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Industry Effects of Bank Lending in Germany

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Abstract

We investigate the industry dimension of bank lending and its role in the monetary transmission mechanism in Germany. We use dynamic panel methods to estimate bank lending functions for eight industries for the period 1992-2002. Our evidence shows that bank lending growth predominantly depends on the industry composition of bank loan portfolios, both through the underlying cyclical fluctuations in industry-specific bank credit demand and through industry-specific credit supply effects.

Keywords: Monetary policy transmission, credit channel, industry structure, dynamic panel data.

JEL classification: C23, E52, G21, L16

1. Introduction

The literature on monetary transmission emphasizes the interest rate and credit channel as important propagation and amplification mechanisms of changes in monetary policy. Both channels predict bank lending to respond to monetary policy actions. While the direction of change is similar, the underlying reasons differ. The credit view explains monetary-policy-induced movements in bank lending with changes in loan supply, whereas the interest rate channel stresses changes in loan demand.

The role of interest rates as joint determinant of credit demand and supply complicates the identification of the interest rate and credit channel effects of monetary policy. In order to identify loan supply effects, empirical studies typically rely on disaggregated bank data. A large literature employs bank-level data to account for bank heterogeneity in terms of asset size (Kashyap and Stein, 1995), liquidity (Kashyap and Stein, 2000), and capitalization (Peek and Rosengren, 1995). These characteristics are assumed to identify loan supply effects, reflecting cross-bank variation in the severity of asymmetric information problems and in banks' ability to offset monetary-policy-induced changes in deposits with alternative sources of funding. Typically, most empirical studies of such credit supply effects include macroeconomic output and price variables to proxy for credit demand. In this setup, possible heterogeneity in firm – industry – credit demand is ignored. Similarly, heterogeneity in corporate balance sheets and its effect on credit supply is not explicitly taken into account. Finally, differences in the industry structure of banks' credit portfolio are assumed away. In turn, monetary policy effectiveness is assumed to be independent of the industry structure of credit portfolios.

We hypothesize that borrower heterogeneity may significantly affect bank lending through demand and supply effects.[1] Ideally, our analysis would build on firm-level as well as bank-level data. Bank-level data allow for the identification of credit channel effects of monetary policy through banks' balance sheets, while firm-level data would allow for firm-specific credit demand effects and balance sheet – credit supply – effects. Unfortunately, firm-level data of sufficient quality are unavailable.

However, we are able to use a unique set of bank lending data at the industry level and estimate bank lending functions across individual banks for eight different industries. Rather than using aggregate macroeconomic price and output variables to proxy for (aggregate) credit demand, we use industry-specific prices and output as proxy variables for industry-specific credit demand.

A few caveats are in order. First, analogous to other studies we are unable to explicitly account for corporate balance sheet effects on credit supply due to lack of appropriate data. Second, differences in bank lending functions across industries may also include credit-supply effects, for instance in case excluded industry characteristics affect bank-customer relations and bank credit portfolio compositions. In the empirical analysis we attempt to control for these effects. Third, output and price variations may not only proxy for credit demand effects but also have credit supply effects. Here, we follow the accepted practice in the literature which typically links output and price movements exclusively to cyclical (demand) characteristics. In addition, we note that German banking was characterized by strong bank-customer relations over the sample period, reducing the potential impact of temporarily low output on credit supply.

The evidence shows that industry lending predominantly responds to changes in industry credit demand rather than to monetary policy changes. Evidence in favor of credit channel – supply – effects of monetary policy crucially depends on the choice of industry. In view of these findings, we conclude that the industry composition of credit cannot be ignored in empirical research on the monetary transmission mechanism. Future research should take this into account.

The paper is structured as follows. Section 2 reviews the existing evidence on the credit channel effects of monetary policy in Germany. Section 3 presents the data and stylized facts with respect to lending to different industries across the three main German banking groups. Section 4 specifies the empirical model and the estimation strategy. Section 5 reports the empirical results and provides a discussion. We conclude in section 6.

[1] See Deutsche Bundesbank (1996) for supportive empirical evidence.

2. The Credit Channel Effects of Monetary Policy in Germany

Most studies on the bank lending effects of monetary policy rely on macroeconomic data, as sector, firm and bank-level data are not widely available. However,Guiso, Kashyap, Panetta and Terlizzese (1999), Dedola and Lippi (2005) argue that relevant differences in the monetary policy response of different groups within one country may go unnoticed with macroeconomic data.[2] As a partial solution, some empirical studies distinguish the monetary policy response of bank lending across different groups (Dale and Haldane 1995, Barran, Coudert, and Mojon 1997, Kakes, Sturm, and Maier 2001, Kakes and Sturm 2002, and De Haan 2003). These studies exploit the between-group variation in agents and markets, but not the within-group variation.

