

## **Heterogeneity in lending and sectoral growth: evidence from German bank-level data**

Claudia M. Buch

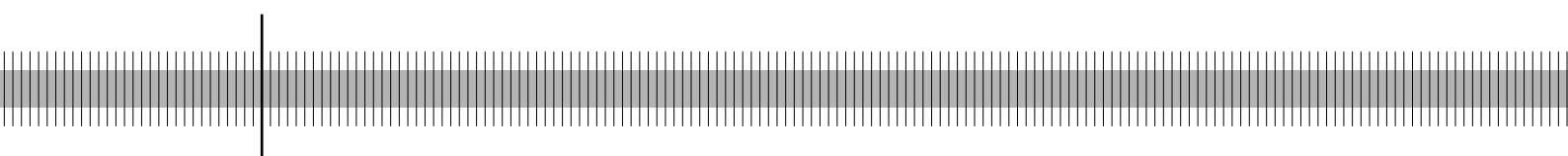
(University of Tuebingen and Kiel Institute for World Economics)

Andrea Schertler

(Christian-Albrechts-University of Kiel)

Natalja von Westernhagen

(Deutsche Bundesbank)



Discussion Paper  
Series 2: Banking and Financial Studies  
No 04/2006

**Editorial Board:**

Heinz Herrmann  
Thilo Liebig  
Karl-Heinz Tödter

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,  
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-1

Telex within Germany 41227, telex from abroad 414431, fax +49 69 5601071

Please address all orders in writing to: Deutsche Bundesbank,  
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Reproduction permitted only if source is stated.

ISBN 3-86558-169-2 (Printversion)

ISBN 3-86558-170-6 (Internetversion)

## **Abstract**

This paper studies the sectoral and geographical dimensions of the response of bank lending to sectoral growth. We use several bank-level datasets provided by the Deutsche Bundesbank for the 1996-2002 period. Our results show that bank heterogeneity affects how lending responds to domestic sectoral growth. We document that banks' total lending to German firms reacts procyclically to domestic sectoral growth, while lending exceeding a threshold of €1.5 million to German and foreign firms does not. Moreover, we find that the response of lending depends on bank characteristics such as the banking groups, the banks' asset size, and the degree of sectoral portfolio concentration. We find that total domestic lending by savings banks and credit cooperatives (including their regional institutions), smaller banks, and banks whose portfolios are heavily concentrated in specific sectors responds positively and, in relevant cases, more strongly to domestic sectoral growth.

Keywords: bank lending, heterogeneity, sectoral growth

JEL Classification: G21, F3

## Non-technical summary

In this paper, we study sectoral and geographical dimensions of bank lending and investigate whether heterogeneity across banks influences the effects of domestic *sectoral* growth on bank *sectoral* lending. Rather than testing specific transmission channels of macroeconomic shocks, the aim of this paper is to document some stylized facts of the German banking industry.

First, we investigate whether domestic and foreign lending exceeding a threshold of €1.5 million taken from the credit register respond differently to domestic sectoral growth. Second, we examine whether domestic lending exceeding a threshold of €1.5 million and total lending from the borrowers statistics, in turn, respond differently to domestic sectoral growth. Third, we analyze whether characteristics such as bank size and bank type affect the response of bank lending to domestic sectoral growth. Finally, we investigate whether the impact of domestic sectoral growth on lending to firms in different sectors depends on the degree of sectoral domestic concentration and the degree of geographical foreign concentration in bank lending portfolios.

We use two bank-level datasets provided by the Deutsche Bundesbank on a large number of German banks for the 1996-2002 period. The first dataset is the *credit register*. The advantage of using this dataset is that it includes information on domestic and foreign exposures. However, its drawback is that it provides information only on large exposures exceeding a threshold of €1.5 million. We therefore complement it with the *borrowers statistics*. The borrowers statistics, despite having the advantage of covering total domestic lending, do not cover foreign lending.

Our results show that domestic and foreign lending exceeding a threshold of €1.5 million respond differently to domestic sectoral growth: Domestic lending does not respond to sectoral growth, while foreign lending responds negatively. Total domestic lending, by contrast, responds positively to sectoral growth. Moreover, we find heterogeneity in the response to domestic sectoral growth with respect to bank characteristics such as the size of its assets and the group a bank belongs to. Total domestic lending by smaller banks reacts to domestic sectoral growth, while lending by larger banks does not. Total domestic lending by savings banks and cooperative banks reacts positively to domestic sectoral growth, while lending by regional banks, big banks, and *Landesbanken* does not. Finally, we find heterogeneity in the response to domestic sectoral growth with respect to the degree of

concentration in banks' lending portfolios. Total domestic lending by banks whose portfolios are heavily sectorally concentrated reacts more strongly to domestic sectoral growth than lending by banks whose portfolios are less sectorally concentrated.

In sum, our results point to the importance of heterogeneity of banks in order to explain the impact of macroeconomic developments on individual loan decisions.

## **Nichttechnische Zusammenfassung**

In diesem Papier analysieren wir unterschiedliche Aspekte der sektoralen und geographischen Kreditvergabe der Banken und untersuchen, ob bankspezifische Heterogenität den Zusammenhang zwischen dem Wachstum der deutschen Bruttowertschöpfung eines Sektors und der Kreditvergabe in einem Sektor deutscher Banken in Deutschland und im Ausland beeinflusst. Die Zielsetzung dieses Papiers ist dabei nicht einzelne Transmissionskanäle makroökonomischer Schocks zu überprüfen, sondern einige stilisierte Fakten des deutschen Bankensektors zu dokumentieren.

Erstens untersuchen wir, ob das Volumen der großen Kredite (d.h. über 1,5 Millionen €) deutscher Banken an Unternehmen im In- und Ausland eines Sektors unterschiedlich auf das Wachstum der deutschen Bruttowertschöpfung in entsprechendem Sektor reagiert. Zweitens untersuchen wir, ob das Volumen der großen Kredite und das Volumen der Gesamtkredite unterschiedlich auf das Wachstum der deutschen Bruttowertschöpfung eines Sektors reagieren. Drittens analysieren wir, ob der Einfluss des Wachstums der deutschen Bruttowertschöpfung eines Sektors auf das Volumen der entsprechenden Bankkredite von den Merkmalen einzelner Banken, wie z.B. die Bankengröße, bestimmt wird. Schließlich untersuchen wir, wie die sektorale inländischer Konzentration und geographische ausländische Konzentration im Kreditportfolio der Banken den Einfluss der deutschen Bruttowertschöpfung eines Sektors auf das Volumen der Kreditvergabe der Banken bestimmt.

Für unsere Analyse verwenden wir zwei von der Deutschen Bundesbank zur Verfügung gestellte Datensätze für den Zeitraum von 1996 bis 2002. Der erste Datensatz stammt aus der Evidenzzentrale für Millionenkredite und hat den Vorteil, dass er sowohl die inländische als auch ausländische Kreditvergabe enthält. Jedoch berücksichtigt dieser Datensatz nur Kreditnehmer, deren Kreditsumme 1,5 Millionen € übersteigt. Deshalb verwenden wir zusätzlich die Kreditnehmerstatistik, die die Gesamtkredite beinhaltet. Dieser Datensatz enthält jedoch nur Angaben über die inländische Kreditvergabe.

Unsere Ergebnisse zeigen, dass das Volumen der inländischen und ausländischen großen Kredite in einem Sektor unterschiedlich auf das Wachstum der deutschen Bruttowertschöpfung in entsprechendem Sektor reagiert: Das Volumen der inländischen großen Kredite reagiert nicht, während das Volumen der ausländischen großen Kredite negativ reagiert. Hingegen reagiert das Volumen der inländischen Gesamtkreditvergabe positiv auf das Wachstum der deutschen Bruttowertschöpfung eines Sektors. Außerdem

finden wir Unterschiede in Bezug auf Bankcharakteristika wie etwa die Bilanzsumme und die Bankengruppe, der ein Kreditinstitut angehört. Das Volumen der inländischen Gesamtkreditvergabe kleinerer Banken reagiert auf das Wachstum der deutschen Bruttowertschöpfung eines Sektors, das der größeren Banken nicht. Das Volumen der inländischen Gesamtkreditvergabe von Sparkassen und Kreditgenossenschaften reagiert positiv auf das Wachstum der deutschen Bruttowertschöpfung eines Sektors, das der Regionalbanken, Großbanken und Landesbanken hingegen nicht. Darüber hinaus finden wir Heterogenität in Bezug auf den Konzentrationsgrad in den Kreditportfolios der Banken. Das Volumen der inländischen Gesamtkreditvergabe von Banken mit einer hohen sektoralen Konzentration reagiert stärker auf das Wachstum der deutschen Bruttowertschöpfung eines Sektors, als dies bei Banken mit geringer sektoraler Konzentration der Fall ist.

**Contents**

- 1 Motivation ..... 1**
- 2 Data Sources ..... 5**
  - 2.1 Credit Register ..... 5**
  - 2.2 Borrowers Statistics ..... 8**
  - 2.3 BAKIS ..... 9**
- 3 Sectoral and Geographical Dimensions of Bank Lending ..... 9**
  - 3.1 Sectoral and Geographical Structure in German Bank Lending ..... 10**
  - 3.2 The Empirical Model for Firm Location ..... 12**
  - 3.3 Regression Results ..... 15**
- 4 Heterogeneity of Banks ..... 17**
  - 4.1 Bank Characteristics ..... 17**
  - 4.2 The Empirical Model for Bank Characteristics ..... 18**
  - 4.3 Regression Results ..... 19**
- 5 Concentration in Bank Portfolios ..... 21**
  - 5.1 Sectoral and Geographical Portfolio Concentration ..... 22**
  - 5.2 The Empirical Model for Portfolio Concentration ..... 23**
  - 5.3 Regression Results ..... 24**
- 6 Conclusions ..... 25**
- 7 References ..... 28**



# Heterogeneity in Lending and Sectoral Growth: Evidence from German Bank-Level Data\*

## 1 Motivation

The impact of economic growth on bank lending has been a recurrent theme in discussions on the role of the banking system for the real economy. In Germany, this discussion has been fuelled recently by a decline in real lending, which could be an indication of a credit crunch. During the period from 2003 till 2005, annual growth rates of lending to domestic firms and households have been negative. At the same time, real GDP growth has been sluggish. Hence, at the aggregated level, bank lending seems to have behaved procyclically.

At the same time, the response of bank lending to economic growth, in fact, seems to be quite heterogeneous. For the German banking system, Ehrmann and Worms (2004) show that lending by small banks which do not belong to liquidity networks of credit cooperatives or savings banks reacts differently to macroeconomic developments than lending by big banks and small banks which belong to liquidity networks. In a similar vein, Kakes and Sturm (2001) point out that German credit cooperatives and savings banks typically have a sufficient liquidity buffer to withstand macroeconomic shocks.

---

\* Corresponding author: Andrea Schertler, Lehrstuhl für Finanzwirtschaft, Christian-Albrechts-Universität zu Kiel, Institute für Betriebswirtschaftslehre, Olshausenstr. 40, 24098 Kiel, Germany, Phone: +49 431 880 4748, E-mail: a.schertler@bwl.uni-kiel.de.

This paper represents the authors' personal opinion and does not necessarily reflect the views of Deutsche Bundesbank or their staff. Financial support from the European Commission DG Research in cooperation with DG ECFIN and DG ESTAT (Contract No. SCS8-CT-2004-502642) is gratefully acknowledged. Part of this paper has been written while Andrea Schertler has visited the National Bureau of Economic Research (NBER), Cambridge MA. The hospitality of the NBER is gratefully acknowledged. Also, the authors would like to thank Thilo Liebig and the Department for Banking and Financial Supervision of the Deutsche Bundesbank for research support, for making available data on German banks, and facilities. In addition, we thank Holger Wolf, Stéphanie Stolz and Ingrid Stein for helpful comments. All errors and inaccuracies are solely in the authors' responsibility.

Earlier literature has also provided evidence on the bank lending channel, i.e. the reaction of bank lending to monetary policy shocks.<sup>1</sup> Given the dominant role of German banks for the financing of firms, this channel has been the subject of extensive research. Results by Favero et al. (1999) do not support the bank lending channel for Germany. In this sense, evidence for Germany is consistent with international studies, which tend to find support for a broad credit channel rather than a narrowly defined bank lending channel (Walsh 1998: 319). Hence, the availability of external finance seems to matter for the propagation of monetary policy shocks, but banks do not appear to play a specific role in this propagation mechanism.

For Germany, Ehrmann and Worms (2004) document that small banks that have access to liquidity through their head institutions respond to macroeconomic developments similarly to large banks. Liquidity networks are likely to limit the exposure of small credit cooperatives and savings banks to macroeconomic shocks.

Rather than testing specific transmission channels of macroeconomic shocks, the aim of this paper is to document some stylized facts of the German banking industry. To study the impact of domestic sectoral growth on German banks' sectoral lending, we use two datasets. We make full use of the datasets by looking at sectoral and geographical dimensions of bank lending, whereby we differentiate between domestic and foreign bank lending. Moreover, in contrast to earlier work on the lending behavior of German banks, our datasets allow taking different layers of heterogeneity across banks into account.

First, we distinguish the ways in which domestic and foreign<sup>2</sup> sectoral lending respond to domestic sectoral growth. Before analyzing empirically the response of bank lending to domestic sectoral growth we describe the structure of sectoral domestic and foreign lending.

---

<sup>1</sup> Early theoretical models of the bank lending channel emphasize the effects of monetary policy measures on the reserve position of banks (Walsh 1998: 286).

<sup>2</sup> Foreign lending refers to lending of German banks and their subsidiaries to firms abroad.

