is now significantly positive (instead of insignificant in table 6a). 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 less restrictively to a restrictive monetary policy measure, the higher are its short-term interbank deposits *and* the larger it is, which is consistent with the *credit channel* theory. However, given that such a positive coefficient of the size-interaction term does not show up in the single-interaction regression presented in table 6a, it may be interpreted as being dominated by the influence exerted by *ibk.* Hence, the regressions presented in table 6a obviously suffer from a strong omitted variable bias.

Another interesting result is the insignificance of the coefficient of the double interaction with *mp.* This 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: A certain combination of *siz* and *ibk* implies a specific reaction of loans to changes in *mp,* i.e. a specific (overall) 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 7 also contains the results of using *ibk* and *cap* simultaneously (regression d2). Here again, the interaction term with short-term interbank deposits is positive, which adds to the impression that this effect is very strong. Additionally, the coefficient of the *cap* interaction term is significantly positive (as in table 6a): Other things being equal., loans of well capitalised banks decline less strongly than loans of less capitalised banks if interest rates are increased.[44]

Another possible combination of two bank-characterising variables is *ibk* and *liq,* which can be interpreted as a test for the dominance of the *ibk* over *liq:* Given the results from the "'single-interaction" regressions, the "weaker" of the two should drop out if it does not contain additional information. Table 7 shows that the coefficient of the *liq* interaction is indeed insignificant (regression d3). This indicates that *ibk* dominates *liq,* i.e. for the average bank *liq* does not contain relevant information that is not already contained in *ibk.* Only the double-interaction term with monetary policy is signifianctly negative. This indicates that the effect of short-term interbank deposits on a bank's reaction to monetary policy decreases with an increasing degree of liquidity, i.e. the more other liquid assets the bank has.

VII Robustness checks

VII.1 Changing 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. This is due to the fact that a central bank does not act in isolation from all other variables of interest but reacts to (some of) them. Such a more or less complex "reaction function" causes a measurement problem with regard to the effects of monetary policy. Based on the assumption that the effects of endogenous and exogenous monetary policy measures are identical, this measurement problem can be obviated by assessing the monetary policy effect on the basis of *exogenous* central

[44] The estimation of the"triple-interaction" equation that simultaneously contains the respective variables for size, short-term interbank deposits and capitalisiation was not feasible, because no adequate set of instrumental variables could be found for applying the Arellano & Bond (1991) procedure.

bank measures ("interest-rate shocks").[45] This, in turn entails a problem of identification of its own, however: the separation of endogenous and exogenous interest-rate changes.

The literature proposes several alternatives for solving this problem, some of which can be found in the overview of the literature in table 2 (see column "identification assumptions with regard to monetary policy"). One is based, for example, on the assumption that the searched-for exogenous component of the interest rate is its *unexpected* part. If it is possible to determine the expected short-term interest rate on the basis of financial market data, this information could be used to calculate the exogenous component of the interest rate.[46] Possible variables which could serve as indicators here are forward rates, because they can ultimately be regarded as a "bet" on future interest rate trends. However, for the case at hand this strategy comes with a major drawback: if, for example, there is a difference between the expected and the realised interest rate due to the unexpected movement of a third variable, say, the exchange rate *e,* the problem of identification of exogenous monetary policy measures remains if the relationships between *e,* the policy instrument, and the other (macro)variables of interest are not considered explicitly. This problem is all the more severe, the lower the frequency of the data used. With the quarterly frequency of the data at hand, possible "third variables" have three months time to change between the statistical record of the forward rate and the realisation of the respective interest rate. Owing to the fact that this is a rather long time span – given that interest rates (and exchange rates) change much faster – the difference between the lagged forward rate and the realisation of the respective interest rate in the next quarter is probably a bad indicator of the unexpected component in the in the interest rate.

An alternative method is the "narrative approach", which tries to find a yardstick for the exogenous interest-rate measures in statements made by central banks or their representatives – as they appear, for example, in speeches, publications and reports.[47] As has been repeatedly discussed in the literature[48], however, this method entails specific serious problems in addition to those attached to most other approaches:

[45] This does not imply an assumption that endogenous central bank measures do not have any impact. It only means that the aforementioned measurement problem does not exist for exogenous central bank measures.

[46] See, for example, Bagliano, F.C./Favero, C.A. (1999) and Rudebusch, G.D. (1996).

[47] For the US, see Boschen, J.F./Mills, L.O. (1991) and Romer, C.D./Romer, D.H. (1989). For Germany, see Tsatsaronis, C. (1993), Maier, P. (2000, 1999) and Worms, A. (1998), particularly pp. 256.

[48] See, for example, McCallum, B.T. (2001), Leeper, E.M. (1996), Uhlig, H. (2001) and Christiano, L.J. (2001).

Firstly, it is difficult to exactly express the degree of restriction of monetary policy using such a discontinuous variable.[49] Secondly, the analysis has to rely on the "narrative sources", such as interviews given by central bank representatives (central bank reports, minutes of meetings, etc.) which are not necessarily homogeneous and which need not correspond to the actual actions taken by the central bank, especially, for example, if the central bank uses some kind of "information policy". Thirdly, empirical studies on the quality of the narrative indicators show that many of their movements are endogenous and that they therefore do not possess significant information advantages over other methods or over the interest rate itself.[50]

Another method is to simply *assume* a specific reaction function of the central bank, e.g. a Taylor rule or a MCI-based rule.[51] This strategy comes with the problem that this reaction function has to be a sufficiently good description of the central bank's policy rule. An alternative that implies much fewer a priori restrictions is to *estimate* the reaction function, for example, within a VAR-framework. Here, the "interest rate shocks" are interpreted as the exogenous interest-rate component. They indicate the deviation of the actual interest rate from the estimated central bank reaction.[52] Based on the fact that the use of an estimated reaction function of the central bank is probably the most prominent alternative used in the literature (besides using the interest rate as such), and given the problems that are inherent in the other methods discussed above, the estimations will be repeated below using VAR shocks as the monetary policy indicator in order to check the robustness of the results obtained so far.

The respective VAR contains a world commodity price index, US real GDP, the US short-term interest rate and a linear trend as exogenous variables. Endogenous variables are German real GDP, consumer prices, the three-month interest rate and the real effective exchange rate.[53] The VAR allows for a contemporaneous response of the interest rate to the exchange rate and is therefore much more realistic than many of the

[49] For an overview and a graph, see Boschen, J.F./Mills, L.O.(1995).
[50] See, for example, Leeper, E.M. (1997).
[51] See Taylor, J.B. (1993) and Deutsche Bundesbank (1999).
[52] See, for example, Sims, C. (1996), Uhlig, H. (1998) and Bernanke, B.S./Mihov, I. (1995). Bemanke, B.S./Mihov, I. (1996) and Clarida, R./Gertler, M. (1997) refer especially to the Bundesbank's policy.
[53] 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.

VARs for Germany that may be found in the existing literature. Moreover, it is able to generate impulse response functions that do not entail a "price puzzle".[54]

Table 8:
Long-run coefficients from regressions with double interactions, various robustness checks

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 d4	regression d5	regression d6	regression d7
			alternative treatment of mergers		
		monetary policy indicator based on VAR-shock °	Procedure (1): "*Bank mergers ignored"*	Procedure (3): "*New bank created"*	exclude time dummies, include time series
$\Delta mp \cdot siz_{-1}$	[?]	-0.0225 (0.0000)	0.0966 *** (0.0370)	0.0774 (0.0504)	0.1440 *** (0.0315)
$\Delta mp \cdot ibk_{-1}$	[?]	0.0196 *** (0.0000)	0.0866 *** (0.0129)	0.0767 *** (0.0162)	0.1087 *** (0.0118)
$\Delta mp \cdot siz_{-1} \cdot ibk_{-1}$	[?]	0.0063 ** (0.0000)	0.0156 *** (0.0064)	0.0443 *** (0.0092)	0.0120 * (0.0063)
Δy	[+]	0.5799 (0.4327)	1.0237 * (0.5653)	-0.6125 (1.4528)	1.7932 ** (0.8328)
$\Delta risk$	[–]	-0.8107 *** (0.1029)	-0.3421 ** (0.1319)	-0.3525 (0.3994)	-0.3892 ** (0.1724)
Δmp	[–]				-1.5497 *** (0.1705)
Δy^{aggr}	[?]				0.1179 (0.1095)
Δp^{aggr}	[+]				5.9586 *** (0.6573)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.622	0.793	0.771	0.327
Sargan (p-val, 2nd step)		1.000	1.000	1.000	1.000
lags of IVs		2-7	2-6	2-3	2-6
no of obs		49258	49738	28766	49241
no of banks		2353	2526	1644	2353

° Coefficients of the interaction terms in case of VAR-shock (regression d4) multiplied by 100.
See table A3 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

The residuals of the short-term interest rate equation are interpreted as the exogenous interest-rate component: $mp_t = i_t - \hat{i}_t^{VAR} = \hat{u}(i)_t^{VAR}$.[55] Tables A4a and A4b (see appendix 2) present the results from reestimating the single-interaction equation (1a)

[54] See, for example, Worms, A. (1998), especially 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).