In contrast, microeconomic studies also exploit within-group heterogeneities to identify the credit demand and supply effects of monetary policy. Several microeconomic studies for Germany use BankScope data (De Bondt 1998; Favero, Giavazzi, and Flabbi 1999; Altunbaş, Fazylov, and Molyneux 2002). Their conclusions differ, possibly due to the choice of estimation method and sample period. Because the BankScope data suffer from a large sample bias, Ehrmann et al. (2003) and Worms (2003) use microeconomic data compiled by the Deutsche Bundesbank. Both studies estimate the response of bank lending growth to changes in credit demand and monetary policy using dynamic panel models. Their results point to the transmission of monetary policy shocks through bank lending. Effects originate from cross-bank differences in liquidity (Ehrmann et al., 2003) and cross-bank heterogeneities in liquidity and capitalization (Worms, 2003).[3] While Ehrmann et al. (2003) and Worms (2003) allow for bank heterogeneity, they still assume customer homogeneity, as do most other studies in this field. Exceptions are Fuinhas (2006) and Ciccarelli, Maddaloni and Peydró (2010) who distinguish between corporate and private – household – loans. Jiménez et al. (2010) match loan

[2] We refer to Boivin, Kiley and Mishkin (2010) for a similar criticism.

[3] Related work emphasizes relationship banking (De Haan and Sterken, 2006), reduced quantitative lending constraints due to easier bank access to market-based funding (Disyatat, 2010), asset securitization (Altunbas, Gambacorta, and Marqués, 2009), and bank riskiness (Altunbas et al., 2010) as additional transmission channels that mitigate bank lending effects of monetary policy.

supply with both firm and bank identity using Spanish data and conclude that if proper account is taken of firm specific determinants of loan demand, stronger bank lending channel effects are found. In our view, allowing for customer heterogeneity may be a crucial element in identifying bank lending effects of monetary policy. Our paper – which in set up is close Jimenez et al. (2010) - aims to contribute to the literature by testing for the effects of both bank and customer (industry) heterogeneity on bank lending.

A caveat applies with respect to the balance sheet effect of monetary policy. Theoretically, the sign of the balance sheet effect is undetermined. Contractionary monetary policy causes credit supply to contract, while credit demand may either expand or contract (Bernanke and Gertler, 1989; Trautwein, 2000). Similar to existing studies, our analysis cannot identify the balance sheet effects on credit supply or demand. Given that existing empirical research lends no or weak support to the existence of balance sheet effects in Germany – see, for instance, Mojon, Smets, and Vermeulen (2002), Chatelain et al. (2003), Arnold and Vrugt (2004) and Von Kalckreuth (2003) – we feel confident that ignoring the balance sheet effect will not significantly affect our conclusions.

3. Data

In the empirical analysis, we use quarterly data for the period 1992-2002. Bank-level data on balance sheet variables and lending to individual industries are obtained from the quarterly borrower statistics and the monthly bank balance sheet statistics of the Deutsche Bundesbank. The analysis is confined to financial institutions which have the status of a monetary financial institution (MFI) throughout the whole sample period.

Industry data are compiled for eight industries at the one-digit industry level: Energy (Mining, Quarrying and Utilities), Manufacturing, Construction, Agriculture (including Forestry and Fishing), Service, Trade (Wholesale and Retail), Transport (including Communication) and Finance (including Insurance) as well as for the grand total of all industries. For most industries, information on

production and prices is available at a monthly frequency from the New Cronos database. For the remaining industries, industry output is approximated with industry value added, provided by the German statistical office. Information on industry prices is only available as of 1995:1. In order to approximate the 1992:1-1994:4 values, we regress the industry-specific price index against a constant and the contemporaneous value of the aggregate price index and use the coefficient estimates to extrapolate the missing values. The resulting quarterly data series have been searched for outliers using a sequential outlier rejection (SOR) algorithm (Corney, 2002) which accounts for the effect of outliers on the standard error and does not assume a normal distribution.

3.1 Stylized facts on German bank and industry data

Whether monetary policy mainly works through short-term or long-term interest rates and credit and is able to influence – expectations of – longer-term interest rates and the slope of the yield curve still is a widely debated issue. For a recent overview from the perspective of central bank communication we refer to Blinder et al. (2008). Gertler and Gilchrist (1993) and Kakes and Sturm (2002) suggest short-term lending responds immediately to changes in monetary policy, while long-term lending does not. Short-term loans are also more likely to respond to cyclical fluctuations in credit demand. Also Boivin et al. (2010) argue that the balance sheet effect of monetary transmission operates through the short-term rather than the long-term interest rate.

