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ECONOMIC PAPERS

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## In Search for a Credit Crunch in Germany

# Imprint

## Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics  
Universitätsstr. 150, 44801 Bochum, Germany

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## Ruhr Economic Papers #361

Responsible Editor: Christoph M. Schmidt

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ISSN 1864-4872 (online) – ISBN 978-3-86788-415-0

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## Bibliografische Informationen der Deutschen Nationalbibliothek

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Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über:  
*<http://dnb.d-nb.de>* abrufbar.

<http://dx.doi.org/10.4419/86788415>

ISSN 1864-4872 (online)

ISBN 978-3-86788-415-0

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Torsten Schmidt and Lina Zwick<sup>1</sup>

## In Search for a Credit Crunch in Germany

### Abstract

*The purpose of this paper is to investigate whether a credit crunch occurred in Germany during the recent financial crisis and to analyze the underlying factors. In order to disentangle credit supply and demand we specify a theory-based dynamic disequilibrium model of the German credit market. To estimate this model we use a new approach based on Bayesian Inference suggested by Bauwens and Lubrano (2007). Besides the analysis of the whole banking sector we will apply the model to five groups of banks (big private banks, “Landesbanken”, savings banks, credit cooperatives, regional institutions of credit cooperatives) that were affected differently by the financial crisis. The results suggest that a credit crunch did not occur in Germany during the recent economic crisis as well as during the following recovery starting in 2010. Furthermore, we find that especially those banks that were more affected by the financial crisis through huge impairments restricted their credit supply more than others. Both supply and demand side factors contributed to the stabilization of credit financing. This suggests that the structure of the German banking sector as well as economic policy measures avoided a credit crunch.*

*JEL Classification: C32, E51, G21*

*Keywords: Credit Crunch; Bank Lending; Financial Crisis*

*August 2012*

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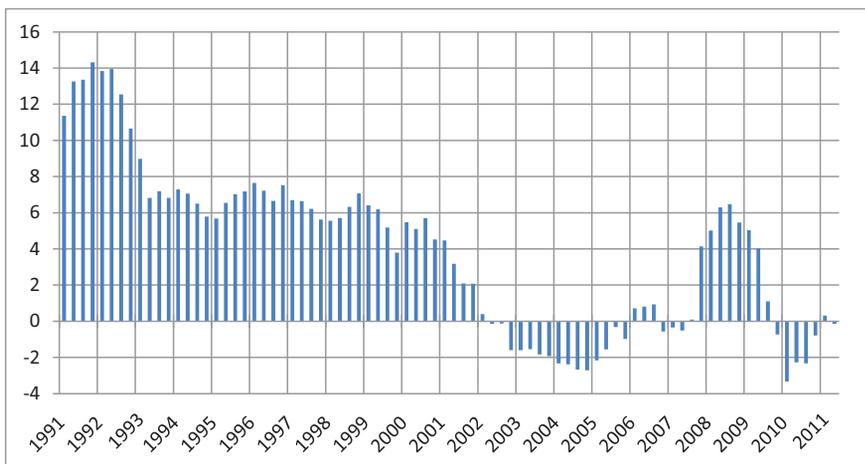
<sup>1</sup> Both RWI. – We thank Christoph M. Schmidt for helpful comments and suggestions. – All correspondence to Lina Zwick, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI), Hohenzollernstr.1-3, 45128 Essen, Germany, Email: lina.zwick@rwi-essen.de.

## 1. Introduction

In the fall of 2008 Lehman Brothers fell into bankruptcy and the banking crisis in the U.S. escalated into a global financial crisis. In Germany, as a reaction to these events the volume of loans from banks to the private sector slowed down and even declined since the fourth quarter of 2009, before displaying first signs of recovery in the first quarter of 2011 (Figure 1). This development has evoked concerns that a supply-sided restriction of credit volume, a credit crunch, might have aggravated the recession and hampered the recovery. Consequently, politicians in the Eurozone as well as in Germany felt obliged to intervene by establishing measures to stabilize the lending of credits.

In particular, the European Central Bank (ECB) provided substantial liquidity to European banks during the crisis and the German Federal Government established the “Special Fund for Financial Market Stabilization (SoFFin)”. This fund was designed in the “Financial Market Stabilization Act” in October 2008 to strengthen the capital stock of German banks through guarantees, recapitalization and overtaking risky positions of banks’ balance sheets. Besides the support for the banking sector the government established the “Deutschlandfonds”, a fund initiated to stabilize the financing conditions for struggling companies by issuing direct guarantees.

**Figure 1: Loans to enterprises and self-employed workers (annual growth rate in %)**



Source: Deutsche Bundesbank, own calculations.