[55] The VAR-shocks are available only 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.

with this alternative monetary policy indicator. The tests indicate an adequate instrumentalisation in all cases. The income variable is insignificant in the cases of size and liquidity, but significantly positive in all other cases. The risk variable has a significantly negative sign in all regressions. Moreover, in all cases (with the possible exception of the *siz* regression), the size of the coefficients of the income and risk variables is fairly similar to those presented in tables 6a and 6b.

A comparison of table A4b and tables 6a/6b shows that the signs of the coefficients of the interaction-terms are robust with respect to a change of the *mp*-variable in the case of *liq* and *ibk.* This, and the fact that the coefficient of the *oli*-interaction in regression 10 is insignificant, further add to the impression that short-term interbank deposits play the crucial role in determining the average bank's reaction to monetary policy.

The coefficient of the interaction term with *siz* becomes significantly negative when basing *mp* on the VAR-shock, which is the opposite of what the *credit channel* theory would predict: According to this result, large banks restrict their lending more strongly in reaction to a restrictive monetary policy measure than small banks (in the case of *cap* the coefficient of the interaction-term becomes insignificant).

Restimating the double-interaction regression dl of table 7 with the VAR shock as the monetary policy indicator confirms the dominance of short-term interbank deposits once again: the coefficient of the *ibk*-interaction term is significantly positive (regression d4 in table 8). But, contrasting regression dl, there is no significant influence of size. Therefore, the significantly positive size effect found when controlling for short-term interbank deposits (table 7) is not robust against this change in the monetary policy indicator.

However, 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 assumptions.[56] One of the most critical is probably that the estimated exogenous (i.e. unexpected) changes in the interest rate should have the same effects as the endogenous (i.e. expected) 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 VAR-specification, the lack of robustness with respect to the monetary policy indicator may not be of great concern.

[56] For criticism of VAR approaches to measure monetary policy effects see, for example, McCallum, B.T. (2001), Faust, J. (1998) and Rudebusch, G.D. (1996).

In order to determine the "adequate" method of measuring monetary policy, these drawbacks have to be weighted against the endogeneity/exogenity-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 the central bank to change the interest rate) and that *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 the preferred measure of monetary policy, the three-month interest rate.

VII.2 Changing the treatment of mergers

In section V.2 several alternative methods for the treatment of bank mergers were presented and discussed. Based on the argument that the most probable motive for the majority of mergers has been the attempt to realize economies of scale, procedure 2 has been chosen for the basic regressions. However, given that alternative motives with different implications for the bank individual effect could have been relevant as well, the robustness of the main results of regression d1 in table 7 is tested by applying procedures 1 and, alternatively, procedure 3 to the data.

Tables A5a/A5b (appendix 2) present the results of the single-interaction estimations when mergers are completely ignored (procedure 1). These estimations lead to results which are not very different from the estimations based on procedure 2 (tables 6a/6b): The results with respect to the income variable do not differ qualitatively (they do not even differ much with respect to the size of the coefficients). The same is true for the risk variable. In case of *liq*, the coefficient of the income variable becomes significant, while it is insignificant in table 6a. As far as the interaction terms are concerned, the qualitative results from applying procedure 2 can be confirmed in all cases.[57]

Tables A6a/A6b (appendix 2) show the results from the single-interaction regression when a meger creates a completely new bank (procedure 3). Again, the qualitative results with respect to the interaction terms are not very different from those presented in tables 6a/6b: Only in the case of *cap* does the coefficient become insignificant. Also, the results with respect to the risk-variable are robust. Somewhat problematic is the

[57] The number of banks in case of procedure (3) is comparatively small. This is due to the fact that, by assuming that a merger leads to a new bank, many banks are in the sample for only a short period of time (because they disappear after a merger or they are created by a merger), meaning that they do not have enough successive observations to enter the regression.

fact that the long-run coefficient of the income variable becomes insignificant or even significantly negative in all cases. This can hardly be interpreted theoretically.

Table 8 presents the results of reestimating the double intercation equation d1 presented in table 7 for the two alternative treatments of merger (regressions d5 and d6). First of all, the coefficient of the *ibk*-interaction term is significantly positive in both cases, indicating the robustness of this effect and the need to explicitly control for it. While a size effect cannot be found when assuming that a merger creates a new bank (regression d6), it is significantly positive if mergers are simply ignored (d5).

Therefore, the answer to the question of whether a bank's size determines its loan reaction to monetary policy depends on how mergers are treated: If mergers are ignored or if we assume that the merger already took place in the initial period, a size effect cannot be rejected as soon as we control for short-term interbank deposits. If mergers lead to a completely new bank, such a size effect cannot be found.

Below, we assume in accordance with the larger part of the literature, that the lion´s share of mergers took place in order to achieve economies of scale. Based on this assumption, procedure 2 is the adequate method – and a significant size effect in the double-interaction regression results.

VII.3 Including time series variables

Owing to the inclusion of a complete set of time dummies d_t, the preceding estimations were carried out without *mp* as an autonomous variable (see equations (1a) and (1b)). However, in order to test whether the results are robust against a separate inclusion of *mp,* the estimation is repeated without the set of time dummies, d_t. In this instance, however, it is extended not just by *mp* itself, but also by the logarithm of aggregate real GDP y^{aggr} and the logarithm of the aggregate price level p^{aggr} (both in first differences). While in the regressions with time dummies four lags of the right-hand variables suffice to capture the dynamics, in the regressions with time series five lags are needed. In the single-interaction case, therefore, the estimation equation looks as follows:

$$\begin{aligned} \Delta \log C_{n,t} &= \alpha_n + \sum_{k=1}^{5} \varphi_k \cdot \Delta \log C_{n,t-k} + bcar_{n,t-1} \cdot \sum_{k=1}^{5} \beta_k \cdot \Delta mp_{t-k} \\ &+ \lambda \cdot bcar_{n,t-1} + \sum_{k=1}^{5} \mathbf{\Phi}_k \cdot \Delta \mathbf{X}_{n,t-k} + \sum_{k=1}^{5} \gamma_{1,k} \cdot \Delta mp_{t-k} \\ &+ \sum_{k=1}^{5} \gamma_{2,k} \cdot \Delta y_{t-k}^{aggr} + \sum_{k=1}^{5} \gamma_{3,k} \cdot \Delta p_{t-k}^{aggr} + cum(dq_t) + cum(tr_t) + \varepsilon_{n,t} \end{aligned} \quad . \tag{1c}$$

In order to capture at least some "standard time effects", a linear trend tr_t and quarterly seasonal dummies dq_t are also included in the regression equation (they enter (1c) in a cumulated fashion in order to obtain a linear trend and seasonal dummies after differencing once).

The inclusion of *mp* in a non-interacted fashion also yields information on the significance of the overall effect of monetary policy on the loans of the average bank. Although it seems natural to expect a negative sign of the long-run coefficient of *mp* – especially if the evidence based on VARs and theoretical considerations are taken into account – this is not necessarily the case in panel regressions. The reason for this is that large (i.e. macroeconomically very important) and small (i.e. macroeconomically less important) banks enter the panel regression with the same weight: While the macroeconomic evidence may be driven by the small number of large banks, the panel evidence may be driven by the large number of small banks. Therefore, the long-run coefficient of *mp* in the panel regressions is not necessarily informative about the overall macroeconomic effect of monetary policy on aggregate bank loans.