By doing so we look at different dimensions of domestic and foreign sectoral lending, which show the relative importance of lending to individual sectors, the number of banks and firms in each sector, the average lending per firm in each sector. We expect to find differences with regard to the regional dimension of bank lending since banks typically face higher information and transactions costs in cross-border lending compared with domestic lending. Thus, an increase in domestic sectoral growth is likely to cause domestic lending to increase more rapidly than foreign lending. Foreign lending might even be reduced if domestic investment opportunities improve relative to foreign investment opportunities.

Second, we study whether bank lending exceeding a threshold of €1.5 million from the credit register and total lending from the borrowers statistics to domestic firms react differently to domestic sectoral growth. The credit register is biased towards larger banks and larger firms. Comparing the two datasets can provide insights into the differences in the response of large- and medium-sized firms and small firms to domestic sectoral growth insofar as large loans typically are given to larger firms. We expect these differences since firms demanding large volumes of credit might have access to other sources of finance when business conditions improve. Firms demanding small credit volumes, by contrast, are likely to be more credit-constrained. Hence, lending to small firms might behave more procyclically.

Third, we analyze whether bank characteristics affect the response of sectoral lending to domestic sectoral growth. Again before testing empirically the differences in the response of bank lending to domestic sectoral growth, we describe banking groups according to their bank characteristics, such as e.g. their asset size. Recent literature suggests that lending by smaller banks with less liquid balance sheets reacts more strongly to macroeconomic shocks (Kashyap and Stein 1995, 1999, De Bondt 2000, Kakes and Sturm 2001).<sup>3</sup> There are several

---

<sup>3</sup> Recent empirical literature has also found a link between the capitalization of banks and their lending activity following monetary shocks (Ehrmann et al. 2003, Altunbas et al. 2002).

possible explanations for this. Smaller banks face more severe information problems and might have only limited access to alternative sources of financing, such as interbank loans, and will consequently not be able to absorb macroeconomic shocks as easily as larger banks. Larger banks, by contrast, have superior access to non-deposit funding, which enables them to better withstand macroeconomic shocks. We revisit this question by splitting our data into banks of different sizes and into different banking groups.

Finally, we study the lending behavior of banks with different degrees of sectoral and geographical concentration in their lending portfolios. Theoretical work by Winton (1999) suggests that banks face a trade-off between portfolio concentration and portfolio diversification. Portfolio concentration lowers information costs, but it also increases the exposure of banks to sectoral and domestic shocks. Our data provide information on banks' strategies regarding their sectoral and geographical patterns of portfolio concentration.

Constructing the Herfindahl indexes allows us to analyze these strategies by looking at the sectoral portfolio concentration for all banks, big banks and for *Landesbanken*. We also analyze the strategies of banks in the geographical portfolio concentration by considering two banking groups such as big banks and the *Landesbanken*, which are most active in foreign lending. However, we expect banks whose lending portfolios are diversified across many sectors to react less strongly to domestic sectoral growth than banks whose lending portfolios are more concentrated on particular sectors.

The remainder of this paper is organized as follows. In Section 2, we describe the datasets. In Section 3, we discuss the sectoral structure in domestic and foreign lending by German banks based on the credit register. Moreover, we analyze whether the total sectoral lending and the sectoral lending exceeding a threshold of €1.5 million respond different to domestic sectoral growth by using the credit register and the borrowers statistics. We find differences in the response of domestic and foreign lending to domestic sectoral growth. In Section 4, we first

describe different banking groups according to their bank characteristics. To analyze the importance of the heterogeneity across banks for the impact of the domestic sectoral growth on bank lending we slice our data according to bank-specific characteristics, i.e. banks' asset size and the banking groups. We find that the impact of domestic sectoral growth on bank sectoral lending depends on the size and the type of a bank. In Section 5, we describe the degree of sectoral and geographical concentration in banks' lending portfolios. We find that total lending by banks whose portfolios are heavily concentrated reacts more strongly to domestic sectoral growth than lending by banks whose portfolios are less concentrated. In Section 6, we summarize our main results and outline some future research questions.

## 2 Data Sources

The empirical analysis in this paper is based on annual data for German banks. Data are available from 1996 to 2002. The data have been taken from three data sources: the credit register, the borrowers statistics, and BAKIS (the BAKred<sup>4</sup> Information System).

### 2.1 Credit Register

The Deutsche Bundesbank's credit register is one of the main data sources that we use in this paper. It contains information on large exposures of at least €1.5 million (formerly DM3 million). German banks are required to report their exposures at the end of each quarter to the Bundesbank if total exposures to a particular borrower or the sum of exposures across the borrowers belonging to single borrower unit has exceeded the threshold of €1.5 million during that period.<sup>5</sup>

---

<sup>4</sup> BAKred is short for *Bundesaufsichtsamt für das Kreditwesen* (the German Federal Banking Supervisory Office), one of the three supervisory agencies that merged in 2002 to form the current national supervisor, BaFin (*Bundesanstalt für Finanzdienstleistungsaufsicht*).

<sup>5</sup> For a more detailed definition see Section 19 of the Banking Act (Deutsche Bundesbank 2001).

The credit register includes information on banks and their foreign subsidiaries, which are included as separate individual entities, i.e. the data are not consolidated<sup>6</sup>. At the end of 2002, exposures by foreign subsidiaries of German banks were €71 billion in the 4th quarter of 2002: total foreign exposures were €580 billion. Unfortunately, foreign subsidiaries and German banks cannot be consolidated. In this paper, we focus only on banking groups which are largely involved in lending to firms. Therefore, we consider big banks, regional banks, *Landesbanken* and savings banks, credit cooperatives and regional institutions of credit cooperatives. Additionally, we adjust our banking sample for mergers. The treatment of mergers is described in more detail in section 2.3.

The data contain information on large exposures to individual borrowers. They contain information on bank exposures not only to non-financial firms but also to firms operating in the financial sector. In this paper, only exposures to non-financial firms is considered, so that we can focus on corporate firm-specific heterogeneity. We distinguish between 14 sectors, including the services sectors (see Table 1). We apply the NACE Rev. 1 sector classification and consider all sectors except “J. Financial Intermediation”.

The important feature of the credit register is that it allows us to construct foreign and domestic large exposures for each German bank. This enables us to analyze whether foreign sectoral large exposures and domestic sectoral large exposures react differently to sectoral domestic growth. Since some firms in the credit register do not have exposures exceeding the threshold of €1.5 million on a regular basis, we focus only on those firms that have such exposures in at least two successive quarters.<sup>7</sup> Moreover, if exposures of €1.5 million or more existed during the reporting period but had been fully repaid by the reporting date, the

---

<sup>6</sup> The consolidation of the data implies that the inter-office positions between a head institution and its domestic and foreign subsidiaries should be netted out and the positions should be allocated to a single corporate banking group (*Konzern*).

<sup>7</sup> The loans received in a starting quarter are also taken into account if they are carried over to the following quarter. In this case, we do not take zero reporting into account.

reported volume of the exposures is zero. We thus focus only on exposures that had a strictly positive value at the end of each reporting period (Table 1a). For the purpose of comparison we also provide figures without excluding firms, which do not appear in the credit register on a regular basis and firms with zero exposures. These figures are reported in Table 1b. The figures in Table 1b are calculated from the same banking sample as the figures in Table 1a<sup>8</sup>. Solely, the banking sample is adjusted for mergers in Table 1a and the banking sample is taken without making the adjustment for mergers in Table 1b. However, comparison of the figures in Table 1a and the figures in Table 1b shows that there is a considerable number of firms, which do not appear in the credit register on a regular basis or report zeros instead of real exposures.

By construction, the credit register contains only large exposures. Therefore, loans to smaller and medium-sized firms, which might be provided especially by small and medium-sized banks, might be underrepresented in this dataset. As regards foreign loans, however, German banks' exposures are quite well-represented in the credit register, the reason being that foreign loans are larger, on average, than domestic loans (Table 1).

Another shortcoming of the credit register should be mentioned. Since the data in the credit register have been primarily gathered for regulatory rather than research purposes, the credit register may overstate and even double-count exposures (Deutsche Bundesbank 1998). Actual exposures of firms to banks are overstated since we include both on-balance sheet and off-balance sheet positions. Some off-balance sheet exposures do not appear to be direct exposures to a firm but e.g. guarantees for this firm's loans from another bank. Therefore, the inclusion of off-balance sheet exposures, which in reality represent guarantees, leads to actual exposure being overstated. Actual exposures are double-counted in some cases, though, since

---

<sup>8</sup> Our banking sample consists big banks, regional banks, *Landesbanken* and savings banks, credit cooperatives and regional institutions of credit cooperatives.

the credit register includes exposures not only at the level of a borrower but also at the level of the “single borrower unit”. If the sum of exposures across firms which belong to the single borrower unit exceeds the threshold of €1.5 million, the exposure of each firm within the borrower unit has to be reported separately. The positions that might arise between the firms within a borrower unit should be netted out. In addition, actual exposures are double-counted when partners of companies under civil law (*Gesellschaft bürgerlichen Rechts*, GBR) are jointly accountable for losses. In this case, the exposure of the GBR is also reflected in the position of each partner with the same amount. Unfortunately, we cannot adjust the data for overstating and double-counting.

From the perspective of this paper, the credit register has the additional shortcoming that it does not report only lending but total large exposures. Unfortunately, it is not possible to differentiate between different exposure positions, i.e. to calculate lending which is comparable to the lending which we get from the borrowers statistics. Nevertheless, we will use the term lending exceeding a threshold of €1.5 million when referring to large exposures from the credit register.

## **2.2 Borrowers Statistics**

Since only large exposures are reported in the credit register we complement the credit register by using the borrowers statistics (*Kreditnehmerstatistik*).<sup>9</sup> The advantage of this second dataset is that it does not have any reporting thresholds. The disadvantage is that it provides information only on total domestic lending in each sector. We can therefore analyze whether lending exceeding a threshold of €1.5 million and total lending react differently to domestic sectoral growth. The borrowers statistics data are not consolidated. Also, we do not have information on bank lending to particular firms. Rather, all loans of a particular bank are

---

<sup>9</sup> A detailed definition of the loans in the borrowers statistics and the group of borrowers may be found in Deutsche Bundesbank (2004). According to this definition, we use loans plus mortgage loans.



aggregated at the sector level. However, the borrowers statistics contain detailed sectoral information. This allows us to use the same sectoral structure for the credit register and the borrowers statistics and to compare the impact of domestic sectoral growth on lending exceeding a threshold of €1.5 million and on total domestic lending.

## **2.3 BAKIS**

The third data source that we use is BAKIS. BAKIS has information from bank balance sheets and from supervisory reports of all German banks. We used this dataset to identify the banking group to which a bank belongs and the size of the bank in terms of assets. In addition, we use the BAKIS dataset to construct various bank-specific control variables, which we will discuss in the next section.

Over the 1996-2002 period, many bank mergers took place. To handle mergers, we separate the two pre-merger banks from the merged bank. At the end, we thus have three banks, which are treated independently. We repeat this procedure as often as a merger took place. Because of this procedure, some banks dropped from our sample because the number of observations over time was too small to estimate a dynamic model. Additionally, in order to avoid the double counting of banks in the year of the merger, we dropped target banks in the year of the acquisition.

## **3 Sectoral and Geographical Dimensions of Bank Lending**

The geographical location of a firm is likely to affect the impact of growth at the sectoral level on bank lending. Due to information and transaction costs, it may be more costly for banks to adjust foreign lending positions than domestic lending positions. Cross-border lending entails fixed costs for first-time entrants into foreign markets and variable costs on a deal-to-deal basis. Larger banks are likely to find it easier to shoulder the fixed costs of lending. This not

only explains why larger banks are more likely to lend across borders but may also affect the impact of cyclical fluctuations on domestic and foreign lending.

There are three parts to this section. In the first part, we offer descriptive statistics on the importance of domestic and foreign lending on a sectoral basis. We do not have information on the nationality of a firm to which a bank lends. Hence, foreign lending also includes lending to domestic firms that are active abroad. In the second part, we introduce our empirical model and our bank-specific control variables. In the third part, we analyze the effects of domestic sectoral growth on domestic and foreign lending.

### **3.1 Sectoral and Geographical Structure in German Bank Lending**

Before analyzing the response of lending to domestic sectoral growth, we will describe the sectoral and geographical structure in German banks' lending. Recent literature has pointed out that firms operating in various sectors differ in their external finance dependence (Rajan and Zingales (1998) and Fisman and Love (2003)).<sup>10</sup> Thus, credit demand is likely to differ from sector to sector. Lending to sectors that are heavily dependent on external finance should react differently to domestic sectoral growth than lending to other sectors. Greater dependence is likely to cause lending to respond more strongly to domestic sectoral growth.

Table 1a, which is based on data taken from the credit register, shows the importance of lending to individual sectors. Overall, the real estate sector dominates domestic lending, accounting for 34% of the total. Services, computer and R&D make up 18%, and the trade, and repair of motor vehicles sector only 4%. The relative importance of the sectors is likewise reflected in the number of banks that are active in each sector.

---

<sup>10</sup> External finance dependence is measured as capital expenditures minus cash flow over capital expenditures. Hence, a negative value indicates that cash flow exceeds capital expenditures and the industry does not require external finance.

The structure of foreign lending differs from the structure of domestic lending. Here, the real estate sector accounts for only 14% of foreign lending. The most important difference is the energy sector's large share of foreign lending compared to domestic lending (15% versus 4%). Another striking difference between domestic and foreign lending is the number of banks active in each sector and the average lending size per firm.<sup>11</sup> For example, in the sector services, computer and R&D, about 1,300 banks are active domestically, while only about 300 banks are active abroad. In all sectors the average lending size per firm is higher for foreign lending than for domestic lending. Due to the €1.5 million cut-off, this implies that foreign lending of German banks is much better represented in this dataset than domestic lending. Overall, compared to domestic lending, a smaller number of banks have larger average foreign lending. This indicates larger fixed costs associated with foreign bank lending.