However, a decrease in credit volume is not unusual in the face of a recession. Credit demand might be reduced because of lower investments and credit supply might decrease due to a higher probability of credit defaults. Nevertheless, in this particular instance concerns about a possible risk of a credit crunch in Germany were justified. German banks had to depreciate huge amounts of asset values during the financial crisis. Especially big private banks and “Landesbanken” reported high losses due to these impairments, while savings banks and credit cooperatives were less affected (Deutsche Bundesbank 2009:52). These losses meant a weakening of banks’ lending capacity and might have had strong negative impacts on the financing opportunities of German firms as bank credits amount for around 40% of the external debt of private firms in Germany (Deutsche Bundesbank 2009:18). Thus, a weakening of banks’ lending capacity due to high impairments could have strong negative effects on investments and hence on economic activity as a whole.

Moreover, during the subsequent recovery financing conditions for the private sector might deteriorate when credit supply does not increase as fast as credit demand. Boysen-Hogrefe et al. (2010), for instance, outlined such an increased risk of a credit crunch in Germany, where recovery started in 2010.

The purpose of this paper is to investigate empirically whether a credit crunch occurred in Germany during the recent recession as well as during the following recovery. In order to disentangle credit supply and demand we specify a dynamic disequilibrium model of the German credit market. To estimate this model we use a new approach based on Bayesian Inference suggested by Bauwens and Lubrano (2007).

Additionally to the analysis of the whole banking sector we apply the model to different groups of banks that were affected differently by the financial crisis. In Germany, the banking system includes three pillars: big private banks, public sector banks and cooperative banks (Hüfner 2010)<sup>2</sup>. Big private banks operate internationally and they faced substantial losses during the financial crisis. While the original function of “Landesbanken” was to serve as central institutions for savings banks, they started to operate internationally as big private banks in recent years and hence were also heavily affected by the financial crisis. In contrast,

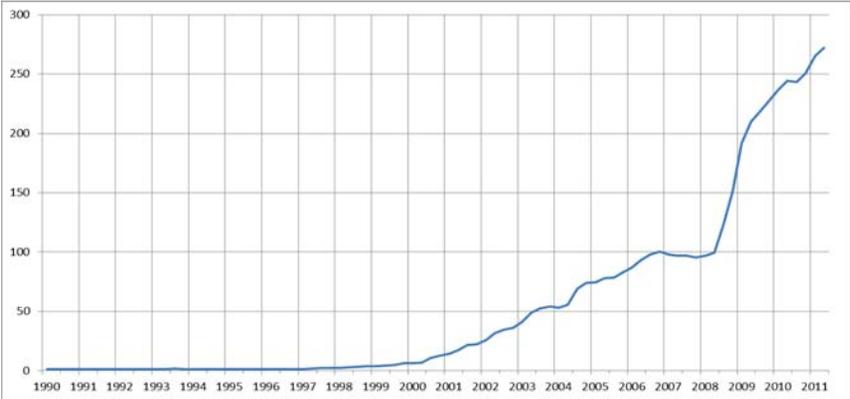
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<sup>2</sup> Public sector banks include “Landesbanken”, which are regional institutions of savings banks and jointly owned by savings banks and the state government, as well as savings banks. Cooperative banks include credit cooperatives and regional institutions of credit cooperatives.

the direct exposure to toxic assets of savings banks, which are owned by local governments and are typically operating regionally, was low. Credit cooperatives and regional institutions of credit cooperatives are similar in their operating behavior as their public counterpart: Credit cooperatives mainly work with small and medium-sized enterprises and are operating regionally, while regional institutions of credit cooperatives provide in their traditional role similar services for individual credit cooperatives to “Landesbanken”. Accordingly these two groups were similar affected by the financial crisis to their public counterparts. Including these five groups in our analysis, we are able to analyze whether banks affected differently by the financial crisis show also a different lending behavior.

We did not find evidence for the occurrence of a credit crunch in Germany, neither during the crisis nor during the recovery. Several factors have probably contributed to avoiding a credit crunch. First, the attractiveness of alternative external financing instruments obviously increased. Before the year 2000 corporate bonds were almost not used by firms as a financing instrument. Since then the amount of outstanding volume of corporate bonds has increased steadily, but in particular since the third quarter of 2008 a tremendous increase is observed (Figure 2).

**Figure 2: Development of Corporate Bonds (Non-MFIs, Billion Euro)**



Source: Deutsche Bundesbank.

Especially firms with access to the capital market obviously used this alternative external financing instrument to substitute bank credits. Small and medium-sized enterprises, that are less able to use this alternative instrument, are more often customers of savings banks

and credit cooperatives that were less affected by the financial crisis. Moreover, in the first phase of recovery firms tend to concentrate, in general, more on internal financing so that restrictions by the supply side were probably not determining the credit market (Deutsche Bundesbank 2011:74). In addition, it is likely that the policy measures taken during the financial crisis have contributed substantially to stabilizing the financial system and strengthening the capital stock of banks.

The remainder of the paper is organized as follows: section 2 provides a short overview of the different approaches proposed in the literature for identifying a credit crunch. The empirical analysis in section 3 continues with a description of the empirical approach and the data used to analyze the German credit market. Section 4 discusses the results and the last section concludes.