Here, we will focus on short-term lending by German banks as our dependent variable. [4] First, we briefly describe the lending patterns of German banks and the industry structure of their credit portfolios, distinguishing the three main banking groups in the German banking system: public savings banks, commercial banks, and credit cooperatives.[5]

Table 1 summarizes the industry composition of credit portfolios by reporting short-term lending to

[4] Unreported results for aggregate lending are qualitatively similar and available from the other on request.
[5] Private savings banks, large Land saving banks as well as central credit institutes are excluded from the analysis, because they operate under a different institutional setting and serve different customers. We refer to Worms (2003) and Hackethal (2004) for comprehensive descriptions of the balance sheet structure of banking groups in Germany.

industry i (i=1,…8) by banking group j (j=1,…3).[6] We express lending to industry i as a share of lending to the grand total of industries. Table 1 shows that all banking groups are significantly involved in lending to the industrial sectors which account for the largest share of output in the aggregate economy: Trade, Services and Manufacturing. Cooperative, savings, and commercial banks hold on average, respectively, 69 percent, 81 percent, and 89 percent of their bank loan portfolio with these sectors. For some of the smaller industrial sectors in terms of credit, one banking group clearly dominates lending. In Agriculture most bank lending comes from the credit cooperatives, while in Construction both savings and cooperatives play an important role. Commercial banks dominate lending to Energy and Finance.

Unreported ANOVA results show i) that banks within each banking group do not significantly differ in terms of balance sheet composition and ii) that significant differences in balance sheet composition exist between banking groups.[7] Overall, the stylized evidence suggests that bank lending may be affected both by banking group characteristics and industry characteristics. We will use this information in the subsequent panel estimation to account for possible credit supply effects that arise from banking groups' choice for specific lending portfolios.

< Table 1 >

4. Empirical Model

We now turn to the empirical investigation of the effect of industry-specific cyclical determinants of credit demand on bank lending. We also investigate the role of monetary policy as a determinant of industry-specific bank lending. The evidence allows us to assess the importance of the industry composition of credit portfolios as a determinant of monetary policy effectiveness.

[6] Bank lending data are also available for nine sub-sectors of the manufacturing industry. To conserve on space, the descriptive statistics are not reported here, but available on request.
[7] Detailed results are available from the authors on request.

4.1 Estimation Framework

To identify the response of industry-specific bank lending to changes in monetary policy and industry-specific credit demand, we apply the dynamic panel framework of Ehrmann et al. (2003), Worms (2003), and Gambacorta and Mistrulli (2004). Our analysis adds to the existing work by incorporating the industry dimension of bank lending. Equation (1) describes the bank lending function for bank b and industry i:[8]

$$\Delta L_{bi,t} = \alpha_b + \sum_{j=1}^{p} \beta_{ij} \Delta L_{bi,t-j} + \sum_{j=1}^{p} \gamma_{1j} \Delta r_{M,t-j} + \sum_{j=1}^{p} \gamma_{2,ij} \Delta IP_{i,t-j} + \sum_{j=1}^{p} \gamma_{3,ij} \Delta Price_{i,t-j} + \gamma_4 X_{b,t-1} + \sum_{j=1}^{p} \gamma_{5j} X_{b,t-1} \Delta r_{M,t-j} + \varepsilon_{bi,t}. \quad (1)$$

The coefficient α_b is a bank-specific intercept which is included to allow for fixed effects across banks and $\varepsilon_{bi,t}$ is an i.i.d. random variable with zero mean and constant variance, i.e. $N \sim (0,\sigma^2)$. $L_{bi,t}$ denotes short-term lending by bank b to industry i at time t, with b =1,…,N_b and t = 1,…T. The autoregressive parameters β_{ij} are assumed to be the same across banks, but heterogeneous across industries. Equation (1) is expressed in log-differences, denoted by the symbol Δ, with the exception of the money market interest rate, where Δ refers to the regular first difference.

$IP_{i,t}$ approximates industry-specific output at time t. This variable serves as a measure of cyclically determined industry-specific credit demand. $Price_{i,t}$ denotes the industry-specific price at time t. It is included to capture cyclical fluctuations in industry-specific price developments. Monetary policy actions are represented by the change in the three-month money market interest rate $\Delta r_{M,t}$. We assume that the interest rate is strictly exogenous to bank lending. Worms (2003) provides evidence in support of this assumption. In order to identify the bank lending effects of monetary policy, the interest rate at time t-j ($r_{M,t-j}$) is interacted with bank characteristics $X_{b,t-1}$ at time t-1.