One reason for the higher average foreign lending per firm might be that the credit register includes only exposures exceeding €1.5 million. Thus, domestic lending per firm might be relatively low because we also include banks that might not be active abroad. These, presumably, smaller banks may give smaller loans than the presumably larger banks which are active abroad.<sup>12</sup> To check whether small banks drive our results, we calculated the average lending size per firm for two banking groups<sup>13</sup> that are most active abroad: big banks<sup>13</sup> and *Landesbanken* (Figure 1). Within the credit register, these two banking groups are of particular relevance. At the end of 2002, the big banks accounted for 35 percent, and the *Landesbanken* for 30 percent of foreign lending by German banks. Looking at these two

---

<sup>11</sup> We calculate the lending size per firm by dividing aggregate lending of each bank towards a particular sector (region) by the number of firms in this sector (region).

<sup>12</sup> Recent literature has argued that the loan size is correlated with the bank size (Kishan and Opiela 2000).

<sup>13</sup> This group of banks includes *Deutsche Bank AG*, *Dresdner Bank AG*, *Commerzbank AG*, and *Bayerische Hypo- und Vereinsbank AG*. Before 1998, there were only three big banks (*Deutsche Bank AG*, *Dresdner Bank AG*, *Commerzbank AG*). In 1998, the merger of *Bayerische Hypo- und Wechselbank AG* with *Bayerische Vereinsbank AG* created an additional big bank.

groups of large banks, however, we see that differences between domestic lending per firm and foreign lending per firm are as pronounced as in the full sample. Differences in the size of domestic versus foreign lending do not seem to be driven by differences between lenders but rather by borrower differences or differences in transaction costs.

Loan demand factors might thus be a second reason for different sizes of domestic and foreign loans. German firms' foreign investments might be larger than domestic investments and thus require more external finance, especially when the foreign country operates in a significantly different framework from that of the domestic country. Therefore, we calculated domestic lending per firm and lending per firm in European countries for big banks and *Landesbanken*. We find pronounced differences in domestic lending per firm and foreign lending per firm indicating that different sizes of domestic and foreign lending are not solely driven by loan demand factors.

Transaction costs are a third source of differences between domestic and foreign lending per firm for at least two reasons. First, it is easier for banks to collect information on domestic firms than on foreign firms. Second, banks are likely to have more experience in the domestic regulatory environment rather than the foreign regulatory environment. Thus, banks' costs of supplying loans are likely to be lower in the domestic market. In our regression analysis below, we will explore whether these presumed differences in transaction costs also affect the response of domestic and foreign lending to sectoral cyclical developments.

### 3.2 The Empirical Model for Firm Location

We are interested in analyzing whether the response of lending to domestic sectoral growth depends on the location of the borrower. Our analysis starts from the following empirical model:

$$\Delta l_{i,j,c,t} = \alpha \Delta l_{i,j,c,t-1} + \sum_{m=0}^1 SVAG_{j,t-m} \beta_m + z_{i,t} \delta + \varepsilon_{i,j,c,t} \quad (1)$$

where  $l_{i,j,c,t}$  denotes lending of bank  $i$  to sector  $j$  in country  $c$  at time  $t$ .  $\Delta$  denotes annual percentage changes.  $SVAG_{j,t}$  denotes the growth rate of real domestic value added at the sectoral level. Effects of domestic sectoral growth on lending are obtained by calculating the cumulative coefficients based on annual percentage changes that are defined as:

$\sum_{m=0}^1 \beta_m / (1 - \alpha)$ . The error term is given by  $\varepsilon_{i,j,c,t} = \gamma_{i,c} + \gamma_{j,c} + \eta_{i,j,c,t}$ , where  $\gamma_{i,c}$  and  $\gamma_{j,c}$  are bank- and sector-specific fixed effects and  $\eta_{i,j,c,t}$  is a disturbance term with  $\eta_{i,j,c,t} \sim iid(0, \sigma_\eta)$ ,  $\gamma_{i,c} \sim iid(0, \sigma_{\gamma_{i,c}})$ , and  $\gamma_{j,c} \sim iid(0, \sigma_{\gamma_{j,c}})$ . We add several bank-specific control variables, which we will discuss below, and we add year dummies in order to capture omitted macroeconomic developments.

The bank-specific control variables are borrowed from the literature on the effects of monetary policy on bank lending (for instance, Altunbas et al. 2002, Kishan and Opiela 2000). We include the Basel I capital ratio. Better-capitalized banks can increase lending more easily when business conditions improve than poorly-capitalized banks. The capital ratio is therefore expected to have a positive effect on lending. We use the lagged capital ratio in order to avoid endogeneity problems. Moreover, the lending behavior of banks is likely to depend on their asset and liability positions. We use liquid assets as a percentage of total assets, securities as a percentage of total assets, and short-term liabilities as a percentage of total assets. Banks that have many liquid assets and securities can increase lending more easily than less liquid banks. Banks that have a high share of short-term liabilities are more likely to reduce their lending in a cyclical downturn than banks with a low share of short-term liabilities. In addition, we include a set of banking group dummy variables, which are equal to one if a bank belongs to a particular banking group, and zero otherwise. We distinguish between four banking groups: (i) regional banks, (ii) big banks and *Landesbanken*, (iii) savings banks, and (iv) regional institutions of credit cooperatives and credit cooperatives. For a discussion of the differences between these banking groups see DIW (2004) and Brunner et

al. (2004). These control variables are not highly correlated; therefore, we include them jointly (Table 2).

Other control variables related to asset and liability positions such as access to interbank deposits may also serve to explain banks' lending behavior. However, as the correlation coefficients in Table 2 indicate, these variables cannot be included jointly because they are highly correlated with the asset and liability positions discussed above. In a similar vein, the size of a bank captured by its assets may explain lending behavior. However, the size of a bank is highly correlated with our control variables, so we decided to run regressions without including the size of banks. Below, we will test whether the cyclicity of bank lending differs for banks of different sizes.

Table 2 shows that changes in domestic lending, irrespective of whether we use the credit register or the borrowers statistics, are highly correlated with real domestic sectoral growth. In contrast, foreign lending is not significantly correlated with real domestic sectoral growth. To test whether domestic and foreign sectoral lending react differently to domestic sectoral growth, we estimated the empirical model given in equation (1) using the generalized method of moments (GMM) estimator proposed by Blundell and Bond (1998) and a finite sample correction proposed by Windmeijer (2005). The estimation results are consistent if we use appropriate instruments for our lagged endogenous variable and if there is no second-order autocorrelation. Therefore, we performed tests on second-order serial correlation and on overidentifying restrictions to check the validity of our instruments (Blundell and Bond 1998). As indicated by the test results presented in Table 3, the tests of overidentifying restrictions indicate validity of instruments in all specifications, and there is no second-order autocorrelation. Thus, our estimations produce consistent results.

### 3.3 Regression Results

Table 3 presents estimation results at different levels of aggregation. For our first aggregation level, we consider total lending which includes both domestic and foreign lending using the credit register. We then consider domestic and foreign lending separately. Thus, our panel variable is lending of bank  $i$  in sector  $j$  at time  $t$ . Results show that lending responds dynamically to domestic sectoral growth. While contemporaneous domestic sectoral growth has a positive and significant effect on bank lending, lagged growth has a negative, albeit insignificant, effect. The cumulative effect suggests that domestic sectoral growth has a positive, albeit insignificant, impact on growth in bank lending.

Our second aggregation level takes the geographical information of borrowers into account in order to check whether domestic and foreign lending reacts to domestic sectoral growth. Our panel variable is now either domestic or foreign lending by bank  $i$  to sector  $j$  at time  $t$ . Thus, we add up lending over all foreign countries. According to the results in column (2), domestic lending reacts positively to contemporaneous domestic sectoral growth and negatively to lagged domestic sectoral growth. Both effects are, however, not significant. According to the results in column (3), foreign lending reacts significantly negatively to contemporaneous domestic sectoral growth. The cumulative coefficient is, however, insignificant. This is consistent with the fact that higher domestic sectoral growth might offer banks better lending opportunities at home than abroad. They therefore reduce their foreign lending.

One reason for these results, which indicate that bank lending does not react procyclically, could be that only exposures above €1.5 million are included in the credit register. When business conditions improve, firms which borrow on a relatively large scale may have better access to other sources of finance, and may therefore not increase their borrowing substantially. We cannot test this hypothesis directly. However, we can reestimate our model using the Bundesbank's borrowers statistics, which contain *total* lending to domestic firms.

This allows us to verify whether bank lending reacts procyclically and to compare the response of large exposures and total domestic lending to domestic sectoral growth.

According to estimation results in column (4) of Table 3, total domestic lending reacts significantly positively to domestic sectoral growth. Both contemporaneous sectoral growth and lagged domestic sectoral growth have a positive and significant impact on domestic lending. We therefore conclude that large loans may react differently to domestic sectoral growth than small loans.

The finding that foreign lending reacts only to contemporaneous domestic sectoral growth is interesting insofar as it shows that transaction costs do not fully prevent banks from adjusting their international lending portfolios. However, this argument ignores the fact that there is a large number of banks which are not active on the international market at all. For these banks, the costs of going abroad might be prohibitively high. Within the group of internationally active banks, adjusting foreign lending in response to domestic sectoral growth does not seem to entail significant (variable) costs. Instead, once they have established an international presence, these banks seem to use their international lending portfolio to hedge themselves against adverse macroeconomic developments in the domestic market.

Looking at our bank-specific control variables, some coefficients are in line with expectations. The capital ratio has a positive and significant effect on the lending growth when using the borrowers statistics. However, it has a negative and significant effect on lending exceeding a threshold of €1.5 million. This may indicate that large banks, which are well-represented in the credit register, differ in their lending behavior from small banks, which are underrepresented in this dataset. The effect of the capital ratio on lending behavior might thus be different for small and large banks, and/or for banks in various banking groups. We will come back to this when we discuss the impact of concentration in bank lending portfolios on bank lending.



Some of the banks' asset and liability positions also affect lending growth. A higher share of short-term liabilities has a negative effect on growth in domestic lending but no effect on foreign lending. A higher securities-to-assets ratio increases lending growth, but this effect is significant only for the borrowers statistics. Liquid assets have no significant effect.

The coefficients of the banking group dummy variables indicate heterogeneity among banking groups. Savings banks have a higher growth in domestic lending than big banks and *Landesbanken*, which serve here as our reference group. This result holds when we used the credit register and the borrowers statistics. Regional banks and credit cooperatives including their regional institutions only have a higher growth in total lending than big banks and *Landesbanken*, but not in lending exceeding a threshold of €1.5 million. Interestingly, our banking group dummy variables do not help in explaining foreign lending.

## **4 Heterogeneity of Banks**

Recent literature has pointed out that the response of bank lending to macroeconomic developments depends on banks' characteristics such as their size and the banking group to which they belong. Kashyap and Stein (1995, 1999), Berger et al. (2001), Berger et al. (2005), Favero et al. (1999), Goldberg (2005) and De Bondt (2000) distinguish between large and small banks when analyzing the response of lending to monetary shocks. Kakes and Sturm (2001) analyze the response of different German banking groups. In this section, we will thus study whether bank characteristics affect how lending responds to domestic sectoral growth.

### **4.1 Bank Characteristics**

Table 4 summarizes the characteristics of the banks in our dataset at the end of 2002. We distinguish between six banking groups, and we include information from the credit register for loans of €1.5 million or more, the borrowers statistics, and BAKIS. Overall, we find that the credit register is quite representative of the German banking industry as a whole

concerning the number of banks and their market shares. Purely domestic banks are therefore relatively small in number. With regard to the number of banks, credit cooperatives including their regional institutions are most important in all three datasets, followed by savings banks. Looking at market share, the importance of big banks and *Landesbanken* is slightly higher in the credit register than in the BAKIS dataset.

Table 4 indicates substantial heterogeneity in the German banking industry. In terms of market shares, the four big banks and the *Landesbanken* account for almost 30% of total bank assets each, while savings banks account for almost 17%. These banks also differ significantly with regard to their average loan size. Whereas the big banks have an average domestic loan size of €4.2 million, *Landesbanken* have an average loan size of €8.7 million and savings banks only €1.7 million. These data confirm that small banks have smaller average loan sizes than large banks (for similar results see Peek and Rosengreen 1995 and Berger et al. 1998).

As regards the allocation of lending across sectors, there are relatively similar patterns across the various types of banks (see Figure 1). This also holds with regard to domestic and foreign lending. Again, the average size of a foreign loan is much larger than the average size of a domestic loan. Across various banking groups, *Landesbanken* give, on average, larger loans to domestic and foreign firms than big banks. The average size-per-firm of loans given by big banks exceeds the average loan size across all banking groups.

Whether this heterogeneity in the German banking industry affects the impact of domestic sectoral growth on lending patterns is an issue to which we turn next.