However, as table A7b (see appendix 2) shows, the long-run coefficients of *mp* in the single-interaction regressions are significantly negative in all cases. A higher rate of inflation Δp^{aggr} increases the growth rate of loans in all cases. Aggregate real output growth Δy^{aggr} is insignificant in all regressions – the reason could be that this variable contains no additional information compared with the bank-individual income variable Δy, which is significantly positive in all cases but the *liq* equation (which was also insignificant when time dummies were used, see table 6a). As in all previous regressions, the coefficient of the bank specific risk variable $\Delta risk$ is very robust and significantly negative in all cases.

Moreover, with respect to the coefficients of the interaction terms these results do not differ qualitatively from those obtained in the basic regressions presented in tables 6a/6b, except in one case: The *liq*-interaction term is significantly negative, whereas it is significantly positive when a set of time dummies is used. This negative coefficient is difficult to interpret theoretically. In the case of size there is no significant coefficient, while it is significantly positive in the cases of capitalisation and short-term interbank deposits, and significantly negative in the case of the other liquid assets. The relative similarity in the results between using a set of time dummies and this set of time series indicates that the chosen set of time series (together with the linear trend and the seasonal dummies) is able to capture the time effect on loan growth more or less adequately.

Table 8 shows the results when reestimating the double-interaction regression d1 from table 7. All control variables are significant and show the expected signs, with the exception of the aggregate income variable which is insignificant. As when using time dummies, there is a significantly positive coefficient of both the *ibk*-interaction term and the *siz*-interaction term, confirming the basic results obtained so far.

VII.4 Restricting the sample to large banks

Table 9 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 3). The group of the largest banks that together holds around 25 % of the loan market consists of only 4 banks, whereas the group of the smallest banks consists of 2188 banks.

Table 9: 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 entered the previous regressions with the same weight, i.e. irrespective of their size, it could well be that the results are driven solely by the many very small banks in the sample. In order to test whether 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 6a and 6b 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 “larger banks”, which amount to around 220-270.

Table 10:
Long-run coefficients from regressions with reduced sample,
***mp* = three-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 26 *siz*	regression 27 *liq*	regression 28 *cap*	regression 29 *ibk*	regression 30 *oli*
$\Delta mp \cdot bcar_{-1}$	[?]	0.1257 ** (0.0524)	0.0455 *** (0.0054)	0.3242 *** (0.0263)	0.0351 *** (0.0124)	0.0372 *** (0.0064)
Δy	[+]	5.1608 *** (1.3142)	5.4195 *** (1.7871)	5.9016 *** (1.8431)	2.4208 (2.6355)	3.0885 * (1.6653)
$\Delta risk$	[–]	-0.3521 *** (0.0485)	-0.3679 *** (0.0580)	-0.3483 *** (0.0697)	-0.5487 *** (0.1505)	-0.2441 *** (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 A8 in appendix 2 for the short-run coefficients. Based on results from 2nd estimation step.

Table 10 presents the results: As 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 now significantly positive: This shows that the results for liquidity, capitalisation and short-term interbank deposits presented in tables 6a and 6b hold qualitatively even if the sample is reduced to contain only the larger banks.

Moreover, even those coefficients of 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.[58] This is especially interesting in the case of the size interaction (regression 26): If the very small banks are excluded from the sample, a significant size effect cannot be rejected even in the single-interaction regression.

Obviously, the insignificance of the coefficient of the size-interaction in table 6a has been caused by the very small banks – indicating that they do not behave in the way predicted by the *credit channel* theory. As has already been pointed out in section VI.2, the reason for this is that these banks are mainly credit cooperatives and savings banks

[58] The qualitative results presented in table 6 are robust against using the VAR-shock in all cases except for "other liquid assets".

(see tables 3 and 9) which use their short-term interbank deposits to cushion the effects of monetary policy on their loan portfolio. This is consistent with the fact that these banks hold relatively large buffers of short-term interbank deposits (see table 9): 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 adapt their loan portfolio more strongly. This would also be also consistent with the hypothesis that these banks maintain close housebank relationships with their loan customers (see above, section III). The large share of short-term interbank deposits in the total assets of the group of the "very large" and "large" banks is probably not due to this motive, but rather to their more intensive overall activity in interbank borrowing and lending.[59]

Table 11:
Long-run coefficients from regressions with reduced sample, double interactions, *mp* = three-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 signs]	*bcar1:* *bcar2:*	regression d8 *siz* *ibk*	regression d9 *siz* *liq*
$\Delta mp \cdot siz_{-1}$	[?]	0.1069 (0.0897)	0.0640 ** (0.0263)
$\Delta mp \cdot bcar2_{-1}$	[?]	0.0313 (0.0213)	0.0370 *** (0.0047)
$\Delta mp \cdot siz_{-1} \cdot bcar2_{-1}$	[?]	0.0399 *** (0.0092)	0.0274 *** (0.0024)
Δy	[+]	-1.8472 (4.7969)	4.5994 *** (1.3403)
$\Delta risk$	[–]	-4.8246 ** (2.1239)	-0.0544 (0.1386)
AR1 (p-val,1st step)		0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.573	0.602
Sargan (p-val, 2nd step)		1.000	1.000
lags of IVs		2-6	2-5
No of observations		4638	5698
No of banks		211	259

See table A9 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 30). This is compatible with the idea that – while the

[59] For a more detailed description, see Upper, C./Worms, A. (2001a).

very small banks do not directly use their "other liquid assets" to cushion monetary policy effects on their loans to private non-banks – the larger banks seem to do so. Given that the "other liquid assets" mainly consist of securities, this is compatible with the idea that (in contrast to the small banks) the large banks sell securities to partly shield their loan portfolios from restrictive monetary policy measures.

However, this effect is comparatively small: While the influence of short-term interbank deposits in the estimations based on the whole sample was strong enough to completely dominate the size effect in the single-interaction regressions (see table 6a, regression 1), the influence of the liquidity variable(s) is obviously too weak to completely offset such a size effect in the case of the larger banks (see table 10, regression 26).

Moreover, the size of the coefficients of the *ibk* and of the *oli* interaction, as well as that of the *liq* interaction are comparatively similar. This, together with 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 regression with *ibk* and *siz* (as in tables 7 and 8) for the sample of large banks yields no significant long-run coefficient for the *mp* interaction with *ibk* and with *siz*, but only a significant coefficient for the double-interaction term (see table 11, regression d8). However, using liquidity *liq* instead of short-term interbank deposits *ibk* basically confirms the results presented in table 7 (regression d9): The long-run coefficient of the liquidity interaction is significantly positive, and there is also a positive dependence of the banks´ reaction to monetary policy on size (the significantly positive coefficients of the interaction terms with liquidity and size remain even if the VAR shock is used in the double-interaction regressions).[60]

VIII 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

[60] 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. Moreover, the long-run coefficients of the control variables are insignificant in most cases.

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 also 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. This is also consistent with the existence of "housebank-relationships" between those banks and their 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 an appropriate control for the strong influence exerted by short-term interbank deposits. Otherwise, an 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 it is not only short-term interbank deposits but rather also their overall liquidity which seems to determine their reaction to monetary policy.

These results are based on the three-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, irrespective of whether there was control for short-term interbank deposits or not. Only the dependence on short-term interbank deposits is robust against this change in the policy indicator. Besides the check for robustness with respect to the monetary policy indicator, further robustness checks have been carried out (with respect to the treatment of mergers and the inclusion of time series).

Overall, there is very robust evidence in favor of a differential reaction to monetary policy across all banks that depends on short-term interbank deposits: Owing to the fact that (smaller) banks draw on their short-term interbank deposits in reaction to a restrictive monetary policy measure, small banks do not reduce loans more sharply 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 of a differential reaction to monetary policy across banks that depends on size: large banks react less strongly than small banks.