The vector of bank-specific characteristics X_b includes capitalization, broad and narrow liquidity and interbank claims, all of which are expressed as a ratio to total bank assets and normalized with respect

[8] An alternative specification of (1) stacks bank lending by industry for all industries and captures industry effects, using dummies. The large number of banks and industries precludes this approach.

to the average across all banks and time. Broad liquidity is defined as cash plus securities plus short-term interbank claims. Possibly, the relation between broad liquidity and the monetary policy response of bank lending is dominated by short-term interbank claims (Worms, 2003 and Ehrmann and Worms, 2004). Therefore, we follow Worms (2003) and split broad liquidity into two components: (i) narrow liquidity defined as the sum of cash and securities and (ii) short-term interbank claims. Consistent with the literature, we also include bank size in X_b to capture the effect of asymmetric information on bank credit supply. Bank size is measured as the log of a bank's total assets in deviation from the average across all banks and time.[9]

In the empirical estimation of equation (1) we will consecutively include each bank characteristic individually in the specification. Bank characteristics are introduced with one lag to avoid endogeneity bias (Kashyap and Stein, 1995, 2000; Ehrmann et al., 2003; Worms, 2003; Gambacorta and Mistrulli, 2004). To be able to present the empirical results in a concise form, we compute long-run elasticities of bank lending ($\alpha_{LR,i}$) with respect to the explanatory variables in equation (1) as follows:[10]

$$\alpha_{LR,i} = \frac{\sum_{j=1}^{J} \gamma_{ij}}{1 - \sum_{j=1}^{J} \beta_{ij}}, \text{ where J=4.}$$

Since the long-run coefficients are a non-linear function of the estimated parameters, we derive the corresponding standard errors by means of the standard delta method. With respect to the sign of our coefficients, we expect a rise in the interest rate – a monetary contraction – to result in lower lending, implying a negative interest rate effect. In line with the literature, we expect that the response of bank lending to monetary policy is less pronounced for larger, more liquid, and better capitalized banks. This holds if the coefficient on the interaction term between each bank characteristic and the interest rate is positive. The effect of industry output growth on bank lending growth is ambiguous. On the one hand, favorable economic conditions increase the number of investment projects with a positive net present value and, hence, credit demand. On the other hand, economic growth generates higher

[9] Worms (2003) and Ehrmann and Worms (2004) argue this may be inappropriate in the German institutional setting due to the tight relationship between the primary and head institutions of the savings and cooperative sector and the practice of savings banks and credit cooperatives to back their funds with mutual guarantees. If so, the interest rate sensitivity of small bank lending may not be higher than that of large banks.

[10] In this we follow the literature (e.g., Gambacorta and Mistrulli, 2004; Worms, 2003; Ehrmann et al., 2003).

internal cash flows which may lower credit demand. Most of the evidence supports a positive relationship between output and bank lending (De Bondt, 1998; Worms, 2003; Ehrmann et al., 2003; and Gambacorta and Mistrulli, 2004). Finally, industry inflation is anticipated to stimulate bank lending growth. This relationship is attributable to the negative effect of positive price changes on real income and cash flows.

4.2 Methodology

The system in (1) represents a fixed effects dynamic (unbalanced) panel with large T and large N. Lagged values of the dependent variable are included to control for omitted variable and endogeneity bias. Because the lagged dependent variable is correlated with the error term, dynamic panel models are typically not estimated with the static panel fixed effects estimator. Doing so would introduce a finite sample bias of order 1/T for $N \rightarrow \infty$ and fixed T (see Nickell, 1981; Kiviet, 1995). In order to avoid biased and inconsistent estimates, Arellano and Bond (1991) suggest the use of a generalized method of moments (GMM) estimator. Recent studies have challenged this method. Blundell and Bond (1998) and Blundell, Bond, and Windmeijer (2001) have shown that the first-differenced GMM estimates are biased downwards in the direction of the within-group estimates. Alvarez and Arellano (2003) show that the GMM estimator is close to the fixed effects estimator for large T. Furthermore, Jung (2005) illustrates that Arrelano and Bond's (1991) test of serial residual correlation may build on inconsistently estimated residuals. Because these are used to decide on the optimal over-identifying restrictions, coefficient estimates are likely to be inconsistent.

In view of this and given a large set of data points in the time dimension, we estimate the dynamic panel model by using the fixed effects estimator. In order to ensure that autocorrelation in the residuals does not result in inconsistent and inefficient estimators we compute White-period standard errors (Arellano, 1987) which are robust to arbitrary serial correlation and time-varying variances in the residuals. We test for the existence of first-order and second-order serial autocorrelation by regressing the within regression residuals against their one- and two-period lag. The underlying model allows for fixed effects and White-period standard errors.

5. Empirical Results

In this section we present and discuss the results of the dynamic panel estimation. The empirical model is estimated for short-term lending over a sample which includes the primary institutions of the commercial, savings, and credit cooperative sector. This group is referred to as the aggregate banking group. Potentially, lending heterogeneity may be caused by variation in bank's choices of credit portfolio composition as well as by variation in bank-customer relations due to unobserved firm characteristics and by credit demand effects. We already reported that significant differences in banks' balance sheet exist between banking groups but not within groups. To capture banking group-specific effects we initially include dummies for the savings and commercial banking group. These turn out to be statistically insignificant in almost all specifications. The subsequent evidence for the aggregate banking group excludes the banking group dummies.