#### **4.2 The Empirical Model for Bank Characteristics**

In order to test whether lending reacts differently to domestic sectoral growth across large and small banks and across banking groups, we interact domestic sectoral growth with dummy variables for asset sizes and banking groups. Our empirical model now looks like this:

$$\Delta l_{i,j,c,t} = \alpha \Delta l_{i,j,c,t-1} + \sum_k D_{i,k} \sum_{m=0}^1 SVAG_{j,t-m} \beta_{m,k} + z_{i,t} \delta + \varepsilon_{i,j,c,t}, \quad (2)$$

where  $D$  denotes a vector of dummy variables. The other variables are specified as in equation (1). For asset sizes, we created the following three dummies. The first dummy is equal to one if the bank's assets are below the 25th percentile of the assets of all banks, and zero otherwise. The second dummy is equal to one if the bank's assets are above the 25th percentile but below the 75th percentile of assets, and zero otherwise. The third dummy is equal to one if the bank's assets are above the 75th percentile. For banking groups, we created dummy variables that equal one if a bank belongs to a particular banking group and zero otherwise. We again distinguish between domestic and foreign sectoral lending. Our estimation method is identical to the one described in section 3.2.

### 4.3 Regression Results

Table 5, Panel a, shows that the response of domestic and foreign sectoral lending to domestic sectoral growth depends to some extent on the size of bank assets.

When using the credit register, the growth in domestic lending reacts negatively to domestic sectoral growth only if the bank's assets are below the 25th percentile. This contrasts with the result reached by Stolz and Wedow (2005): [For savings and cooperative banks, they find that risk-weighted assets, which are probably highly correlated with lending, fluctuate procyclically]. Since especially cooperative banks are underrepresented in the credit register, columns (2)-(4) present estimation results based on the borrowers statistics to make our results comparable to the results by Stolz and Wedow. We find, in fact, that domestic lending growth reacts positively to domestic sectoral growth if the bank's assets are below the 75th percentile. Tests on equality of the cumulative coefficients indicate that the first asset group does not differ from the second asset group, while both differ significantly from the third asset group. Thus, according to the borrowers statistics lending of large banks is not procyclical, whereas lending by small and medium-sized banks is. Moreover, we checked whether the

growth in lending by savings banks reacts procyclically to domestic sectoral growth. We find a significant effect only for banks below the 25th percentile.

These pieces of evidence are consistent with small banks tending to increase lending to small firms demanding small loan volumes, while they tend to decrease lending to large firms during booms. Why might small banks increase lending to small firms and reduce lending to large firms? Small firms' credit demand may increase more than that of large firms if domestic sectoral growth increases. This may be because credit demand of small and large firms is adversely affected when domestic growth increases. Small firms are more likely to be credit-constrained than large firms (Brierley 2001, Petersen and Rajan 1994, Egelin et al. 1997). Therefore, the relative credit demand by large firms may decrease because large firms may have better access to alternative sources of finance particularly relevant during growth phases. In addition, small banks may not be able to lend to large and small firms simultaneously because of capacity constraints. This would imply that domestic sectoral growth has adverse effects on lending of small banks which are included in the credit register and on lending of small banks which are not included in the credit register.

Growth in foreign lending shows a negative response to contemporaneous domestic sectoral growth only for the mid-sized banks. The cumulative coefficient, however, is insignificant.

As for our control variables, most of the variables keep the signs and significance levels already discussed above (Table 3). Interestingly, the capital ratio is significantly positive when we use domestic lending from the borrowers statistics and all banks, while the capital ratio is insignificant when we analyze lending by savings banks only. Moreover, when we use lending from the credit register, we find, as in Table 3, that the capital ratio has a negative impact on domestic and foreign lending. Thus, better-capitalized banks reduce their large exposures.

As regards the interaction of domestic sectoral growth and dummies for banking groups, our results show that lending to domestic sectoral growth responds in a variety of ways. With respect to domestic lending exceeding a threshold of €1.5 million, we find a negative impact of domestic sectoral growth for credit cooperatives including their regional institutions. With respect to domestic total lending, we find a positive impact of domestic sectoral growth for savings banks and credit cooperatives including their regional institutions. With respect to foreign lending, we find no significant effects.

## **5 Concentration in Bank Portfolios**

The results presented in the previous section show that the impact of domestic sectoral growth on bank lending growth depends on bank characteristics. Banks respond differently to domestic sectoral growth. How they react depends on their asset size and on the banking group to which the bank belongs. In this section, we go one step further by introducing concentration in the lending portfolios of banks as another source of bank heterogeneity. We allow for sectoral and geographical concentration in bank lending portfolios.

From a theoretical point of view, we expect that banks that have heavily sectorally concentrated lending patterns and lend primarily to a particular sector will be likely to have better information on this sector than banks lending to a large number of sectors. Hence, banks are facing a trade-off between sectoral portfolio diversification, which lowers their exposure to a particular sector, and sectoral portfolio concentration, which lowers the costs of collecting information on borrowers (Saunders et al. 2002, Winton 1999). The benefits of portfolio diversification might accrue across regions but also across sectors, as different sectors may react differently to macroeconomic developments. Hence, if the economy expands, banks that are sectorally diversified can adjust their lending portfolios towards those sectors that expand. One implication of the implied trade-off between sectoral portfolio

diversification and sectoral portfolio concentration may be that the response to domestic sectoral growth differs according to the degree of sectoral portfolio concentration of banks.

Besides sectoral portfolio concentration, geographical portfolio concentration may affect the cyclicity of bank lending. More specifically, banks that hold an internationally diversified portfolio will find it easier to adjust lending away from the domestic economy if growth declines (and vice versa).

Banks whose portfolios are heavily concentrated in certain sectors might be more interested in geographical portfolio diversification than banks whose portfolios are not concentrated in certain sectors. The costs of gathering information on foreign firms that operate in the bank's field of expertise may be lower than gathering information on a domestic firm operating in a sector in which the bank has no expertise. Banks whose portfolios are concentrated may therefore increase domestic and foreign lending simultaneously and with similar intensities.

### **5.1 Sectoral and Geographical Portfolio Concentration**

To measure sectoral portfolio concentration in the lending portfolios of banks, we use the Herfindahl index. The Herfindahl index is calculated as the sum of squares of lending as a percentage of the square of total lending. For each bank  $i$  at time  $t$ , we calculated the sectoral portfolio concentration according to

$$HI_{it} = \sum_{j=1}^{14} \left( \frac{X_{ijt}}{X_{it}} \right)^2, \quad (3)$$

where  $X_j$  measures the lending towards sector  $j$ . The Herfindahl indexes are bounded by  $1/K \leq HI_{it} \leq 1.0$ . A Herfindahl index close to one means that bank lending is heavily concentrated on certain sectors. A Herfindahl index close to its minimum means that banks are highly diversified across sectors.

Figure 2 presents Herfindahl indexes (HHI) for sectoral domestic lending based on the borrowers statistics. For big banks, sectoral portfolio concentration is lower than for all banks. For *Landesbanken*, however, Herfindahl indexes are higher than for all banks. Overall, Herfindahl indexes are quite stable over time.

For geographical portfolio concentration, we also calculated Herfindahl indexes. The calculation of the geographical portfolio concentration is based on foreign lending from the credit register. We restrict our description to those banks that are most active abroad: big banks and *Landesbanken*. As Figure 3 indicates, differences between big banks and *Landesbanken* in average geographical portfolio concentration are not pronounced. In 1996, the Herfindahl indexes were about 0.12 for big banks and 0.10 for *Landesbanken*. The Herfindahl indexes for geographical portfolio concentration did not fluctuate for big banks over time, while the lending of *Landesbanken* became more concentrated geographically over time. In summary, the descriptions show some heterogeneity with respect to sectoral portfolio concentration, but only little heterogeneity with respect to geographical concentration in lending portfolios.

## **5.2 The Empirical Model for Portfolio Concentration**

In order to gain insight into whether portfolio concentration affects the response of sectoral lending to domestic sectoral growth, we use the empirical model presented in equation (2) where  $D$  is now a vector of dummy variables capturing banks' sectoral and geographical portfolio concentration.

We created three dummy variables to measure sectoral portfolio concentration. The first dummy variable is equal to one if the bank's Herfindahl index is below the 25th percentile of the Herfindahl index of all banks, and zero otherwise. These banks have a *low degree of sectoral concentration* in their lending portfolios. The second dummy variable is equal to one if the bank's Herfindahl index is above the 25th percentile but below the 75th percentile and

zero otherwise. These banks have a *medium degree of sectoral concentration* in their lending portfolios. The third dummy is equal to one if the bank's Herfindahl index is above the 75th percentile and zero otherwise. These banks have a *high degree of sectoral concentration* in their lending portfolios.

We created only two dummy variables for the degree of geographical portfolio concentration because the underlying number of banks is comparatively low. The first dummy variable is equal to one if the bank's Herfindahl index is below the 75th percentile of the Herfindahl index of all banks and zero otherwise. The second dummy variable is equal to one if the bank's Herfindahl index is above the 75th percentile. These banks have a *high degree of geographical concentration* in their lending portfolios.

### **5.3 Regression Results**

Table 6 presents the results where we interact domestic sectoral growth with our measures of sectoral and geographical portfolio concentration.

If data from the credit register are used, concentration in banks' lending portfolios has little impact on the response of lending to growth. According to the cumulative coefficients of geographical portfolio concentration interacted with domestic sectoral growth, domestic lending does not react significantly negatively to domestic sectoral growth for banks whose lending is heavily internationally concentrated.

If data from the borrowers statistics are used, sectoral portfolio concentration affects the impact of growth on lending whereas geographical portfolio concentration does not.

Sectoral portfolio concentration dummies interacted with domestic sectoral growth have a significantly positive effect on growth in domestic lending taken from the borrowers statistics.

As indicated by the tests of equality of the cumulative coefficients, banks with a low degree of sectoral portfolio concentration do not differ from banks with a medium degree of portfolio concentration. However, banks whose portfolios are heavily concentrated react more.



Table 6 gives further insights into the role of the capital ratio for growth in bank lending. In Table 3, we reported a negative and significant effect of the capital ratio when we used the credit register but a positive and significant effect when we used the borrowers statistics. We explained this negative coefficient by the fact that large banks are overrepresented in the credit register compared to small and medium-sized banks. Large banks, which are well-capitalized, may reduce their lending, while small and medium-sized banks, which are less capitalized, may not reduce their lending because they are part of liquidity networks. The results we document in Table 6 support the difference between small and large banks: When we use the borrowers statistics and when we restrict our analysis to big banks and *Landesbanken* only, we find a negative and significant coefficient of the capital ratio on lending growth. This indicates that, indeed, the effect of the capitalization of banks on lending growth depends on the size and/or banking group under consideration.

## **6 Conclusions**

In this paper, we have studied the importance of heterogeneity across banks for the response of German banks' sectoral lending to sectoral cyclical developments, measured through the growth in sectoral value added. This response is interesting from both a microeconomic, banking-related perspective as well as from a macroeconomic perspective. From a microeconomic perspective, heterogeneity in the response of bank lending to macroeconomic developments informs us about the importance of credit market frictions and transaction costs. From a macroeconomic perspective, the results of this paper shed light on the propagation of shocks through the domestic economy and the transmission of shocks across countries. At the same time, we have not tested specific theories and specific transmission channels of macroeconomic shocks. Rather, the aim of this paper has been to document stylized facts of the German banking industry.

We have used several datasets provided by the Deutsche Bundesbank. The data allow tracking changes in lending by more than 1,500 German banks over the 1996-2002 period. We have exploited the datasets to study sectoral and geographical dimensions of bank lending as well as different layers of bank characteristics.

We have used these datasets to study whether sectoral domestic and foreign lending of German banks react differently to domestic growth in the same sector. Moreover, we studied whether lending exceeding a threshold of €1.5 million and total lending react differently to growth. We also took different bank-specific characteristics into account when analyzing the response of sectoral lending to domestic sectoral growth, such as information on the type of bank, bank size, and the sectoral domestic concentration and the geographical foreign concentration in lending portfolios.

Our main empirical findings can be summarized as follows:

- Growth of domestic lending exceeding a threshold of €1.5 million does not react procyclically to domestic growth in the same sector. This result also holds for banks of different sizes, for banks belonging to different banking groups, and for banks with different degrees of sectoral and geographical concentration in their lending portfolios.
- Growth of total domestic lending of German banks in a sector, in contrast, does react procyclically to domestic sectoral growth. This result may indicate that the demand for loans to larger firms which we observe as large loans does not depend to the same extent on business cycle movements as the demand for loans to smaller firms.
- Growth of total domestic lending depends on bank characteristics. Growth of total domestic lending by smaller banks reacts to domestic sectoral growth, while lending by larger banks does not. Moreover, growth of total domestic lending by savings banks and credit cooperatives including their regional institutions reacts positively to

domestic sectoral growth, while growth of domestic lending by regional banks, big banks and *Landesbanken* does not.

- The response of sectoral lending growth depends on the degree of concentration in the banks' lending portfolios. Banks whose portfolios are heavily sectorally concentrated tend to react more strongly to domestic sectoral growth than banks whose portfolios are less concentrated.

In sum, our results point to the importance of heterogeneity of banks for the response of loans to macroeconomic developments. This heterogeneity also has potentially important repercussions at macro level. Moreover, our analysis has shown several directions for future research. First, while we have compared the response of lending to domestic sectoral growth based only on large and total exposures, the data allow the impact of macroeconomic developments to be studied separately for small and large borrowers. Supplementing our analysis with information on the development on financial markets which determine the costs of capital may yield insights into credit constraints of small firms over the economic cycle. Second, when analyzing sectoral lending and portfolio concentration in German banks' lending portfolios, we ignored two important facets. From the banks' point of view, we have ignored the correlation between growth rates across sectors. Moreover, lending by banks whose portfolios are heavily concentrated may respond differently to domestic sectoral growth depending on whether banks have accumulated experience in a particular sector. We will leave these issues to future research.