The key assumption that must hold in order to interpret these results as evidence of 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 stated 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 decline more sharply than the loan *demand* faced by large (and more liquid) banks.

Interpreted in this way, 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 the fact that – by using the bank-individual income and risk variables, and by explicitly considering bank-individual seasonal patterns – the regressions allow for many more differences in the movements of loans across banks which are not attributable to monetary-policy-induced supply changes than was the case in most of the previous literature.

Appendix 1: Definition of variables

n	=	bank index
t	=	period (quarter) index
j	=	sector index
i_t	=	short-term market rate (three-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* (private households are generally assumed to be solvent).
$siz_{n,t}$	=	log of total assets of bank *n*
$cap_{n,t}$	=	capital of bank *n* as a percentage of total assets of bank *n*
$liq_{n,t}$	=	liquid assets of bank *n* as a percentage of total assets of bank *n*; liquid assets *la* 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* as a percentage 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* = three-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 at 1% level, ** Significance at 5% level , * Significance at 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)
Δcr	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)
Δy	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* = three-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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable:	bcar1: / bcar2:	regression d1 *siz* / *ibk*	regression d2 *cap* / *ibk*	regression d3 *liq* / *ibk*
$\Delta mp \cdot bcar1_{-1}$	lag 1	-0.0320 *** (0.0089)	0.0473 *** (0.0169)	0.0016 (0.0021)
	lag 2	0.0335 *** (0.0062)	-0.0003 (0.0152)	0.0028 * (0.0017)
	lag 3	-0.0115 (0.0098)	0.0623 *** (0.0191)	-0.0033 * (0.0022)
	lag 4	0.0977 *** (0.0104)	-0.0056 (0.0193)	0.0065 (0.0022)
$\Delta mp \cdot ibk_{-1}$	lag 1	0.0204 *** (0.0033)	0.0170 *** (0.0038)	0.0483 *** (0.0134)
	lag 2	0.0313 *** (0.0032)	0.0224 *** (0.0037)	0.0312 ** (0.0124)
	lag 3	0.0227 *** (0.0037)	0.0237 *** (0.0040)	0.0415 *** (0.0154)
	lag 4	0.0113 *** (0.0035)	0.0026 *** (0.0040)	0.0305 ** (0.0152)
$\Delta mp \cdot bcar1_{-1} \cdot ibk_{-1}$	lag 1	0.0013 (0.0018)	-0.0026 (0.0031)	-0.0008 *** (0.0003)
	lag 2	0.0011 (0.0016)	0.0023 (0.0030)	-0.0002 (0.0003)
	lag 3	0.0046 *** (0.0017)	-0.0007 (0.0032)	-0.0004 (0.0004)
	lag 4	0.0005 (0.0018)	0.0143 *** (0.0032)	-0.0008 ** (0.0004)
Δcr	lag 1	0.1024 *** (0.0060)	0.1206 *** (0.0058)	0.1174 *** (0.0060)
	lag 2	0.0955 *** (0.0049)	0.1119 *** (0.0057)	0.1103 *** (0.0056)
	lag 3	0.0584 *** (0.0041)	0.0535 *** (0.0056)	0.0616 *** (0.0056)
	lag 4	-0.1239 *** (0.0037)	-0.1346 *** (0.0050)	-0.1251 *** (0.0049)
Δy	lag 1	0.3782 ** (0.1523)	-0.0011 (0.2004)	-0.1016 (0.1954)
	lag 2	-0.1254 (0.1493)	0.0350 (0.2117)	-0.1269 (0.2078)
	lag 3	0.3548 ** (0.1406)	0.2544 (0.2082)	0.2140 (0.1988)
	lag 4	0.2565 * (0.1376)	0.3706 ** (0.1887)	0.3269 * (0.1839)
$\Delta risk$	lag 1	-0.3403 *** (0.0373)	-0.2686 *** (0.0571)	-0.2403 *** (0.0566)
	lag 2	-0.1357 *** (0.0295)	-0.0745 * (0.0435)	-0.0510 (0.0424)
	lag 3	-0.0792 *** (0.0254)	0.0287 (0.0399)	0.0054 (0.0386)
	lag 4	-0.1197 *** (0.0218)	-0.0207 (0.0326)	-0.0236 (0.0320)
bcar1	lag 1	-0.0487 *** (0.0084)	-0.0051 ** (0.0023)	0.0008 *** (0.0003)
ibk	lag 1	0.0005 *** (0.0001)	0.0002 ** (0.0001)	0.0004 ** (0.0002)
bcar1·ibk	lag 1	0.0002 *** (0.0000)	0.0001 (0.0001)	0.0000 *** (0.0000)
constant		-0.0003 (0.0004)	0.0003 (0.0005)	-0.0004 (0.0005)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.263	0.559	0.619
Sargan (p-val, 2nd step)		1.000	1.000	1.000
lags of IVs		2-6	2-5	2-5
No of observations		51597	52334	52422
No of banks		2353	2386	2390

Table A3: Estimation results, double interaction, robustness checks

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included in regressions d4 – d6;
Linear trend and quarterly dummies included in regression d7

variable [expected sign]		regression d4	regression d5	regression d6	regression d7
			alternative treatment of mergers		
		monetary policy indicator based on VAR-shock °	Procedure (1): "*Bank mergers ignored*"	Procedure (3): "*New bank created*"	exclude time dummies, include time series
$\Delta mp \cdot siz_{-1}$	lag 1	-0.0076 ** (0.0030)	-0.0204 * (0.0113)	-0.0432 ** (0.0200)	-0.0063 (0.0117)
	lag 2	-0.0075 ** (0.0036)	0.0308 *** (0.0077)	0.0245 * (0.0130)	0.0189 * (0.0101)
	lag 3	0.0027 (0.0041)	-0.0192 (0.0124)	-0.0197 (0.0197)	-0.0164 (0.0110)
	lag 4	-0.0078 ** (0.0037)	0.0943 *** (0.0128)	0.1123 *** (0.0201)	0.0668 *** (0.0114)
	lag 5				0.0659 *** (0.0109)
$\Delta mp \cdot ibk_{-1}$	lag 1	0.0052 *** (0.0011)	0.0161 *** (0.0038)	0.0143 ** (0.0060)	0.0240 *** (0.0039)
	lag 2	0.0048 *** (0.0016)	0.0279 *** (0.0036)	0.0170 *** (0.0060)	0.0298 *** (0.0038)
	lag 3	0.0043 *** (0.0018)	0.0209 *** (0.0042)	0.0192 *** (0.0061)	0.0212 *** (0.0040)
	lag 4	0.0033 ** (0.0013)	0.0118 *** (0.0040)	0.0227 *** (0.0058)	0.0078 * (0.0041)
	lag 5				0.0147 *** (0.0036)
$\Delta mp \cdot siz_{-1} \cdot ibk_{-1}$	lag 1	0.0010 * (0.0006)	0.0057 *** (0.0019)	0.0092 *** (0.0034)	0.0043 ** (0.0021)
	lag 2	0.0020 *** (0.0008)	0.0019 (0.0018)	0.0080 *** (0.0030)	0.0009 (0.0020)
	lag 3	0.0015 * (0.0008)	0.0030 (0.0019)	0.0131 *** (0.0034)	0.0044 ** (0.0020)
	lag 4	0.0010 * (0.0006)	0.0032 * (0.0019)	0.0119 *** (0.0032)	-0.0008 (0.0021)
	lag 5				0.0019 (0.0018)
Δcr	lag 1	0.0866 *** (0.0061)	0.1042 *** (0.0070)	0.0804 *** (0.0244)	0.0973 *** (0.0083)
	lag 2	0.0938 *** (0.0051)	0.1045 *** (0.0053)	0.0533 ** (0.0226)	0.0894 *** (0.0061)
	lag 3	0.0565 *** (0.0042)	0.0475 *** (0.0046)	-0.0120 (0.0237)	0.0522 *** (0.0048)
	lag 4	-0.1338 *** (0.0038)	-0.1421 *** (0.0041)	-0.0755 ** (0.0355)	-0.1377 *** (0.0044)
	lag 5				0.0023 (0.0050)
Δy	lag 1	0.1454 (0.1601)	0.2013 (0.1896)	-0.7066 * (0.4270)	0.5569 ** (0.2291)
	lag 2	-0.2523 (0.1580)	0.0478 (0.1888)	-0.2884 (0.4577)	0.0332 (0.1902)
	lag 3	0.2783 * (0.1448)	0.4691 ** (0.1899)	-0.1391 (0.3816)	0.4350 ** (0.1894)
	lag 4	0.3487 ** (0.1441)	0.1887 (0.1867)	0.5499 ** (0.2252)	0.3425 * (0.1913)
	lag 5				0.2399 (0.1987)