5.1 ANOVA Results

To condense and structure the subsequent analysis of the empirical findings, this subsection reports ANOVA results for the long-run coefficients of (1). Our aim is to explore the sensitivity of the long-run coefficients of industry output growth, industry inflation, and the interest rate change to the choice of bank characteristic, and the choice of industry and banking group.

We first investigate whether the estimates of the long-run coefficients of industry output growth, industry inflation, and the interest rate change are influenced by the choice of bank characteristic X_b, i.e. bank asset size, capitalization, broad and narrow liquidity, and short-term interbank claims. To this end, we estimate equation (1) for all combinations of 9 industries – including the grand total of industries – and five bank characteristics. The subsequent ANOVA results (Table 2) show that the choice of bank characteristic does not significantly affect the long-run sensitivity of bank lending with respect to either industry-specific credit demand or the interest rate.

< Table 2>

Next, we investigate whether the variation in long-run coefficients is accounted for mostly by industries or by banking groups. To this end, we estimate equation (1) for all combinations of eight industries and four banking groups. Since the group of commercial banks has too few observations, it is excluded from the analysis. Next to the group of savings banks, we include three (sub) groups of cooperatives, rural cooperatives, commercial credit cooperatives, and Raiffeisen banks. We only report the results bank asset size, noting that the evidence for the other bank characteristics does not differ.[11] Table 3 summarizes the key results. The variation in the responsiveness of bank lending to industry output growth, industry inflation, and interest rate changes can be attributed to industry, but not to banking group. That is, the evidence shows discernible industry dissimilarities in the bank lending effects of changes in credit demand and monetary policy.

< Table 3 >

The ANOVA evidence illustrates that industries are the more important source of differences in the bank lending effects of industry credit demand and monetary policy. Motivated by these findings and to condense on space, the following section presents and discusses the evidence of the dynamic panel estimation (1) on the determinants of industry-specific short-term bank lending growth for the aggregate banking group only.

5.2 Evidence from Industry-Specific Bank Lending Functions

Since table 2 shows that long-run coefficients for output, growth, inflation and the interest rate do not significantly differ for different bank characteristics, we choose to only present the coefficient estimates for the industry-specific bank lending functions including bank size in table 4.[12] We report evidence for individual industries and for the grand total of industries. The evidence for the grand total

[11] The ANOVA test statistics for estimations with bank capitalization, liquidity, and interbank assets and for aggregate lending are available on request.

is our benchmark in the following discussion and allows for comparison with earlier studies which do not adopt an industry-specific focus. Table 4 also reports the short-run coefficients on the one period lags of bank size. Since these have no intrinsic meaning, we do not discuss them here.

< Table 4 >

5.2.1 The Bank Lending Effects of Loan Demand and Monetary Policy

First, we focus on the response of bank lending growth to changes in credit demand (i.e., industry output growth, industry inflation) and to changes in the interest rate. Table 4 illustrates that bank lending to the grand total of industries increases in response to higher output growth. This response reflects the statistically significant and positive responses of lending to growth in construction, trade, and services. At least for the construction sector, the positive reaction of bank lending is influenced by the 1992-1995 re-unification construction boom. The opposite relationship exists for the manufacturing sector, suggesting that manufacturing firms demand less credit in response to output growth. Deutsche Bundesbank (1996) arrives at a similar conclusion. Possible reasons are higher internal flows of finance which reduce external financing needs and/or the absence of promising economic prospects which yield disincentives for investment. Indeed, German manufacturing has experienced a continuous decline in terms of relative value added during the 1990s. Next to the manufacturing industry, we also find an inverse relationship between lending growth and output growth for the finance sector. In contrast to the manufacturing industry, the finance sector accounts for an increasingly larger share of aggregate value added. The decline in bank lending may hence reflect the effect of higher internal cash flows which reduce the need for bank finance.

The response of bank lending growth to inflation is significant and positive for the grand total of industries. This reflects a positive response in almost all industries. The exceptions are the transport and finance industry. Bank lending to the transport sector significantly contracts in response to higher industry inflation. Bank lending to the finance industry, in turn, does not significantly respond to

[12] Results for the specifications using other bank characteristics are available on request.

industry inflation.

Turning to the response of bank lending to changes in interest rates, the evidence in Table 4 confirms the view that interest rate increases lead to a contraction in lending to the grand total of industries. The decline in bank lending reflects the negative effect of higher interest rates on bank reserves and credit rationing on the part of banks in response to an increase in the risk of loan default. We find substantial cross-industry variation in the response of bank lending to interest rates. A negative response is found in the energy, manufacturing, and transport industries, with the interest rate effect being most pronounced for the first two sectors. We attribute this to the comparatively high capital intensity of production (Deutsche Bundesbank, 1996). In contrast, a monetary policy contraction induces higher lending to the construction, trade, and finance industries.