## 7 References

- Altunbas, Y., O. Fazylov, and P. Molyneux (2002). Evidence on the Bank Lending Channel in Europe. *Journal of Banking and Finance* 26: 2093-2110.
- Berger, A., N.A. Saunders, J.M. Scalise, and G.V. Udell. (1998). The Effects of Bank Mergers and Acquisitions on Small Business Lending, *Journal of Financial Economics* 50: 187-229.
- Berger, A.N., L.F. Klapper, and G.F. Udell (2001). The Ability of Banks to Lend to Informationally Opaque Small Businesses, *Journal of Banking and Finance* 25 (12): 2127-2168.
- Berger, A.N., N.H. Miller, M.A. Petersen, R.G. Rajan and J.C. Stein (2005). Does Function Follow Organizational Form? Evidence from the Lending Practices of Large and Small Banks. *Journal of Financial Economics* 76(2): 237-269.
- Blundell, R. and S. Bond (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics* 87: 115-143.
- Brierley, P. (2001). The Financing of Technology-Based Small Firms: A Review of the Literature. *Quarterly Bulletin, Bank of England* 41 (1): 64-83.
- Brunner, A., J. Decressin, D. Hardy and B. Kudela (2004). Germany's Three-Pillar Banking System: Cross-Country Perspectives in Europe. IMF Occasional Paper, Washington DC.
- De Bondt, G.J. (2000). *Financial Structure and Monetary Transmission in Europe*, A Cross-Country Study, Edward Elgar, Cheltenham.
- Deutsche Bundesbank (1998). Instruction Sheet for the Reporting of Large Exposures and Loans of 3 million Deutsche Mark or More Pursuant to Sections 13 to 14 of the Banking Act, in: Banking Regulations 7.
- Deutsche Bundesbank (2001). Banking Act, in: Banking Regulation 2.

- Deutsche Bundesbank (2004). Banking Statistics Guidelines and Customer Classification, Special Publication, July 2004.
- DIW (2004). Untersuchung der Grundlagen und Entwicklungsperspektiven des Bankensektors in Deutschland (Dreisäulensystem). DIW Gutachten im Auftrag des Bundesministeriums der Finanzen, Berlin.
- Egeln, J., G. Licht, and F. Steil (1997). Firm Foundations and the Role of Financial Constraints. *Small Business Economics* 9 (2): 137-150.
- Ehrmann, M. and A. Worms (2004). Bank Networks and Monetary Policy Transmission. *Journal of the European Economic Association* 2 (6): 1148-1171.
- Ehrmann, M., L. Gambacorta, J. Martinez-Pages, P. Sevestre, and A. Worms (2003). Financial Systems and the Role of Banks in Monetary Policy Transmission in the Euro Area. In *Monetary Policy Transmission in the Euro Area*, edited by I. Angeloni, A. Kashyap, and B. Mojon. Cambridge University Press.
- Favero, C.A., F. Gavazzi, and L. Flabbi (1999). The Transmission Mechanism on Monetary Policy in Europe: Evidence from Banks' Balance Sheet. NBER Working Paper 7231.
- Fisman, R. and I. Love (2003). Financial Dependence and Growth Revisited. NBER Working Paper 9582.
- Goldberg, L. (2005). The International Exposure of U.S. Banks. NBER. Working Paper 11365.
- Kakes, J. and J.E. Sturm (2001). Monetary Policy and Bank Lending Evidence from German Banking Groups, Netherlands Central Bank Working Paper.
- Kashyap, A.K. and J.C. Stein (1995). The Impact of Monetary Policy on Bank Balance Sheets. *Carnegie-Rochester Conference Series on Public Policy* 42: 151-195.
- Kashyap, A.K. and J.C. Stein (1999). What Do a Million Observations on Banks Say About the Transmission of Monetary Policy? *American Economic Review*, 90: 407-428.

- Kishan, R.P., and T.P. Opiela (2000). Banks Size, Bank Capital and the Bank Lending Channel. *Journal of Money, Credit, and Banking* 32: 121-141.
- Peek, J. and E. Rosengreen (1995). The Capital Crunch: Neither a Borrower nor a Lender be. *Journal of Money, Credit and Banking* 27 (3): 625-638.
- Petersen, M. and R. Rajan (1994). The Benefits of Lending Relationships: Evidence from Small Business Data. *The Journal of Finance* 49 (1): 3-37.
- Rajan, R.G. and L. Zingales (1998). Financial Dependence and Growth. *American Economic Review* 88: 559-586.
- Saunders, A. V. Acharya, and I. Hasan (2002). Should Banks be Diversified? Evidence from Individual Bank Loan Portfolios. BIS Working Papers 118.
- Stolz, S. and M. Wedow (2005): Banks' Regulatory Capital Buffer and the Business Cycle: Evidence for German Savings and Cooperative Banks. Deutsche Bundesbank, mimeo.
- Walsh, C.E. (1998). *Monetary Theory and Policy*. MIT Press. Cambridge and London.
- Windmeijer, F. (2005): A Finite Sample Correction for the Variance of Linear Two-Step GMM Estimators *Journal of Econometrics* 126: 25-51.
- Winton, A. (1999). Don't Put All Your Eggs in One Basket? Diversification and Specialization in Lending. University of Minnesota. Mimeo.

**Table 1: Descriptive Statistics for Sectoral Domestic and Foreign Lending**

*a:*

This table reports descriptive statistics for sectoral domestic and foreign lending. The figures are calculated from the banking sample which includes big banks, regional banks, *Landesbanken* and savings banks, credit cooperatives and regional institutions of credit cooperatives. The banking sample is adjusted for mergers. Additionally, we exclude firms from the sample, which do not have exposures of €1.5 million or more in at least two successive quarters and we exclude firms with exposures equal to zeros. Number of banks (firms) is the sum of banks (firms) in each sector. The number of firms might be overestimated because firms may borrow from more than one bank. Aggregate lending is the sum of loans of all banks in each sector as a percentage of total loans. Average number of firms is the number of firms to which average bank give loans in each sector. The data are for 2002Q4.

	Domestic lending			Foreign lending						
	Number of banks	Aggregate lending (% total)	Average number of firms	Number of firms	Lending per firm (million €)	Number of banks	Aggregate lending (% total)	Average number of firms	Number of firms	Lending per firm (million €)
Agriculture, hunting, forestry, fishing	610	0.57	5	2,638	1.5	36	0.36	4	117	10.5
Electricity, gas, water supply, mining and quarrying	640	3.88	8	4,933	5.5	109	14.95	27	2,418	21.2
Food, tobacco, textiles, leather	892	2.91	8	7,139	2.9	94	2.62	11	803	11.2
Wood, pulp, paper, publishing, printing, furniture, recycling	902	2.62	9	7,471	2.5	74	2.5	12	705	12.2
Chemicals	858	3.26	9	7,035	3.3	144	6.05	16	1,891	11
Metal products	867	2.39	10	7,772	2.2	90	1.74	10	786	7.6
Manufacturing of machinery	972	6.78	13	12,360	3.9	179	6.21	14	2,224	9.6
Construction	1249	4.88	14	16,196	2.1	73	1.84	10	592	10.6
Trade, repair of motor vehicles	1351	9.91	25	32,449	2.2	198	5.4	15	2,402	7.7
Hotels and restaurants	786	1.15	6	4,279	1.9	46	1.3	6	242	18.4
Transport, storage, communication	1021	5.23	9	7,975	4.6	295	18.14	15	3,802	16.4
Real estate	1465	34.27	37	51,459	4.7	163	13.51	16	2,342	19.8
Services, computer, R&D	1347	19.22	25	31,397	4.3	307	25.12	16	3,641	23.7
Health and social work	792	2.94	11	8,409	2.5	32	0.26	4	95	9.2

Source: Deutsche Bundesbank, credit register.

b:

This table reports descriptive statistics for sectoral domestic and foreign lending. Number of banks (firms) is the sum of banks (firms) in each sector. The figures are calculated from the banking sample which includes big banks, regional banks, *Landesbanken* and savings banks, credit cooperatives and regional institutions of credit cooperatives. The banking sample is not adjusted for mergers. The figures are calculated for the whole sample of firms without excluding firms, which do not have exposures of €1.5 million or more in at least two successive quarters and we firms with exposures equal to zeros. The number of firms might be overestimated because firms may borrow from more than one bank. Aggregate lending is the sum of loans of all banks in each sector as a percentage of total loans. Average number of firms is the number of firms to which average bank give loans in each sector. The data are for 2002Q4.

	Domestic lending				Foreign lending					
	Number of banks	Aggregate lending (% total)	Average number of firms	Number of firms	Lending per firm (million €)	Number of banks	Aggregate lending (% total)	Average number of firms	Number of firms	Lending per firm (million €)
Agriculture, hunting, forestry, fishing	610	0.57	5	3,140	1.3	36	0.33	4	152	8.3
Electricity, gas, water supply, mining and quarrying	640	3.98	9	6,061	4.9	109	14.59	26	2,840	19.4
Food, tobacco, textiles, leather	893	2.87	10	8,543	2.5	94	2.66	11	1,060	9.5
Wood, pulp, paper, publishing, printing, furniture, recycling	902	2.6	10	9,065	2.1	74	2.46	12	904	10.3
Chemicals	858	3.23	10	8,518	2.8	144	5.81	16	2,351	9.3
Metal products	867	2.35	11	9,242	1.9	90	1.74	11	983	6.7
Manufacturing of machinery	973	6.76	15	14,963	3.4	179	6.1	16	2,820	8.2
Construction	1250	4.78	15	19,084	1.9	73	1.81	10	739	9.2
Trade, repair of motor vehicles	1352	10.03	29	39,693	1.9	198	5.83	17	3,374	6.5
Hotels and restaurants	786	1.18	6	5,047	1.7	46	1.4	7	304	17.5
Transport, storage, communication	1021	5.3	10	9,931	4	295	18.05	16	4,611	14.8
Real estate	1466	33.64	41	59,711	4.2	163	14.1	18	2,908	18.3
Services, computer, R&D	1348	19.8	30	40,222	3.7	307	24.88	15	4,661	20.2
Health and social work	793	2.91	13	9,937	2.2	32	0.24	4	117	7.9

Source: Deutsche Bundesbank, credit register.



**Table 2: Correlations**

This table reports correlation coefficients between our various exogenous and endogenous variables. (1) German lending (credit register), (2) German lending (credit register), (3) Foreign lending (credit register), (4) Real value added growth, (5) Sectoral HHI, (6) Geographical HHI, (7) Capital ratio, (8) Liquid assets I to assets, (9) Liquid assets II to assets, (10) Liabilities to firms and individuals to assets, (11) Liabilities to non-banks to assets, (12) Short-term liabilities to enterprises and individuals to assets, (13) Short-term liabilities to non-banks to assets, (14) Short-term interbank borrowings to assets, (15) Short-term interbank assets to assets, (16) Difference in short-term interbank assets and borrowings to assets, (17) Securities to assets, (18) Size (Ln(assets)). \* significant at the 10%, \*\* significant at the 5%, \*\*\* significant at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(4)	0.027*** (0.00)	0.038*** (0.00)	0.026 (0.35)	1													
(5)	-0.013** (0.02)	0.027*** (0.00)	-0.003 (0.93)	0.010* (0.07)	1												
(6)	0.036** (0.00)	0.040*** (0.00)	-0.086*** (0.00)	0.033 (0.00)	-0.226*** (0.00)	1											
(7)	-0.049*** (0.00)	-0.011*** (0.00)	-0.037 (0.18)	-0.004 (0.51)	0.043*** (0.00)	-0.028*** (0.00)	1										
(8)	-0.016*** (0.00)	0.005 (0.18)	-0.014 (0.62)	-0.001 (0.89)	0.160*** (0.00)	-0.133*** (0.00)	0.388*** (0.00)	1									
(9)	-0.019*** (0.00)	0.004 (0.30)	0.018 (0.52)	-0.003 (0.63)	0.169*** (0.00)	-0.192*** (0.00)	0.391*** (0.00)	0.984*** (0.00)	1								
(10)	-0.070*** (0.00)	-0.022*** (0.00)	-0.080*** (0.00)	-0.023*** (0.00)	-0.111*** (0.00)	0.319*** (0.00)	0.154*** (0.00)	0.205*** (0.00)	0.153*** (0.00)	1							
(11)	-0.081*** (0.00)	-0.025*** (0.00)	-0.076*** (0.01)	-0.024*** (0.00)	-0.113*** (0.00)	0.288*** (0.00)	0.179*** (0.00)	0.239*** (0.00)	0.202*** (0.00)	0.974*** (0.00)	1						
(12)	-0.015*** (0.01)	-0.009** (0.02)	-0.082*** (0.00)	-0.009* (0.09)	-0.211*** (0.00)	0.381*** (0.00)	0.132*** (0.00)	0.151*** (0.00)	0.099*** (0.00)	0.877*** (0.00)	0.831*** (0.00)	1					
(13)	-0.016*** (0.00)	-0.001** (0.01)	-0.083*** (0.00)	-0.008 (0.151)	-0.221*** (0.00)	0.375*** (0.00)	0.142*** (0.00)	0.157*** (0.00)	0.112*** (0.00)	0.856*** (0.00)	0.840*** (0.00)	0.987*** (0.00)	1				
(14)	-0.023*** (0.00)	0.004 (0.33)	0.070** (0.01)	0.011* (0.07)	0.170*** (0.00)	-0.385*** (0.00)	0.004 (0.48)	0.293*** (0.00)	0.356*** (0.00)	-0.421*** (0.00)	-0.370*** (0.00)	-0.444*** (0.00)	-0.428*** (0.00)	1			
(15)	-0.059*** (0.00)	-0.014*** (0.00)	-0.012 (0.67)	-0.019*** (0.00)	0.179*** (0.00)	-0.166*** (0.00)	0.122*** (0.00)	0.386*** (0.00)	0.406*** (0.00)	0.047*** (0.00)	0.100*** (0.00)	-0.078*** (0.00)	-0.068*** (0.00)	0.310*** (0.00)	1		
(16)	-0.030*** (0.00)	-0.015*** (0.00)	-0.089*** (0.00)	-0.018*** (0.00)	0.024*** (0.00)	0.226*** (0.00)	0.107*** (0.00)	0.086*** (0.00)	0.053*** (0.00)	0.380*** (0.00)	0.386*** (0.00)	0.298*** (0.00)	0.291*** (0.00)	-0.570*** (0.00)	0.611*** (0.00)	1	
(17)	-0.019*** (0.00)	-0.001 (0.70)	-0.027 (0.33)	-0.030*** (0.00)	0.032*** (0.00)	0.058*** (0.00)	0.015*** (0.00)	0.211*** (0.00)	0.204*** (0.00)	0.065*** (0.00)	0.072*** (0.00)	0.091*** (0.00)	0.097*** (0.00)	-0.004 (0.47)	-0.129*** (0.00)	-0.139*** (0.00)	1
(18)	0.006 (0.29)	-0.012*** (0.00)	0.073*** (0.01)	-0.047*** (0.00)	0.241*** (0.00)	-0.571*** (0.00)	-0.008 (0.17)	0.127*** (0.00)	0.199*** (0.00)	-0.418*** (0.00)	-0.371*** (0.00)	-0.385*** (0.00)	-0.364*** (0.00)	0.510*** (0.00)	0.116*** (0.00)	-0.328*** (0.00)	0.134*** (0.00)