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Table A3 (ctd): Estimation results, double interaction, robustness checks

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included in regressions d4 – d6;
Linear trend and quarterly dummies included in regression d7

variable [expected sign]		regression d4	regression d5	regression d6	regression d7
		monetary policy indicator based on VAR-shock °	alternative treatment of mergers: Procedure (1): "*Bank mergers ignored*"	Procedure (3): "*New bank created*"	exclude time dummies, include time series
Δrisk	lag 1	-0.3625 *** (0.0383)	-0.3328 *** (0.0554)	-0.0622 (0.0978)	-0.3128 *** (0.0476)
	lag 2	-0.1531 *** (0.0307)	-0.0450 (0.0393)	-0.0387 (0.1007)	0.0184 (0.0456)
	lag 3	-0.1032 *** (0.0259)	0.0920 ** (0.0375)	-0.0924 (0.0985)	-0.0115 (0.0395)
	lag 4	-0.1084 *** (0.0217)	-0.0173 (0.0283)	-0.1430 (0.1060)	-0.0835 ** (0.0395)
	lag 5				0.0406 (0.0298)
Δmp	lag 1				-0.0050 (0.0497)
	lag 2				0.1794 *** (0.0392)
	lag 3				-0.1246 *** (0.0442)
	lag 4				-0.4381 *** (0.0622)
	lag 5				-1.0009 *** (0.0794)
Δy^{aggr}	lag 1				-0.3983 *** (0.0647)
	lag 2				-0.1272 *** (0.0378)
	lag 3				-0.2996 *** (0.0555)
	lag 4				0.2506 *** (0.0234)
	lag 5				0.6802 *** (0.0531)
Δp^{aggr}	lag 1				-1.4892 *** (0.1437)
	lag 2				2.1757 *** (0.2107)
	lag 3				1.1433 *** (0.1126)
	lag 4				0.9638 *** (0.1067)
	lag 5				2.5478 *** (0.2785)
siz	lag 1	-0.0708 *** (0.0088)	-0.0265 ** (0.0104)	-0.0018 (0.0256)	-0.0380 *** (0.0109)
ibk	lag 1	-0.0001 (0.0001)	0.0006 *** (0.0001)	0.0001 (0.0002)	0.0006 *** (0.0001)
siz·ibk	lag 1	0.0002 *** (0.0000)	0.0001 *** (0.0001)	0.0005 *** (0.0001)	0.0002 *** (0.0001)
constant	-	-0.0006 (0.0004)	-0.0012 ** (0.0005)	0.0001 (0.0006)	0.0139 *** (0.0020)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.622	0.793	0.771	0.327
Sargan (p-val, 2nd step)		1.000	1.000	1.000	1.000
lags of IVs		2-7	2-6	2-3	2-6
no of obs		49258	49738	28766	49241
no of banks		2353	2526	1644	2353

Table A4a: Estimation results, single 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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable:	bcar:	regression 6 *siz*	regression 7 *liq*	regression 8 *cap*	regression 9 *ibk*	regression 10 *oli*
$\Delta mp \cdot bcar_{-1}$ (multiplied by 100)	lag 1	-0.0180 *** (0.0032)	0.0023 *** (0.0006)	0.0115 ** (0.0057)	0.0044 *** (0.0012)	0.0000 (0.0007)
	lag 2	-0.0158 *** (0.0039)	0.0029 *** (0.0008)	0.0154 ** (0.0075)	0.0038 ** (0.0018)	-0.0001 (0.0010)
	lag 3	-0.0111 *** (0.0043)	0.0021 ** (0.0009)	0.0086 (0.0084)	0.0042 ** (0.0020)	-0.0008 (0.0011)
	lag 4	-0.0140 *** (0.0040)	-0.0003 (0.0007)	0.0086 (0.0070)	0.0048 *** (0.0014)	-0.0031 *** (0.0009)
Δcr	lag 1	0.1032 *** (0.0066)	0.1277 *** (0.0052)	0.1175 *** (0.0053)	0.1187 *** (0.0058)	0.1149 *** (0.0055)
	lag 2	0.1036 *** (0.0056)	0.1244 *** (0.0050)	0.1172 *** (0.0050)	0.1207 *** (0.0053)	0.1138 *** (0.0051)
	lag 3	0.0601 *** (0.0046)	0.0696 *** (0.0045)	0.0673 *** (0.0044)	0.0678 *** (0.0047)	0.0654 *** (0.0045)
	lag 4	-0.1335 *** (0.0042)	-0.1293 *** (0.0042)	-0.1332 *** (0.0041)	-0.1323 *** (0.0044)	-0.1335 *** (0.0041)
Δy	lag 1	0.0707 (0.1694)	0.0739 (0.1751)	0.1487 (0.1734)	0.2362 (0.1799)	0.2146 (0.1725)
	lag 2	0.0278 (0.1666)	-0.0030 (0.1712)	-0.0428 (0.1730)	-0.0274 (0.1777)	0.2040 (0.1691)
	lag 3	0.3215 ** (0.1568)	0.2261 (0.1565)	0.3104 ** (0.1559)	0.2767 * (0.1569)	0.3813 ** (0.1549)
	lag 4	0.3401 ** (0.1577)	0.3309 ** (0.1612)	0.4479 *** (0.1604)	0.4269 *** (0.1642)	0.5019 *** (0.1608)
$\Delta risk$	lag 1	-0.2691 *** (0.0352)	-0.2834 *** (0.0376)	-0.2713 *** (0.0368)	-0.3816 *** (0.0463)	-0.3165 *** (0.0383)
	lag 2	-0.1605 *** (0.0313)	-0.1922 *** (0.0338)	-0.1565 *** (0.0335)	-0.1788 *** (0.0370)	-0.1953 *** (0.0340)
	lag 3	-0.0455 (0.0278)	-0.0867 *** (0.0304)	-0.0272 (0.0298)	-0.1056 *** (0.0309)	-0.0849 *** (0.0313)
	lag 4	-0.0865 *** (0.0229)	-0.1085 *** (0.0245)	-0.0699 *** (0.0240)	-0.1167 *** (0.0251)	-0.1275 *** (0.0251)
bcar	lag 1	-0.0361 *** (0.0087)	0.0000 (0.0001)	0.0032 * (0.0020)	-0.0004 *** (0.0001)	0.0003 *** (0.0001)
constant		-0.0008 * (0.0004)	-0.0006 (0.0005)	-0.0008 * (0.0005)	-0.0001 (0.0005)	-0.0007 (0.0005)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.845	0.970	0.843	0.639	0.968
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		54994	55626	55719	50182	54732
No of banks		2625	2654	2659	2397	2611

Table A4b: Long-run coefficients, single 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 2[nd] step results).
*** Significance at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable [expected sign]		regression 6 *siz*	regression 7 *liq*	regression 8 *cap*	regression 9 *ibk*	regression 10 *oli*
$\Delta mp \cdot bcar_{-1}$ (multiplied by 100)	[?]	-0.0681 *** (0.0157)	0.0088 *** (0.0003)	0.0530 * (0.0300)	0.0209 ** (0.0067)	-0.0048 (0.0038)
Δy	[+]	0.8770 * (0.4770)	0.7776 (0.5111)	1.0398 ** (0.5011)	1.1058 ** (0.5105)	1.5510 *** (0.4962)
$\Delta risk$	[–]	-0.6481 *** (0.1122)	-0.8307 *** (0.1316)	-0.6315 *** (0.1235)	-0.9487 *** (0.1338)	-0.8629 *** (0.1300)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.845	0.970	0.843	0.639	0.968
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		54994	55626	55719	50182	54732
no of banks		2625	2654	2659	2397	2611