The positive interest rate response of lending to construction is inconsistent with expectations. A potential explanation may be found in the specific structural and cyclical characteristics of the construction sector. The construction industry is characterized by a large share of small firms which predominantly obtain credit from local credit cooperatives and regional savings banks. Knowledge of local market conditions and local debtors reduces information asymmetries and fosters 'housebank' relationships. During periods of high interest rates and low demand, housebank relationships facilitate the access to bank finance. Considering cyclical factors, the positive interest rate response of bank lending reflects the demand-driven re-unification boom in construction. During the 1991-1992 period of high interest rates, demand for residential buildings and production plants was high and even continued to increase.

The positive interest rate response of bank lending to the finance industry may be explained in terms of financial stability considerations. A contraction in monetary policy lowers the net present value of financial assets and impedes the ability of finance and insurance companies to generate profits on asset portfolios. As a result, portfolio holders may withdraw their funds from the finance sector. Besides return considerations, portfolio holders may also withdraw funds to accommodate the negative effect

of higher interest rates on internal cash flows. The drain of funds reduces the ability of finance and insurance companies to meet liquidity requirements. This development may constitute a threat to the stability of the sector. In view of this, the positive response may describe the efforts of banks to ensure the stability of the financial system.

Overall, the evidence illustrates that the use of aggregate lending provides an incomplete view on the bank lending effects of credit demand and monetary policy. Our results indicate that the direction and strength of bank lending effects depend on the industry composition of credit portfolios. In turn, this suggests that the effectiveness of monetary policy may also depend on industry structure.

5.2.2 The Interaction between Bank Characteristics and Monetary Policy

So far, the discussion has focused on the direct effects of monetary policy on bank lending growth. This section analyzes the interaction terms between bank characteristics and monetary policy to draw conclusions about the existence of a bank lending channel and the bank variable through which the channel operates. Table 5 contains the estimates of the interaction term coefficients that capture industry-specific bank lending effects of monetary policy associated with cross-bank differences in asset size, capitalization, liquidity, or short-term interbank claims. Conclusions regarding the bank lending effects of monetary policy transmission are sensitive to the choice of bank characteristic and vary with the choice of industry.

< Table 5 >

The evidence lends strong support to the existence of bank size effects in monetary policy transmission. For the grand total of industries and for almost all sampled industries, a monetary policy contraction causes bank lending of large banks to adjust less than bank credit of small banks. That is, large banks are better able to insulate their lending activities against monetary-policy-induced changes in the availability of funding. Inconsistent with the credit channel theory, the interest rate response of bank lending to the finance industry is more pronounced for large than for small banks. This finding possibly reflects the importance of commercial banks as source of lending to the finance industry

(Table 1) and the fact that commercial banks are on average larger in terms of asset size than savings banks and credit cooperatives. Insignificant effects are recorded in estimations for the construction and transport sector.

In contrast to bank asset size, cross-bank heterogeneities in capitalization do not explain cross-bank differences in the interest rate sensitivity of credit to the grand total of industries and to most individual industries. The exception is lending to agriculture, finance, services, and manufacturing. Except for the agricultural sector, better capitalized banks adjust lending less than poorly capitalized banks.

Cross-bank asymmetries in the monetary policy response of lending can be attributed to cross-bank heterogeneities in liquidity. As discussed, the liquidity effects of monetary policy are separately identified for a broad and narrow measure of liquidity and for short-term interbank claims. The evidence shows that broad and/or narrow liquidity significantly attenuate the interest rate response of lending to the grand total of industries and to the agricultural, construction, trade, and transport industry. The evidence only lends weak support to the role of short-term interbank claims as determinant of liquidity effects. Indeed, significant short-term interbank effects are confined to few industries: construction, trade, and transport. In addition, because interbank claims are insignificant in explaining the interest rate response of lending to industries for which bank asset size possesses explanatory power, bank asset size appears to capture the bank lending effects of information asymmetries. That is, the evidence in the present study does not lend support to the finding of Worms (2003) according to which interbank claims dwarf the effects associated with bank asset size.

Overall, the evidence lends weak support to the transmission of monetary policy changes through bank lending. More importantly, the conclusions as to the bank lending effects of monetary policy are sensitive to the choice of industry. This provides suggestive evidence of the existence of industry effects of monetary policy on bank lending through the credit supply side. In view of this, studies for the grand total of industries are likely to provide an incomplete view of the credit channel effects of

monetary policy.