**Table 3: Domestic Versus Foreign Lending**

The dependent variable is the percentage change in bank lending. Results are based on GMM estimations with absolute Windmeijer's (2005) corrected  $t$ -statistics in parentheses. In column (1) the cross-section variable is domestic and foreign lending (total lending) from the credit register per bank  $i$  to sector  $j$ . In column (2) the cross-section variable is domestic lending from credit register per bank  $i$  to sector  $j$ . In column (3) the cross-section variable is foreign lending from the credit register per bank  $i$  to sector  $j$ . In column (4) the cross-section variable is domestic lending from the borrowers statistics per bank  $i$  to sector  $j$ . All estimations include year dummies. \* significant at the 10%, \*\* significant at the 5%, \*\*\* significant at the 1% level.

Statistics used	(1) Credit register	(2) Credit register	(3) Credit register	(4) Borrowers statistics
Lending focus	Total	German	Foreign	German
Endogenous variable (t-1)	-0.062*** (4.72)	-0.060*** (4.53)	0.008 (0.12)	-0.064*** (5.19)
Sectoral growth	0.271** (2.34)	0.145 (1.31)	-1.086* (1.66)	0.313*** (4.48)
Sectoral growth (t-1)	-0.168 (1.42)	-0.178 (1.58)	0.667 (0.82)	0.166** (2.36)
Capital ratio (t-1)	-0.564** (2.04)	-0.772*** (2.84)	-3.203** (2.22)	0.367** (2.47)
Liquid assets to assets	-0.025 (0.42)	-0.041 (0.69)	0.310 (0.66)	0.029 (0.82)
Short-term liabilities to firms and individuals to assets	-0.112** (2.34)	-0.093** (2.01)	-0.522 (1.48)	-0.050* (1.65)
Securities to assets	0.112 (0.90)	0.084 (0.68)	0.510 (0.54)	0.196*** (2.73)
Regional banks	-1.034 (0.38)	0.411 (0.15)	1.751 (0.14)	6.194** (2.41)
Savings banks	4.165* (1.90)	6.709*** (2.93)	8.770 (0.69)	4.622** (2.42)
Credit cooperatives including regional institutions	-3.198 (1.33)	-0.716 (0.29)	6.263 (0.36)	4.476** (2.25)
Constant	22.889*** (6.89)	1.682 (0.51)	38.221** (2.14)	-10.453*** (4.69)
Observations	26,521	26,395	1,012	63,784
Number of groups	6,532	6,498	2,60	15,482
Number of instruments	17	17	17	17
F-test (p-value)	0.00	0.00	0.00	0.00
Sargan test (p-value)	0.33	0.77	0.73	0.23
AR1 (p-value)	0.00	0.00	0.00	0.00
AR2 (p-value)	0.49	0.87	0.79	0.55
<b>Cumulative coefficients</b>				
Sectoral growth	0.097 (0.68)	-0.031 (0.23)	-0.422 (0.50)	0.449*** (4.95)

**Table 4: Characteristics of Banking Groups**

This table reports descriptive statistics for bank characteristics. Market shares are assets per banking group to total assets in the banking industry (for the banking groups under consideration). Number of firms captures average number of firms to which a banking group gives loans. Loan size per firm is the average ratio of aggregate lending to the number of firms. The data presented in the table are for 2002Q4.

<i>Panel a:</i>									
Banking group number	Domestic number of banks (credit register)	Domestic number of banks (borrowers statistics)	Number of banks (BAKIS)	Foreign number of banks (credit register)	Market share (credit register)	Market share (BAKIS)	Average assets (credit register)		
Big banks	110	4	4	4	29.91	29.6	430,315		
Regional banks	120	144	217	90	10.25	10.5	4,041		
<i>Landesbanken</i>	210	14	14	14	29.85	29.6	122,737		
Savings banks	230	512	520	264	17.04	16.9	1,916		
Regional institutions of credit cooperatives	310	2	2	2	3.82	3.8	110,098		
Credit cooperatives	390	1,094	1,488	203	9.10	9.5	478		
<i>Panel b:</i>									
Banking group number	Average aggregate domestic lending (credit register)	Average aggregate domestic lending (borrowers statistics)	Average aggregate foreign lending (credit register)	Average number of domestic firms (credit register)	Average number of foreign firms (credit register)	Average domestic loan size per firm (credit register) (million €)	Average foreign loan size per firm (credit register) (million €)		
Big banks	44,405.9	46,602.1	40,038.0	10,752	2,439	4.2	16.4		
Regional banks	575.7	653.7	336.6	145	36	3.2	6.1		
<i>Landesbanken</i>	15,502.2	15,620.6	9,992.5	1,930	510	8.7	23		
Savings banks	303.5	513.5	11.0	149	3	1.7	3.2		
Regional institutions of credit cooperatives	12,721.0	12,294.4	4,358.8	1,949	330	6.2	10.2		
Credit cooperatives	42.9	104.5	4.8	28	2	1.4	1.9		

Source: Deutsche Bundesbank, credit register, borrowers statistics, BAKIS

**Table 5: Bank Heterogeneity**

The dependent variable is the percentage change in bank lending. Results are based on GMM estimations with absolute Windmeijer's (2005) corrected  $t$ -statistics in parentheses. In Panel a, we interact sectoral growth with different asset sizes. Asset1 (Asset2, Asset3) is a dummy variable equal to one if the bank's assets are below the 25th percentile (above the 25th percentile but below the 75th percentile, above the 75th percentile), and zero otherwise. In Panel b, we interact sectoral growth with banking groups. All estimations include year dummies. \* significant at the 10%, \*\* significant at 5%, \*\*\* significant at 1% level.

<i>Panel a</i>				
Statistics used	(1)	(2)	(3)	(5)
Lending focus	Credit register	Borrowers statistics	Borrowers statistics	Credit register
Banking groups included	German	German	German	Foreign
Banking groups included	All	All	Savings banks	All
Endogenous variable (t-1)	-0.060 <sup>***</sup> (4.52)	-0.064 <sup>***</sup> (5.22)	-0.080 <sup>***</sup> (2.96)	0.007 (0.11)
Sectoral growth*Asset1	-0.052 (0.22)	0.228 (1.49)	0.523 <sup>***</sup> (3.14)	0.455 (0.25)
Sectoral growth*Asset2	0.191 (1.27)	0.402 <sup>***</sup> (4.47)	0.032 (0.38)	-2.090 <sup>**</sup> (2.10)
Sectoral growth*Asset3	0.229 (1.20)	0.189 (1.42)	0.110 (0.74)	-0.492 (0.55)
Sectoral growth*Asset1 (t-1)	-0.406 <sup>*</sup> (1.80)	0.479 <sup>***</sup> (2.87)	0.049 (0.34)	-0.509 (0.30)
Sectoral growth*Asset2 (t-1)	-0.078 (0.49)	0.144 (1.59)	-0.066 (0.68)	1.458 (1.02)
Sectoral growth*Asset3 (t-1)	-0.164 (0.95)	-0.061 (0.55)	-0.286 <sup>**</sup> (2.38)	0.014 (0.02)
Capital ratio (t-1)	-0.767 <sup>***</sup> (2.82)	0.358 <sup>**</sup> (2.41)	-0.040 (0.23)	-3.284 <sup>**</sup> (2.32)
Liquid assets to assets	-0.044 (0.75)	0.032 (0.90)	0.054 (1.60)	0.243 (0.82)
Short-term liabilities to enterprises and individuals to assets	-0.092 <sup>**</sup> (1.97)	-0.053 <sup>*</sup> (1.72)	-0.058 <sup>**</sup> (2.02)	-0.337 <sup>**</sup> (2.09)
Securities to assets	0.082 (0.67)	0.203 <sup>***</sup> (2.84)	0.178 <sup>**</sup> (2.57)	0.640 (0.69)
Regional banks	0.423 (0.16)	5.952 <sup>**</sup> (2.31)		
Savings banks	6.679 <sup>***</sup> (2.92)	4.366 <sup>**</sup> (2.27)		
Credit cooperatives including regional institutions	-0.295 (0.12)	4.013 <sup>**</sup> (2.00)		
Observations	26,395	63,784	29,150	1,012
Number of groups	6,498	15,482	6,554	260
Number of instruments	21	21	18	18
F-test (p-value)	0.00	0.00	0.00	0.00
Sargan test (p-value)	0.78	0.23	0.79	0.73
AR1 (p-value)	0.00	0.00	0.00	0.00
AR2 (p-value)	0.87	0.56	0.67	0.79

**Cumulative coefficients**

---

Sectoral growth*Asset1 (A1)	-0.432*	0.664***	0.530***	-0.054
	(1.62)	(3.64)	(3.17)	(0.03)
Sectoral growth*Asset2 (A2)	0.107	0.513***	-0.031	-0.635
	(0.57)	(4.49)	(0.25)	(0.46)
Sectoral growth*Asset3 (A3)	0.061	0.119	-0.163	-0.481
	(0.28)	(0.73)	(0.84)	(0.45)
<i>Tests on equality</i>				
A1 vs A2	2.92*	0.55	8.64***	0.05
A2 vs A3	0.03	4.33**	0.37	0.01
A1 vs A3	2.16	5.21**	8.34***	0.03

---

Panel b

Statistics used	(1) Credit register German	(2) Borrowers statistics German	(3) Credit register Foreign
Endogenous variable (t-1)	-0.060*** (4.56)	-0.064*** (5.18)	0.009 (0.14)
Sectoral growth*Regional banks	0.890 (1.47)	0.770 (1.56)	-1.534 (1.00)
Sectoral growth*Big banks and <i>Landesbanken</i>	0.585 (1.42)	0.260 (0.82)	-0.314 (0.40)
Sectoral growth*Savings banks	0.119 (0.96)	0.219*** (3.02)	-1.472 (1.40)
Sectoral growth* Credit cooperatives including regional institutions	0.090 (0.39)	0.382*** (3.42)	-0.519 (0.11)
Sectoral growth*Regional banks (t-1)	-0.459 (1.03)	0.259 (0.41)	1.943 (0.86)
Sectoral growth*Big banks and <i>Landesbanken</i> (t-1)	-0.211 (0.67)	-0.164 (0.63)	0.035 (0.05)
Sectoral growth*Savings banks (t-1)	0.006 (0.05)	-0.012 (0.17)	0.456 (0.35)
Sectoral growth* Credit cooperatives including regional institutions (t-1)	-0.705*** (2.84)	0.321*** (2.89)	1.850 (0.76)
Capital ratio (t-1)	-0.722*** (2.69)	0.347** (2.34)	-3.311** (2.37)
Liquid assets to assets	-0.053 (0.96)	0.036 (1.07)	0.168 (0.51)
Short-term liabilities to firms and individuals to assets	-0.086** (2.23)	-0.051* (1.91)	-0.302* (1.84)
Securities to assets	0.359*** (3.11)	0.235*** (3.74)	0.638 (0.69)
Observations	26,395	63,784	1,012
Number of groups	6,498	15,482	260
Number of instruments	20.00	20.00	20.00
F-test (p-value)	0.00	0.00	0.00
Sargan test (p-value)	0.78	0.24	0.70
AR1 (p-value)	0.00	0.00	0.00
AR2 (p-value)	0.87	0.56	0.80

**Cumulative coefficients**

---

---

Sectoral growth*Regional banks (RB)	0.407 (0.66)	0.967 (1.25)	0.411 (0.22)
Sectoral growth*Big banks and <i>Landesbanken</i> (BB)	0.353 (0.69)	0.089 (0.22)	-0.281 (0.28)
Sectoral growth*Savings banks (SB)	0.117 (0.79)	0.194** (2.00)	-1.025 (0.72)
Sectoral growth*Credit cooperatives including regional institutions (RI)	-0.580** (2.06)	0.660*** (4.83)	1.343 (0.33)
<i>Tests on equality</i>			
RB vs BB	0.00	1.03	0.11
RB vs SB	0.21	0.99	0.37
RB vs RI	2.15	0.15	0.04
BB vs SB	0.20	0.06	0.18
BB vs RI	2.58*	1.81	0.15
SB vs RI	5.20**	8.98***	0.30