Table A5a: Estimation results, single interaction, *mp* = three-month interest rate alternative treatment of mergers: procedure (1) [*mergers ignored*]

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

		regression 11	regression 12	regression 13	regression 14	regression 15
variable:	*bcar:*	*siz*	*liq*	*cap*	*ibk*	*oli*
$\Delta mp \cdot bcar_{-1}$	lag 1	-0.0510 *** (0.0096)	0.0135 *** (0.0022)	0.0568 *** (0.0161)	0.0232 *** (0.0039)	-0.0047 * (0.0025)
	lag 2	-0.0058 (0.0052)	0.0084 *** (0.0016)	0.0503 *** (0.0126)	0.0276 *** (0.0038)	-0.0051 *** (0.0020)
	lag 3	-0.0345 *** (0.0108)	0.0062 *** (0.0022)	0.0373 ** (0.0177)	0.0230 *** (0.0042)	-0.0091 *** (0.0026)
	lag 4	0.0807 *** (0.0126)	0.0087 *** (0.0022)	0.0013 (0.0192)	0.0063 (0.0043)	0.0039 (0.0025)
Δcr	lag 1	0.1139 *** (0.0064)	0.1089 *** (0.0055)	0.1027 *** (0.0055)	0.1142 *** (0.0060)	0.1147 *** (0.0058)
	lag 2	0.1069 *** (0.0053)	0.1088 *** (0.0048)	0.1018 *** (0.0048)	0.1127 *** (0.0051)	0.1110 *** (0.0050)
	lag 3	0.0534 *** (0.0046)	0.0528 *** (0.0044)	0.0522 *** (0.0045)	0.0533 *** (0.0046)	0.0549 *** (0.0045)
	lag 4	-0.1155 *** (0.0041)	-0.1161 *** (0.0041)	-0.1179 *** (0.0041)	-0.1179 *** (0.0043)	-0.1193 *** (0.0042)
Δy	lag 1	0.4187 ** (0.1819)	0.1881 (0.1832)	0.1514 (0.1804)	0.1891 (0.1897)	0.2605 (0.1846)
	lag 2	0.1257 (0.1832)	0.1072 (0.1826)	-0.0457 (0.1886)	-0.1591 (0.1959)	0.2493 (0.1821)
	lag 3	0.5776 *** (0.1763)	0.4543 *** (0.1741)	0.3864 ** (0.1791)	0.5690 *** (0.1823)	0.4978 *** (0.1770)
	lag 4	0.4966 *** (0.1743)	0.4371 ** (0.1714)	0.5894 *** (0.1754)	0.3720 ** (0.1835)	0.5348 *** (0.1786)
$\Delta risk$	lag 1	-0.2051 *** (0.0321)	-0.1824 *** (0.0313)	-0.2128 *** (0.0326)	-0.3669 *** (0.0456)	-0.1661 *** (0.0309)
	lag 2	-0.1305 *** (0.0295)	-0.1371 *** (0.0291)	-0.1294 *** (0.0297)	-0.1145 *** (0.0342)	-0.1222 *** (0.0303)
	lag 3	0.0403 (0.0260)	0.0208 (0.0267)	0.0393 (0.0278)	0.0392 (0.0317)	0.0213 (0.0281)
	lag 4	-0.0659 *** (0.0218)	-0.0522 ** (0.0221)	-0.0641 *** (0.0227)	-0.0571 ** (0.0245)	-0.0847 *** (0.0229)
bcar	lag 1	0.0105 (0.0079)	0.0007 *** (0.0001)	0.0037 ** (0.0015)	0.0003 *** (0.0001)	0.0000 (0.0001)
constant	-	-0.0014 *** (0.0005)	-0.0016 *** (0.0005)	-0.0015 *** (0.0005)	-0.0012 ** (0.0006)	-0.0013 ** (0.0005)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.791	0.454	0.597	0.592	0.296
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		49610	49498	49665	44143	48559
no of banks		2262	2255	2264	2015	2212

Table A5b: Long-run coefficients, single interaction, *mp* = three-month interest rate, alternative treatment of mergers: procedure (1) [*mergers ignored*]

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable [expected sign]		regression 11 *siz*	regression 12 *liq*	regression 13 *cap*	regression 14 *ibk*	regression 15 *oli*
$\Delta mp \cdot bcar_{-1}$	[?]	-0.0126	0.0435 ***	0.1691 ***	0.0956 ***	-0.0179 ***
		(0.0283)	(0.0059)	(0.0418)	(0.0118)	(0.0065)
Δy	[+]	1.9238 ***	1.4033 ***	1.2559 **	1.1591 **	1.8393 ***
		(0.5352)	(0.5107)	(0.5163)	(0.5414)	(0.5335)
$\Delta risk$	[–]	-0.4293 ***	-0.4150 ***	-0.4260 ***	-0.5961 ***	-0.4196 ***
		(0.1044)	(0.1055)	(0.1067)	(0.1195)	(0.1088)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.791	0.454	0.597	0.592 ***	0.296
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		49610	49498	49665	44143	48559
no of banks		2262	2255	2264	2015	2212

Table A6a: Estimation results, single interaction, *mp* = three-month interest rate alternative treatment of mergers: procedure (3) [*new banks created*]

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

		regression 16	regression 17	regression 18	regression 19	regression 20
variable:	*bcar:*	*siz*	*liq*	*cap*	*ibk*	*oli*
$\Delta mp \cdot bcar_{-1}$	lag 1	-0.0610 ***	0.0093 ***	0.0009	0.0177 ***	-0.0076 **
		(0.0145)	(0.0027)	(0.0207)	(0.0048)	(0.0033)
	lag 2	-0.0178 **	0.0069 ***	-0.0064	0.0238 ***	-0.0059 **
		(0.0083)	(0.0021)	(0.0172)	(0.0046)	(0.0027)
	lag 3	-0.0429 ***	0.0119 ***	0.0010	0.0277 ***	-0.0078 **
		(0.0143)	(0.0026)	(0.0220)	(0.0047)	(0.0033)
	lag 4	0.0620 ***	0.0096 ***	0.0140	0.0207 ***	0.0004
		(0.0151)	(0.0025)	(0.0218)	(0.0049)	(0.0031)
Δcr	lag 1	0.1176 ***	0.1200 ***	0.1167 ***	0.1242 ***	0.1286 ***
		(0.0069)	(0.0064)	(0.0059)	(0.0068)	(0.0078)
	lag 2	0.1095 ***	0.1202 ***	0.1117 ***	0.1137 ***	0.1208 ***
		(0.0059)	(0.0061)	(0.0054)	(0.0064)	(0.0075)
	lag 3	0.0532 ***	0.0609 ***	0.0526 ***	0.0558 ***	0.0537 ***
		(0.0052)	(0.0057)	(0.0050)	(0.0058)	(0.0074)
	lag 4	-0.1536 ***	-0.1508 ***	-0.1529 ***	-0.1588 ***	-0.1636 ***
		(0.0047)	(0.0053)	(0.0048)	(0.0053)	(0.0065)
Δy	lag 1	-0.3556 ***	-0.1996 *	-0.3465 ***	-0.2795 ***	-0.0142
		(0.0938)	(0.1041)	(0.0955)	(0.1034)	(0.1278)
	lag 2	-0.1112	0.0111	-0.1380	-0.1542	0.1257
		(0.0870)	(0.0979)	(0.0892)	(0.0955)	(0.1308)
	lag 3	-0.2949 ***	-0.1577 *	-0.3102 ***	-0.0718	-0.0845
		(0.0823)	(0.0881)	(0.0840)	(0.0872)	(0.1145)
	lag 4	-0.1624 *	0.0028	-0.2003 **	-0.0010	-0.0348
		(0.0898)	(0.1025)	(0.0909)	(0.0985)	(0.1249)
$\Delta risk$	lag 1	-0.1409 ***	-0.1565 ***	-0.1419 ***	-0.1764 ***	-0.2199 ***
		(0.0188)	(0.0235)	(0.0194)	(0.0239)	(0.0288)
	lag 2	-0.1183 ***	-0.1169 ***	-0.1033 ***	-0.1294 ***	-0.1496 ***
		(0.0168)	(0.0187)	(0.0175)	(0.0186)	(0.0224)
	lag 3	-0.1666 ***	-0.1672 ***	-0.1592 ***	-0.1665 ***	-0.1439 ***
		(0.0166)	(0.0182)	(0.0170)	(0.0182)	(0.0235)
	lag 4	-0.1693 ***	-0.1660 ***	-0.1563 ***	-0.1466 ***	-0.1339 ***
		(0.0120)	(0.0141)	(0.0122)	(0.0141)	(0.0178)
bcar	lag 1	-0.0059	0.0008 ***	0.0012	0.0006 ***	-0.0007 ***
		(0.0097)	(0.0002)	(0.0014)	(0.0001)	(0.0002)
constant	-	-0.0012 **	-0.0016 ***	-0.0014 ***	-0.0010 *	-0.0009
		(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.792	0.894 ***	0.524	0.692 ***	0.849
Sargan (p-val, 2nd step)		1.000	1.000 ***	1.000	1.000 ***	1.000
lags of IVs		2-7	2-6	2-7	2-6	2-5
no of observations		32133	32252	32270	29161	31778
no of banks		1810	1822	1821	1670	1787