5.2.3 Comparison with other Results

For the grand total of industries, our evidence can be compared with that of existing studies. Our results only partly match those in Ehrmann et al. (2003) and Worms (2003). Possible sources of divergence are our exclusion of household lending from the analysis, the use of a different outlier adjustment procedure and, most importantly, a different estimation method. Earlier studies estimate the dynamic panel model with GMM. We find this estimator to be inapplicable and prefer the fixed effects panel estimator.

Both our finding that bank lending grows in response to output growth and inflation and declines in the wake of monetary contraction and our finding that cross-bank differences in the interest rate sensitivity of aggregate bank credit cannot be attributed to differences in capitalization, but to differences in liquidity are consistent with Ehrmann et al. (2003). On the other hand, our evidence suggests that bank size is an appropriate proxy of bank lending effects of monetary policy, which is in contrast with Worms (2003) and Ehrmann and Worms (2004).

6. Conclusions

This paper uses a unique dataset with bank-level data on balance sheet items and industry lending to investigate the bank lending effects of credit demand and monetary policy for Germany over the period 1992-2002. In contrast to existing work, we focus on customer heterogeneity by estimating the industry effects of bank lending. In line with earlier studies, we use bank asset size, capitalization, liquidity, and short-term interbank claims as proxy variables of cross-bank differences in the severity of information asymmetries.

Our empirical findings suggest that bank lending growth predominantly depends on the industry composition of bank loan portfolios and the underlying cyclical fluctuations in bank credit demand. Credit supply effects of monetary policy changes depend on bank asset size and bank liquidity, but not

on capitalization and interbank claims. As the magnitude of the credit supply effect differs across industries, the aggregate credit supply effects of monetary policy again depend on the industry composition of a credit portfolio. The evidence thus strongly points to the importance of the industry composition of bank credit portfolios as determinant of monetary policy effectiveness. Overall, we conclude that research on monetary policy transmission should take industry effects into account. In the end, to investigate the ultimate sources of credit heterogeneity across firms and banks in Germany, information on the firm level, including among others size, capitalization, capital-intensity, operational risk, and operating surplus, will be necessary in our view. This falls beyond the scope of the current paper and is left for future research.

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Table 1: Summary Statistics of Short-Term Bank Lending to Industries 1992:1-2002:4

Lending to:	N	Mean	Stdev	Skew.	Kurtosis
Agriculture					
Commercial BG	3,060	0.04	0.10	6.35	48.10
Savings BG	24,292	0.04	0.04	3.06	17.56
Cooperative BG	93,216	0.13	0.13	1.88	7.59
Energy					
Commercial BG	2,564	0.04	0.12	6.06	47.45
Savings BG	17,606	0.01	0.02	7.37	95.52
Cooperative BG	33,024	0.01	0.03	9.52	191.63
Construction					
Commercial BG	3,916	0.06	0.06	2.38	14.02
Savings BG	25,030	0.15	0.06	1.00	4.84
Cooperative BG	94,296	0.17	0.10	1.35	6.64
Trade					
Commercial BG	5,308	0.33	0.27	1.23	3.69
Savings BG	24,939	0.25	0.08	0.54	4.23
Cooperative BG	94,422	0.22	0.11	0.98	7.19
Transport					
Commercial BG	3,960	0.03	0.05	4.13	28.94
Savings BG	24,720	0.03	0.03	4.06	37.58
Cooperative BG	83,667	0.03	0.06	63.72	8,349
Finance					
Commercial BG	5,088	0.11	0.35	24.50	925.41
Savings BG	24,392	0.01	0.01	8.79	149.53
Cooperative BG	70,116	0.01	0.03	19.00	600.86
Services					
Commercial BG	5,367	0.42	0.98	64.95	4,565
Savings BG	25,031	0.31	0.12	0.61	3.54
Cooperative BG	95,445	0.25	0.15	1.41	6.85
Manufacturing					
Commercial BG	4,957	0.22	0.18	1.91	10.45
Savings BG	25,039	0.22	0.10	0.91	4.04
Cooperative BG	95,240	0.21	0.11	1.14	6.13

Short-term lending to industry i is expressed relative to short-term lending to the grand total of industries. The data are from the quarterly borrower statistics of the Deutsche Bundesbank. For each banking group, the sum of the means deviates from one due to rounding and due to the use of unbalanced sets of bank-quarter observations. Besides missing observations, the cross-industry differences in the number of bank-quarter observations also result from the removal of outliers.

Table 2: One-Way ANOVA Test Statistics: Bank Characteristics versus Industry

Long-Run Coef.:	Source of Variation	SS	DF	MS	F-statistic
ΔIP	Bank Characteristics	0.043	4	0.011	0.003
	Industry	164	40	4.11	
ΔPrice	Bank Characteristics	0.669	4	0.167	0.043
	Industry	157	40	3.93	
ΔIR	Bank Characteristics	0.0002	4	0.0000	0.086
	Industry	0.024	40	0.001	

Notes: Notes: Columns 3 to 6 report the results for the hypothesis that the long-run elasticities do not differ across estimates that differ in the choice of bank characteristic (bank asset size, bank capitalization, narrow liquidity, broad liquidity or short-term interbank claims). The ANOVA test statistics are reported for short-term lending by the aggregate banking group. In this table, the variation between industries reflects the within groups variation.