---

---

**Table 6: Sectoral and Geographical Portfolio Concentration**

The dependent variable is the percentage change in bank lending. Results are based on GMM estimations with absolute Windmeijer's (2005) corrected *t*-statistics in parentheses. When we used sectoral portfolio concentration, HHI1 (HHI2, HHI3) is a dummy variable equal to one if the bank's Herfindahl index is below the 25th percentile (above the 25th percentile but below the 75th percentile, above the 75th percentile). When we used geographical portfolio concentration, HHI1 (HHI2) is a dummy variable equal to one if the bank's Herfindahl index is below the 75th percentile (above the 75th percentile). All estimations include year dummies. \* significant at the 10%, \*\* significant at the 5%, \*\*\* significant at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Statistics used	Credit register	Credit register	Borrowers statistics	Borrowers statistics	Credit register	Credit register
Lending focus	German	German	German	German	Foreign	Foreign
Portfolio concentration	Sectoral	Geograph.	Sectoral	Geograph.	Sectoral	Geograph.
Endogenous variable (t-1)	-0.060*** (4.53)	-0.040 (0.63)	-0.057*** (4.59)	-0.066 (0.70)	0.015 (0.24)	-0.066 (0.83)
Sectoral growth*HHI1	0.319 (1.50)	0.905** (2.16)	0.326*** (2.65)	0.188 (0.40)	-1.239 (1.01)	-1.451 (1.44)
Sectoral growth*HHI2	0.008 (0.06)	0.881 (1.02)	0.295*** (3.23)	-0.120 (0.25)	-1.344 (1.43)	0.713 (0.56)
Sectoral growth*HHI3	0.171 (0.86)		0.297** (2.08)		-0.225 (0.20)	
Sectoral growth*HHI1 (t-1)	-0.558*** (3.08)	-0.070 (0.16)	-0.030 (0.25)	0.046 (0.16)	-0.723 (0.62)	-0.338 (0.39)
Sectoral growth*HHI2 (t-1)	0.014 (0.08)	0.086 (0.15)	0.104 (1.15)	-0.657 (1.21)	1.706 (1.29)	-0.442 (0.49)
Sectoral growth*HHI3 (t-1)	-0.097 (0.50)		0.468*** (3.08)		0.179 (0.16)	
Capital ratio (t-1)	-0.725*** (2.65)	-0.707 (0.46)	0.223 (1.57)	-2.452*** (2.67)	-3.192** (2.21)	-8.125*** (3.05)
Liquid assets to assets	-0.037 (0.61)	0.165 (0.50)	0.049 (1.42)	0.096 (0.32)	0.192 (0.64)	-0.616 (0.82)
Short-term liabilities to firms to assets	-0.089* (1.90)	-0.651 (1.51)	-0.038 (1.27)	-1.095*** (3.01)	-0.316** (2.08)	-2.555** (2.18)
Securities to assets	0.069 (0.57)	-0.715 (0.65)	0.110 (1.58)	1.595 (1.38)	0.753 (0.81)	2.732 (0.72)
Regional banks	1.943 (0.72)		5.759** (2.27)			
Savings banks	6.680*** (2.91)		4.732** (2.51)			
Credit cooperatives incl. regional institutions	-0.735 (0.30)		4.106** (2.10)			
Observations	26,198	350	63,514	350	994	292
Number of groups	6,453	84	15,440	84	255	65
Number of instruments	21	16	21	16	18	16
F-test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Sargan test (p-value)	0.79	0.06	0.60	0.12	0.72	0.46
AR1 (p-value)	0.00	0.00	0.00	0.03	0.00	0.00
AR2 (p-value)	0.89	0.63	0.73	0.46	0.81	0.41



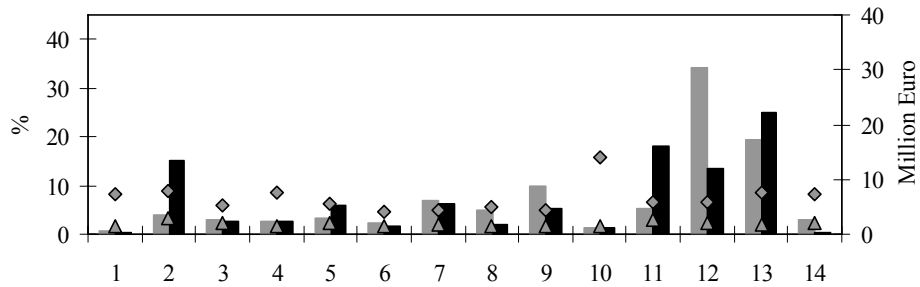
**Cumulative coefficients**

Sectoral growth*HHI1 (H1)	-0.225 (0.82)	0.802 (1.29)	0.280* (1.79)	0.219 (0.46)	-1.992 (1.36)	-1.679* (1.61)
Sectoral growth*HHI2 (H2)	0.020 (0.11)	0.929 (0.89)	0.377*** (3.19)	-0.728 (1.00)	0.367 (0.31)	0.254 (0.18)
Sectoral growth*HHI3 (H3)	0.070 (0.30)		0.724*** (4.01)		-0.047 (0.03)	
<i>Test on equality</i>						
H1 vs H2	0.58	0.01	0.28	1.33	1.71	1.17
H2 vs H3	0.03		2.82*		0.05	
H1 vs H3	0.70		3.70**		0.82	

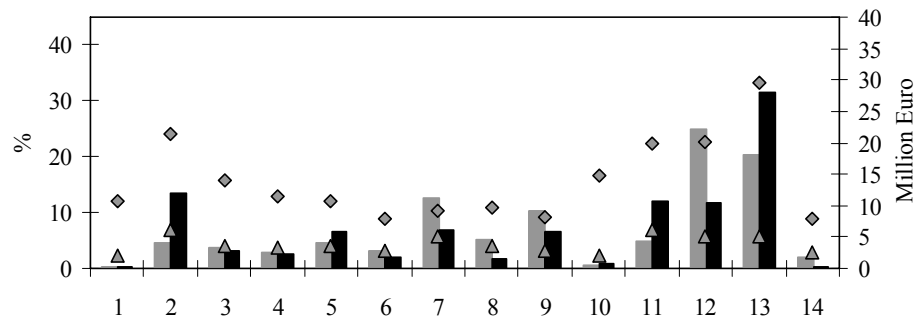
### Figure 1: Characteristics of Banking Groups

This figure distinguishes between 14 sectors: Agriculture, hunting, forestry, fishing (1), Electricity, gas, water supply, mining and quarrying (2), Food, tobacco, textiles, leather (3), Wood, pulp, paper, publishing, printing, furniture, recycling (4), Chemicals (5), Metal products (6), Manufacturing of machinery (7), Construction (8), Trade, repair of motor vehicles (9), Hotels and restaurants (10), Transport, storage, communication (11), Real estate (12), Services, computer, R&D (13), Health and social work (14). Domestic and foreign sectoral lending represents lending to each sector as a percentage of total lending.

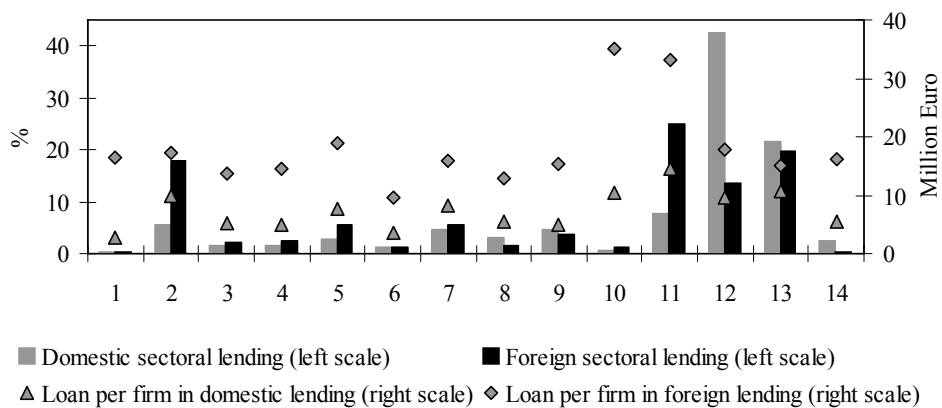
Panel a: All banks



Panel b: Big banks



Panel c: Landesbanken

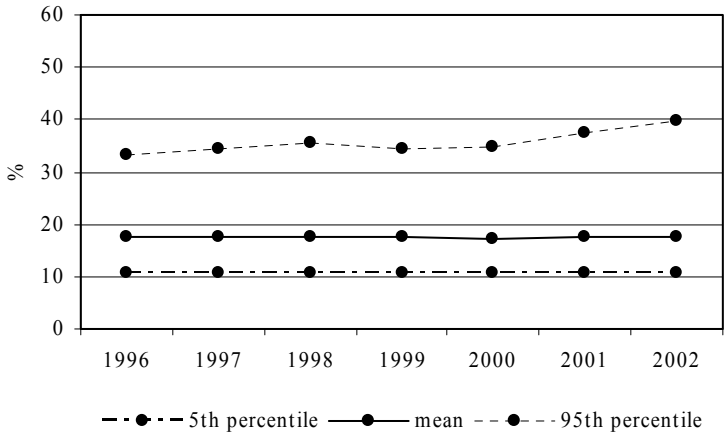


■ Domestic sectoral lending (left scale)      ■ Foreign sectoral lending (left scale)  
 ▲ Loan per firm in domestic lending (right scale)    ◆ Loan per firm in foreign lending (right scale)

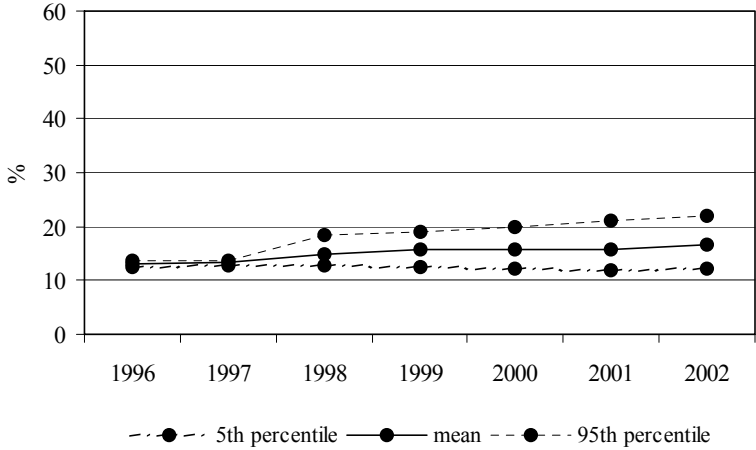
Source: Deutsche Bundesbank, credit register.

**Figure 2: Herfindahl Indices for Sectoral Lending by Banking Groups**

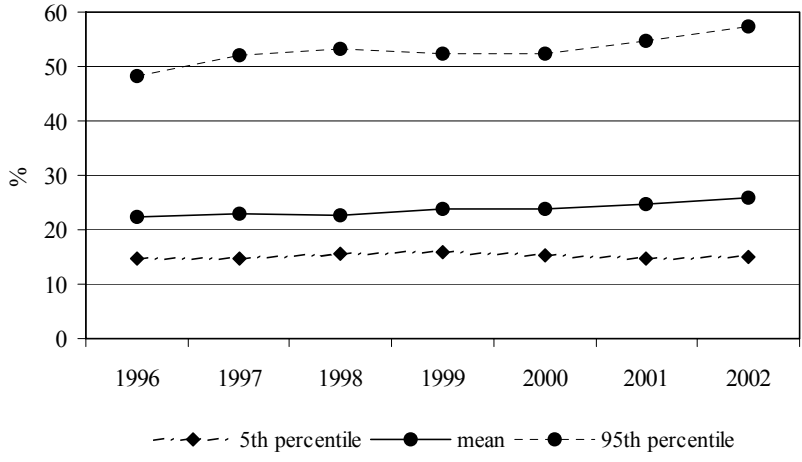
This figure shows sectoral Herfindahl indexes for domestic lending by banking groups.  
*Panel a: All banks*



*Panel b: Big banks*



*Panel c: Landesbanken*

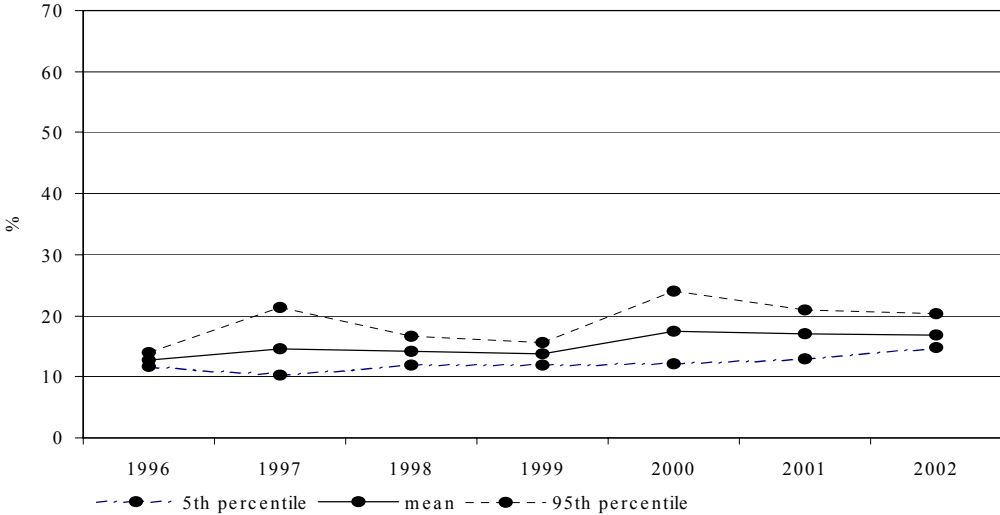


Source: Deutsche Bundesbank, borrowers statistics.