Table A6b: Long-run coefficients, single interaction, *mp* = three-month interest rate, alternative treatment of mergers: procedure (3) [*new banks created*]

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable [expected sign]		regression 16 *siz*	regression 17 *liq*	regression 18 *cap*	regression 19 *ibk*	regression 20 *oli*
$\Delta mp \cdot bcar_{-1}$	[?]	-0.0684 *	0.0443 ***	0.0110	0.1039 ***	-0.0243 ***
		(0.0368)	(0.0062)	(0.0551)	(0.0136)	(0.0088)
Δy	[+]	-1.0581 ***	-0.4041	-1.1412 ***	-0.5855 *	-0.0090
		(0.3055)	(0.3483)	(0.3133)	(0.3402)	(0.4682)
$\Delta risk$	[–]	-0.6815 ***	-0.7139 ***	-0.6431 ***	-0.7154 ***	-0.7522 ***
		(0.0594)	(0.0717)	(0.0612)	(0.0690)	(0.0909)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.792	0.894	0.524	0.692	0.849
Sargan (p-val, 2nd step)		1.000	1.000	1.000	1.000	1.000
lags of IVs		2-7	2-6	2-7	2-6	2-5
no of obs		32133	32252	32270	29161	31778
no of banks		1810	1822	1821	1670	1787

Table A7a: Estimation results, single interaction, *mp* = three-month interest rate no time dummies, quarterly dummies and linear trend included

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.

variable [expected sign]		regression 21 *siz*	regression 22 *liq*	regression 23 *cap*	regression 24 *ibk*	regression 25 *oli*
$\Delta mp \cdot bcar_{-1}$	lag 1	-0.0425 *** (0.0112)	-0.0052 ** (0.0026)	0.0482 *** (0.0184)	0.0235 *** (0.0041)	-0.0052 ** (0.0026)
	lag 2	-0.0274 *** (0.0087)	-0.0039 * (0.0022)	0.0389 ** (0.0155)	0.0301 *** (0.0041)	-0.0039 * (0.0022)
	lag 3	-0.0409 *** (0.0103)	-0.0119 *** (0.0025)	0.0465 *** (0.0178)	0.0252 *** (0.0041)	-0.0119 *** (0.0025)
	lag 4	0.0541 *** (0.0112)	0.0042 * (0.0025)	-0.0227 (0.0188)	0.0057 (0.0044)	0.0042 * (0.0025)
	lag 5	0.0589 *** (0.0107)	-0.0032 (0.0023)	-0.0374 ** (0.0180)	0.0109 *** (0.0037)	-0.0032 (0.0023)
Δcr	lag 1	0.1263 *** (0.0077)	0.1260 *** (0.0077)	0.1158 *** (0.0063)	0.1285 *** (0.0067)	0.1260 *** (0.0077)
	lag 2	0.1116 *** (0.0059)	0.1101 *** (0.0061)	0.1090 *** (0.0052)	0.1157 *** (0.0055)	0.1101 *** (0.0061)
	lag 3	0.0649 *** (0.0048)	0.0589 *** (0.0052)	0.0618 *** (0.0045)	0.0653 *** (0.0049)	0.0589 *** (0.0052)
	lag 4	-0.1285 *** (0.0044)	-0.1371 *** (0.0049)	-0.1317 *** (0.0043)	-0.1282 *** (0.0044)	-0.1371 *** (0.0049)
	lag 5	0.0120 ** (0.0051)	0.0037 (0.0057)	0.0087 * (0.0051)	0.0183 *** (0.0052)	0.0037 (0.0057)
Δy	lag 1	0.5361 *** (0.2012)	0.4962 ** (0.2426)	0.4225 ** (0.2050)	0.5324 ** (0.2133)	0.4962 ** (0.2426)
	lag 2	0.2463 (0.1833)	0.3230 (0.2071)	0.1218 (0.1877)	0.1910 (0.1923)	0.3230 (0.2071)
	lag 3	0.4472 *** (0.1733)	0.5521 *** (0.2057)	0.4439 ** (0.1741)	0.4982 *** (0.1727)	0.5521 *** (0.2057)
	lag 4	0.3464 * (0.1780)	0.3878 * (0.2061)	0.3732 ** (0.1774)	0.4189 ** (0.1827)	0.3878 * (0.2061)
	lag 5	0.1085 (0.1811)	0.2337 (0.2145)	0.0771 (0.1794)	0.2191 (0.1852)	0.2337 (0.2145)
$\Delta risk$	lag 1	-0.3377 *** (0.0395)	-0.3358 *** (0.0463)	-0.2987 *** (0.0395)	-0.3880 *** (0.0481)	-0.3358 *** (0.0463)
	lag 2	-0.1609 *** (0.0395)	-0.1357 *** (0.0461)	-0.1345 *** (0.0396)	-0.0778 * (0.0469)	-0.1357 *** (0.0461)
	lag 3	-0.0770 ** (0.0339)	-0.0619 (0.0420)	-0.0374 (0.0339)	-0.0806 ** (0.0387)	-0.0619 (0.0420)
	lag 4	-0.1779 *** (0.0321)	-0.1693 *** (0.0386)	-0.1401 *** (0.0309)	-0.1704 *** (0.0374)	-0.1693 *** (0.0386)
	lag 5	-0.0791 *** (0.0259)	-0.0443 (0.0303)	-0.0568 ** (0.0265)	-0.0367 (0.0292)	-0.0443 (0.0303)
Δmp	lag 1	-0.1971 *** (0.0461)	-0.1109 * (0.0584)	-0.1872 *** (0.0480)	-0.0051 (0.0522)	-0.1109 * (0.0584)
	lag 2	0.0747 ** (0.0377)	0.0901 ** (0.0408)	0.0623 (0.0405)	0.1256 *** (0.0428)	0.0901 ** (0.0408)
	lag 3	-0.1640 *** (0.0428)	-0.2630 *** (0.0519)	-0.2448 *** (0.0465)	-0.2071 *** (0.0465)	-0.2630 *** (0.0519)
	lag 4	-0.4579 *** (0.0612)	-0.3641 *** (0.0713)	-0.3798 *** (0.0622)	-0.3632 *** (0.0611)	-0.3641 *** (0.0713)
	lag 5	-1.1877 *** (0.0773)	-1.0071 *** (0.0930)	-1.1309 *** (0.0805)	-0.9387 *** (0.0821)	-1.0071 *** (0.0930)
Δy^{aggr}	lag 1	-0.4450 *** (0.0625)	-0.3177 *** (0.0769)	-0.3696 *** (0.0636)	-0.3213 *** (0.0625)	-0.3177 *** (0.0769)
	lag 2	-0.1758 *** (0.0356)	-0.0969 ** (0.0448)	-0.1170 *** (0.0360)	-0.0935 *** (0.0347)	-0.0969 ** (0.0448)
	lag 3	-0.3919 *** (0.0540)	-0.2612 *** (0.0660)	-0.3168 *** (0.0563)	-0.2775 *** (0.0563)	-0.2612 *** (0.0660)
	lag 4	0.2455 *** (0.0227)	0.2170 *** (0.0284)	0.2302 *** (0.0230)	0.1899 *** (0.0219)	0.2170 *** (0.0284)
	lag 5	0.7291 *** (0.0514)	0.6362 *** (0.0635)	0.7011 *** (0.0525)	0.6217 *** (0.0533)	0.6362 *** (0.0635)

... continued on next page.