Table 3: Two-Way ANOVA Test Statistics: Banking Group versus Industry

Long-Run Coef.:	Source of Variation	SS	DF	MS	F-statistic
ΔIP	Banking Group	12.66	3	4.22	0.88
	Industry	141	7	20.19	4.21*
ΔPrice	Banking Group	19.92	3	6.64	1.25
	Industry	140	7	20.07	3.77*
ΔIR	Banking Group	0.001	3	0.0004	1.31
	Industry	0.025	7	0.004	11.80*

Notes: The results refer to estimations with bank asset size. The banking group involves savings banks, rural and commercial credit cooperatives, and Raiffeisen banks. The industry dimension includes 8 industries at the one-digit level.* denotes the statistical significance at the one percent level.

Table 4: Long-Run Coefficients for Short-Term Lending by the Aggregate Banking Group

	Total	Agriculture	Energy	Construction	Trade	Transport	Finance	Services	Manufacturing
Long-Run Coef.									
ΔIP	0.539*	0.257	1.173	0.716*	1.724*	0.169	-5.550*	1.456**	-0.588*
	(0.100)	(0.158)	(1.422)	(0.100)	(0.269)	(0.323)	(0.529)	(0.611)	(0.139)
ΔPrice	3.535*	0.462*	4.712*	5.248*	1.436*	-0.392***	0.178	1.882*	2.969*
	(0.206)	(0.135)	(1.720)	(0.273)	(0.083)	(0.228)	(0.617)	(0.221)	(0.589)
ΔIR	-0.023*	0.001	-0.074*	0.007*	0.009*	-0.008**	0.032*	-0.003	-0.009*
	(0.001)	(0.002)	(0.015)	(0.003)	(0.002)	(0.004)	(0.011)	(0.002)	(0.003)
Size*ΔIR	0.003*	0.005*	0.024*	-0.001	0.006*	0.003	-0.010**	0.004*	0.006*
	(0.001)	(0.001)	(0.008)	(0.002)	(0.001)	(0.002)	(0.004)	(0.001)	(0.001)
Short-Run Coef.									
$Size_{t-1}$	0.015*	-0.014*	0.069**	-0.010**	0.008***	0.004	0.108*	0.023*	-0.002
	(0.002)	(0.005)	(0.031)	(0.005)	(0.004)	(0.008)	(0.016)	(0.005)	(0.004)
Obs	91,047	85,083	28,012	87,533	87,408	75,907	54,406	88,32	89,297
# Banks	3,397	3,281	1,900	3,342	3,356	3,151	2,812	3,389	3,370
R2-adj.	0.03	0.05	0.11	0.04	0.05	0.05	0.06	0.02	0.05
AR(1)	0.26	0.08	0.88	0.25	0.10	0.08	0.87	0.08	0.15
AR(2)	0.03	0.25	0.08	0.06	0.05	0.03	0.07	0.04	0.10

Table 5: Long-Run Interaction Coefficients per Industry

	Bank Characteristic				
	Size	Cap	Bliq	Nliq	Ibk
Industry					
Total	0.003*	0.162	0.061*	0.064*	0.025
	(0.001)	(0.112)	(0.013)	(0.013)	(0.027)
Agriculture	0.005*	-0.734*	0.084*	0.074*	0.030
	(0.001)	(0.213)	(0.023)	(0.024)	(0.049)
Energy	0.024*	-1.903	0.216	0.126	0.364
	(0.008)	(1.143)	(0.135)	(0.137)	(0.280)
Construction	-0.001	0.164	0.045***	0.022	0.103***
	(0.002)	(0.237)	(0.026)	(0.027)	(0.056)
Trade	0.006*	0.140	0.043**	0.018	0.090**
	(0.001)	(0.179)	(0.021)	(0.022)	(0.046)
Transport	0.003	0.333	0.033	0.084**	-0.207**
	(0.002)	(0.376)	(0.041)	(0.042)	(0.086)
Finance	-0.010**	1.514*	0.044	0.111	-0.222
	(0.004)	(0.584)	(0.074)	(0.075)	(0.166)
Services	0.004*	0.386***	0.004	0.018	-0.041
	(0.001)	(0.208)	(0.025)	(0.025)	(0.052)
Manufacturing	0.006*	0.515*	-0.010	0.007	-0.035
	(0.001)	(0.192)	(0.021)	(0.021)	(0.045)