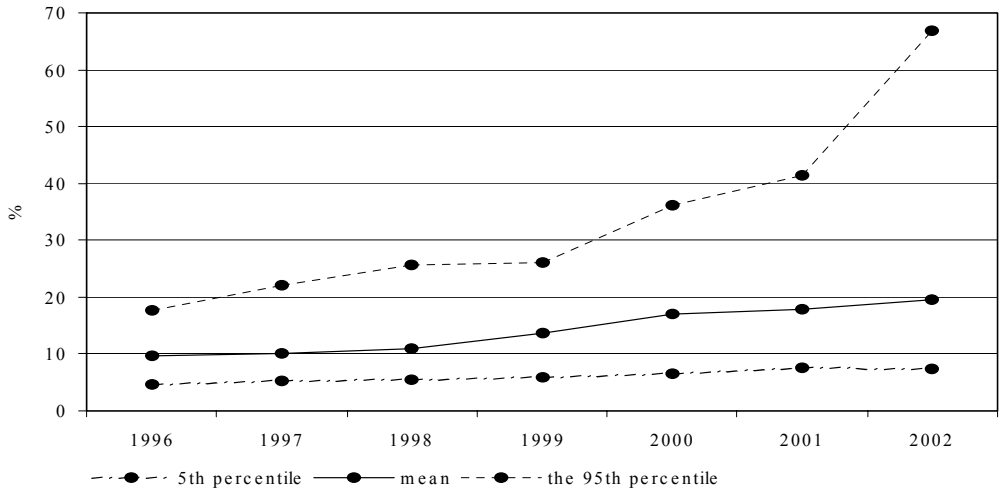
**Figure 3: Geographical Concentration in Lending Portfolios**

This figure reports geographical portfolio concentration for two banking groups for foreign lending. Geographical portfolio concentration is measured by Herfindahl indexes.

*Panel a: Big banks*



*Panel b: Landesbanken*



Source: Deutsche Bundesbank, credit register.

## The following Discussion Papers have been published since 2005:

### Series 1: Economic Studies

1	2005	Financial constraints and capacity adjustment in the United Kingdom – Evidence from a large panel of survey data	Ulf von Kalckreuth Emma Murphy
2	2005	Common stationary and non-stationary factors in the euro area analyzed in a large-scale factor model	Sandra Eickmeier
3	2005	Financial intermediaries, markets, and growth	F. Fecht, K. Huang, A. Martin
4	2005	The New Keynesian Phillips Curve in Europe: does it fit or does it fail?	Peter Tillmann
5	2005	Taxes and the financial structure of German inward FDI	Fred Ramb A. J. Weichenrieder
6	2005	International diversification at home and abroad	Fang Cai Francis E. Warnock
7	2005	Multinational enterprises, international trade, and productivity growth: Firm-level evidence from the United States	Wolfgang Keller Steven R. Yeaple
8	2005	Location choice and employment decisions: a comparison of German and Swedish multinationals	S. O. Becker, K. Ekholm, R. Jäckle, M.-A. Muendler
9	2005	Business cycles and FDI: evidence from German sectoral data	Claudia M. Buch Alexander Lipponer
10	2005	Multinational firms, exclusivity, and the degree of backward linkages	Ping Lin Kamal Saggi

11	2005	Firm-level evidence on international stock market comovement	Robin Brooks Marco Del Negro
12	2005	The determinants of intra-firm trade: in search for export-import magnification effects	Peter Egger Michael Pfaffermayr
13	2005	Foreign direct investment, spillovers and absorptive capacity: evidence from quantile regressions	Sourafel Girma Holger Görg
14	2005	Learning on the quick and cheap: gains from trade through imported expertise	James R. Markusen Thomas F. Rutherford
15	2005	Discriminatory auctions with seller discretion: evidence from German treasury auctions	Jörg Rocholl
16	2005	Consumption, wealth and business cycles: why is Germany different?	B. Hamburg, M. Hoffmann, J. Keller
17	2005	Tax incentives and the location of FDI: evidence from a panel of German multinationals	Thiess Buettner Martin Ruf
18	2005	Monetary Disequilibria and the Euro/Dollar Exchange Rate	Dieter Nautz Karsten Ruth
19	2005	Berechnung trendbereinigter Indikatoren für Deutschland mit Hilfe von Filterverfahren	Stefan Stamford
20	2005	How synchronized are central and east European economies with the euro area? Evidence from a structural factor model	Sandra Eickmeier Jörg Breitung
21	2005	Asymptotic distribution of linear unbiased estimators in the presence of heavy-tailed stochastic regressors and residuals	J.-R. Kurz-Kim S.T. Rachev G. Samorodnitsky

22	2005	The Role of Contracting Schemes for the Welfare Costs of Nominal Rigidities over the Business Cycle	Matthias Paustian
23	2005	The cross-sectional dynamics of German business cycles: a bird's eye view	J. Döpke, M. Funke S. Holly, S. Weber
24	2005	Forecasting German GDP using alternative factor models based on large datasets	Christian Schumacher
25	2005	Time-dependent or state-dependent price setting? – micro-evidence from German metal-working industries –	Harald Stahl
26	2005	Money demand and macroeconomic uncertainty	Claus Greiber Wolfgang Lemke
27	2005	In search of distress risk	J. Y. Campbell, J. Hilscher, J. Szilagyi
28	2005	Recursive robust estimation and control without commitment	Lars Peter Hansen Thomas J. Sargent
29	2005	Asset pricing implications of Pareto optimality with private information	N. R. Kocherlakota Luigi Pistaferri
30	2005	Ultra high frequency volatility estimation with dependent microstructure noise	Y. Aït-Sahalia, P. A. Mykland, L. Zhang
31	2005	Umstellung der deutschen VGR auf Vorjahrespreisbasis – Konzept und Konsequenzen für die aktuelle Wirtschaftsanalyse sowie die ökonomische Modellierung	Karl-Heinz Tödter

32	2005	Determinants of current account developments in the central and east European EU member states – consequences for the enlargement of the euro area	Sabine Herrmann Axel Jochem
33	2005	An estimated DSGE model for the German economy within the euro area	Ernest Pytlarczyk
34	2005	Rational inattention: a research agenda	Christopher A. Sims
35	2005	Monetary policy with model uncertainty: distribution forecast targeting	Lars E.O. Svensson Noah Williams
36	2005	Comparing the value relevance of R&D reporting in Germany: standard and selection effects	Fred Ramb Markus Reitzig
37	2005	European inflation expectations dynamics	J. Döpke, J. Dovern U. Fritsche, J. Slacalek
38	2005	Dynamic factor models	Sandra Eickmeier Jörg Breitung
39	2005	Short-run and long-run comovement of GDP and some expenditure aggregates in Germany, France and Italy	Thomas A. Knetsch
40	2005	A “wreckers theory” of financial distress	Ulf von Kalckreuth
41	2005	Trade balances of the central and east European EU member states and the role of foreign direct investment	Sabine Herrmann Axel Jochem
42	2005	Unit roots and cointegration in panels	Jörg Breitung M. Hashem Pesaran
43	2005	Price setting in German manufacturing: new evidence from new survey data	Harald Stahl



1	2006	The dynamic relationship between the Euro overnight rate, the ECB's policy rate and the term spread	Dieter Nautz Christian J. Offermanns
2	2006	Sticky prices in the euro area: a summary of new micro evidence	Álvarez, Dhyne, Hoeberichts Kwapil, Le Bihan, Lünnemann Martins, Sabbatini, Stahl Vermeulen, Vilmunen
3	2006	Going multinational: What are the effects on home market performance?	Robert Jäckle
4	2006	Exports versus FDI in German manufacturing: firm performance and participation in international markets	Jens Matthias Arnold Katrin Hussinger
5	2006	A disaggregated framework for the analysis of structural developments in public finances	Kremer, Braz, Brosens Langenus, Momigliano Spolander
6	2006	Bond pricing when the short term interest rate follows a threshold process	Wolfgang Lemke Theofanis Archontakis
7	2006	Has the impact of key determinants of German exports changed? Results from estimations of Germany's intra euro-area and extra euro-area exports	Kerstin Stahn
8	2006	The coordination channel of foreign exchange intervention: a nonlinear microstructural analysis	Stefan Reitz Mark P. Taylor
9	2006	Capital, labour and productivity: What role do they play in the potential GDP weakness of France, Germany and Italy?	Antonio Bassanetti Jörg Döpke, Roberto Torrini Roberta Zizza
10	2006	Real-time macroeconomic data and ex ante predictability of stock returns	J. Döpke, D. Hartmann C. Pierdzioch

11	2006	The role of real wage rigidity and labor market frictions for unemployment and inflation dynamics	Kai Christoffel Tobias Linzert
12	2006	Forecasting the price of crude oil via convenience yield predictions	Thomas A. Knetsch
13	2006	Foreign direct investment in the enlarged EU: do taxes matter and to what extent?	Guntram B. Wolff
14	2006	Inflation and relative price variability in the euro area: evidence from a panel threshold model	Dieter Nautz Juliane Scharff
15	2006	Internalization and internationalization under competing real options	Jan Hendrik Fisch
16	2006	Consumer price adjustment under the microscope: Germany in a period of low inflation	Johannes Hoffmann Jeong-Ryeol Kurz-Kim
17	2006	Identifying the role of labor markets for monetary policy in an estimated DSGE model	Kai Christoffel Keith Küster Tobias Linzert
18	2006	Do monetary indicators (still) predict euro area inflation?	Boris Hofmann
19	2006-	Fool the markets? Creative accounting, fiscal transparency and sovereign risk premia	Kerstin Bernoth Guntram B. Wolff
20	2006	How would formula apportionment in the EU affect the distribution and the size of the corporate tax base? An analysis based on German multinationals	Clemens Fuest Thomas Hemmelgarn Fred Ramb

21	2006	Monetary and fiscal policy interactions in a New Keynesian model with capital accumulation and non-Ricardian consumers	Campbell Leith Leopold von Thadden
22	2006	Real-time forecasting and political stock market anomalies: evidence for the U.S.	Martin Bohl, Jörg Döpke Christian Pierdzioch
23	2006	A reappraisal of the evidence on PPP: a systematic investigation into MA roots in panel unit root tests and their implications	Christoph Fischer Daniel Porath
24	2006	Margins of multinational labor substitution	Sascha O. Becker Marc-Andreas Münder

## Series 2: Banking and Financial Studies

1	2005	Measurement matters – Input price proxies and bank efficiency in Germany	Michael Koetter
2	2005	The supervisor’s portfolio: the market price risk of German banks from 2001 to 2003 – Analysis and models for risk aggregation	Christoph Memmel Carsten Wehn
3	2005	Do banks diversify loan portfolios? A tentative answer based on individual bank loan portfolios	Andreas Kamp Andreas Pfingsten Daniel Porath
4	2005	Banks, markets, and efficiency	F. Fecht, A. Martin
5	2005	The forecast ability of risk-neutral densities of foreign exchange	Ben Craig Joachim Keller
6	2005	Cyclical implications of minimum capital requirements	Frank Heid
7	2005	Banks’ regulatory capital buffer and the business cycle: evidence for German savings and cooperative banks	Stéphanie Stolz Michael Wedow
8	2005	German bank lending to industrial and non-industrial countries: driven by fundamentals or different treatment?	Thorsten Nestmann
9	2005	Accounting for distress in bank mergers	M. Koetter, J. Bos, F. Heid C. Kool, J. Kolari, D. Porath
10	2005	The eurosystem money market auctions: a banking perspective	Nikolaus Bartzsch Ben Craig, Falko Fecht
11	2005	Financial integration and systemic risk	Falko Fecht Hans Peter Grüner

12	2005	Evaluating the German bank merger wave	Michael Koetter
13	2005	Incorporating prediction and estimation risk in point-in-time credit portfolio models	A. Hamerle, M. Knapp, T. Liebig, N. Wildenauer
14	2005	Time series properties of a rating system based on financial ratios	U. Krüger, M. Stötzel, S. Trück
15	2005	Inefficient or just different? Effects of heterogeneity on bank efficiency scores	J. Bos, F. Heid, M. Koetter, J. Kolatri, C. Kool
01	2006	Forecasting stock market volatility with macroeconomic variables in real time	J. Döpke, D. Hartmann C. Pierdzioch
02	2006	Finance and growth in a bank-based economy: is it quantity or quality that matters?	Michael Koetter Michael Wedow
03	2006	Measuring business sector concentration by an infection model	Klaus Düllmann
04	2006	Heterogeneity in lending and sectoral growth: evidence from German bank-level data	Claudia M. Buch Andrea Schertler Natalja von Westernhagen



## **Visiting researcher at the Deutsche Bundesbank**

The Deutsche Bundesbank in Frankfurt is looking for a visiting researcher. Among others under certain conditions visiting researchers have access to a wide range of data in the Bundesbank. They include micro data on firms and banks not available in the public. Visitors should prepare a research project during their stay at the Bundesbank. Candidates must hold a Ph D and be engaged in the field of either macroeconomics and monetary economics, financial markets or international economics. Proposed research projects should be from these fields. The visiting term will be from 3 to 6 months. Salary is commensurate with experience.

Applicants are requested to send a CV, copies of recent papers, letters of reference and a proposal for a research project to:

Deutsche Bundesbank  
Personalabteilung  
Wilhelm-Epstein-Str. 14

D - 60431 Frankfurt  
GERMANY