Table A7a(ctd): Estimation results, single interaction, *mp*=three-month interest rate, no time dummies, quarterly dummies and linear trend included

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.

variable [expected sign]		regression 21 *siz*	regression 22 *liq*	regression 23 *cap*	regression 24 *ibk*	regression 25 *oli*
Δp^{aggr}	lag 1	-1.5935 *** (0.1412)	-1.3216 *** (0.1678)	-1.5223 *** (0.1473)	-1.3851 *** (0.1523)	-1.3216 *** (0.1678)
	lag 2	2.4557 *** (0.2050)	2.0708 *** (0.2534)	2.2915 *** (0.2099)	2.0027 *** (0.2098)	2.0708 *** (0.2534)
	lag 3	1.2352 *** (0.1100)	1.0660 *** (0.1360)	1.1357 *** (0.1116)	1.0631 *** (0.1104)	1.0660 *** (0.1360)
	lag 4	1.0520 *** (0.1041)	0.8871 *** (0.1278)	0.9494 *** (0.1051)	0.8349 *** (0.1021)	0.8871 *** (0.1278)
	lag 5	2.8211 *** (0.2696)	2.2811 *** (0.3342)	2.5516 *** (0.2739)	2.2533 *** (0.2726)	2.2811 *** (0.3342)
bcar	lag 1	0.0093 (0.0089)	-0.0003 * (0.0002)	0.0023 (0.0021)	0.0005 *** (0.0001)	-0.0003 * (0.0002)
constant	-	0.0151 *** (0.0019)	0.0126 *** (0.0024)	0.0134 *** (0.0018)	0.0101 *** (0.0017)	0.0126 *** (0.0024)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.687	0.421	0.444	0.620	0.648
Sargan (p-val, 2nd step)		1.000	1.000	1.000	1.000	1.000
lags of IVs		2-7	2-6	2-7	2-7	2-6
no of obs		54987	55619	55712	50165	54727
no of banks		2625	2654	2659	2397	2611

Table A7b: Long-run coefficients, single interaction, *mp* = three-month interest rate, no time dummies, quarterly dummies and linear trend included

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 at 1% level, ** Significance at 5% level , * Significance at 10% level.

variable [expected sign]		regression 21 *siz*	regression 22 *liq*	regression 23 *cap*	regression 24 *ibk*	regression 25 *oli*
$\Delta mp \cdot bcar_{-1}$	[?]	0.0027 (0.0303)	-0.0238 *** (0.0071)	0.0879 ** (0.0473)	0.1192 *** (0.0138)	-0.0238 *** (0.0078)
Δy	[+]	2.0699 *** (0.7942)	2.3771 (0.9755)	1.7197 *** (0.7641)	2.3233 *** (0.8176)	-0.0089 *** (0.9719)
$\Delta risk$	[–]	-1.0232 *** (0.1691)	-0.8912 ** (0.1718)	-0.7980 *** (0.1584)	-0.9414 *** (0.1939)	-0.8912 *** (0.1909)
Δmp	[–]	-2.3743 *** (0.1858)	-1.9742 *** (0.2266)	-2.2481 *** (0.1805)	-1.7349 *** (0.1930)	-1.9742 *** (0.2053)
Δy^{aggr}	[?]	-0.0468 (0.1184)	0.2115 (0.1390)	0.1530 (0.1202)	0.1491 (0.1230)	0.2115 (0.1387)
Δp^{aggr}	[+]	7.3368 *** (0.7134)	5.9445 *** (0.8472)	6.4630 *** (0.6839)	5.9586 *** (0.6926)	5.9445 *** (0.8251)
AR1 (p-val,1st step)		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.687	0.421	0.444	0.620	0.648
Sargan (p-val, 2nd step)		1.000	1.000	1.000	1.000	1.000
lags of IVs		2-7	2-6	2-7	2-7	2-6
no of obs		54987	55619	55712	50165	54727
no of banks		2625	2654	2659	2397	2611

Table A8: Estimation results, reduced sample (75 % of loan market),
***mp* = three-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 2[nd] step results).
*** Significance at 1% level, ** Significance at 5% level , * Significance at 10% level **.**
Time dummies included.

variable:	*bcar:*	regression 26 *siz*	regression 27 *liq*	regression 28 *cap*	regression 29 *ibk*	regression 30 *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)
Δcr	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)
Δy	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 A9: Estimation results from regressions with double interactions, reduced sample (75 % of loan market), *mp* = three-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 at 1% level, ** Significance at 5% level , * Significance at 10% level.
Time dummies included.

variable:	*bcar1:* / *bcar2:*	regression d8 *siz* *ibk*	regression d9 *siz* *liq*
$\Delta mp \cdot siz_{-1}$	lag 1	-0.1997 *** (0.0208)	-0.1521 *** (0.0070)
	lag 2	0.0219 (0.0254)	0.0773 *** (0.0060)
	lag 3	0.1117 *** (0.0192)	0.0521 *** (0.0102)
	lag 4	0.1427 *** (0.0194)	0.0743 *** (0.0104)
$\Delta mp \cdot bcar2_{-1}$	lag 1	0.0238 *** (0.0054)	0.0108 *** (0.0016)
	lag 2	0.0186 *** (0.0055)	0.0142 *** (0.0013)
	lag 3	-0.0109 *** (0.0066)	0.0046 *** (0.0018)
	lag 4	-0.0091 * (0.0052)	0.0002 ** (0.0017)
$\Delta mp \cdot siz_{-1} \cdot bcar2_{-1}$	lag 1	0.0098 *** (0.0025)	0.0124 *** (0.0008)
	lag 2	0.0085 *** (0.0026)	0.0105 *** (0.0007)
	lag 3	0.0080 *** (0.0028)	-0.0058 *** (0.0009)
	lag 4	0.0023 (0.0022)	0.0050 *** (0.0009)
Δcr	lag 1	0.0820 *** (0.0171)	0.0564 *** (0.0076)
	lag 2	0.1561 *** (0.0164)	0.1045 *** (0.0067)
	lag 3	0.1128 *** (0.0175)	0.1064 *** (0.0077)
	lag 4	-0.0676 *** (0.0150)	-0.0734 *** (0.0068)
Δy	lag 1	1.5512 (0.9714)	1.0265 *** (0.3664)
	lag 2	-0.5813 (1.2460)	1.0745 *** (0.3707)
	lag 3	0.0033 (1.3710)	1.6280 *** (0.3382)
	lag 4	-2.2973 ** (0.9327)	-0.0211 (0.2414)
$\Delta risk$	lag 1	-0.8813 ** (0.4023)	-0.1168 *** (0.0389)
	lag 2	-1.1547 ** (0.5061)	-0.0201 (0.0315)
	lag 3	-1.0247 ** (0.4636)	0.0078 (0.0264)
	lag 4	-0.3977 (0.3015)	0.0853 *** (0.0188)
siz	lag 1	-0.0134 (0.0085)	-0.0195 *** (0.0041)
bcar2	lag 1	0.0004 *** (0.0001)	0.0020 *** (0.0001)
siz·bcar2	lag 1	0.0006 *** (0.0001)	-0.0001 *** (0.0000)
constant		-0.0005 (0.0011)	-0.0015 *** (0.0003)
AR1 (p-val,1st step)		0.000 ***	0.000 ***
AR2 (p-val,1st step)		0.573	0.602
Sargan (p-val, 2nd step)		1.000	1.000
lags of IVs		2-6	2-5
No of observations		4638	5698
No of banks		211	259

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