## 2. Literature

When analyzing excess demand on the credit market, two situations have to be distinguished: credit rationing and a credit crunch. Credit rationing describes a situation of permanent excess demand due to imperfect information on credit markets. Lending behavior of banks depends on both the interest rate and the riskiness of the loans. Additionally, Stiglitz and Weiss (1981) show that the interest rate itself influences the riskiness of loans through adverse selection and incentive effects. Thus, a rising interest rate increases the average riskiness of loans and hence the probability of default reducing the expected rate of return to banks. Accordingly, banks might not be willing to increase the interest rate, although credit demand exceeds credit supply. Instead, they restrict lending to firms. Obviously, this behavior of banks is economically rational from the individual perspective. Nevertheless, it might have negative effects on the economy as a whole (Reize 2010).

The term credit crunch is used in different ways in the literature. In this paper, we follow Berger and Udell (1994: 586) who define a credit crunch as a “significant reduction in the supply of credit available to commercial borrowers”. This definition implies that in contrast to credit rationing a credit crunch describes a situation where the credit market is temporarily in disequilibrium due to an exogenous shock. Moreover, some authors argue that a credit crunch is a generic part of the business cycle (Sinai 1993;Wojnilower 1980),

while in most empirical studies it is seen as an isolated incident (Bernanke and Lown 1992; Owens and Schreft 1992; Peek and Rosengreen 1995). In the case of an isolated shock, property market crashes or changes in banking regulation are often seen as likely causes.

The analysis of a possible credit crunch requires the separate identification of credit supply and demand in order to determine which side of the market is restricting the other. However, the problem with this identification is that demand and supply are unobservable, only the realized credit volume can be observed. In the literature two approaches have been used to deal with this problem, one based on microeconomic survey data, the other on macroeconomic time series.

The first approach is to use microeconomic data like survey or firm level data to see whether banks refuse lending even to profitable firms. Thus, a credit crunch would be identified if even those firms do not receive loans who demonstrate sound creditworthiness. In addition to the existence of a supply-sided restriction of credit volume this approach also facilitates analyzing the nature of a credit crunch, in particular, whether groups of firms are affected differently (Borensztein and Lee 2000). The results of these surveys are typically available without any substantial time lag. However, in many cases the history of these surveys is rather short.

Most prominently, the system of European central banks launched a bank lending survey in 2003 (Berg et al. 2005). In each member country of the European monetary union loan officers of a representative sample of banks have to answer qualitative questions about their lending behavior. However, so far the bank lending survey doesn't cover any phase of substantial credit restrictions. Concerning the actual economic crisis Hempell and Sorensen (2010) use data from this survey to disentangle credit demand and supply in the Euro Area. Although they find mainly cyclical and demand-side factors to explain the slowdown in loan growth, the financial crisis significantly reduced the ability of banks to lend. For Germany, Blaes (2011) analyzes the same data source and finds that bank related factors had a strong impact on the loan development during the crisis.

Rottmann and Wollmershäuser (2010) derive a credit crunch indicator based on data from a survey among German firms (Ifo Business Survey). It measures those restrictions in these firms' access to credit which are neither explained by firm-specific factors nor by refinancing

costs. They did not find strong evidence for a credit crunch in Germany in the financial crisis. Only for large firms the indicator shows signs of a restriction in credit supply that cannot be explained by the creditworthiness of borrowers or by refinancing costs.

Moreover, Reize (2010) uses data from the KfW-Mittelstandspanel for the years 2004 to 2009 to analyze whether small and medium-sized enterprises (SME) in Germany have been affected by a credit crunch. Employing a random-effects logit-model he does not find signs for such a supply-sided restriction. By contrast, the restrictiveness on the credit market appears to have its origin to a large extent in the deterioration of the economy. However, the author stresses the risk of a credit crunch in 2010 when the economy recovered and investments increased, while banks restricted lending due to higher capital restrictions.

The other approach to identifying credit supply and demand is to use macroeconomic time series data which is available at least at a quarterly frequency. For the actual economic crisis in Germany, Busch et al. (2010) apply a Bayesian VAR with sign restrictions to disentangle loan demand and supply shocks. They find considerable loan supply shocks in the period between 2004 and 2007 and after 2008. Boysen-Hogrefe et al. (2010) analyze whether there was a credit crunch in Germany and also assess the future risk that a credit crunch might occur during the recovery, using an econometric model and simulation methods which include different scenarios of GDP and the equity to capital ratio. They do not find any signs of a credit crunch in Germany in 2009, but highlight the considerable risk of such a situation that tends to emerge when the economy recovers.

Yet another way to identify a credit crunch by using macroeconomic data is to apply a disequilibrium model of the credit market. This approach disentangles credit supply and demand and identifies a credit crunch through implementing a minimum restriction so that the smaller side of the market is determining and therefore constraining the credit volume. Disequilibrium models have been used in several studies for single countries like Finland (Pazarbasioglu 1997), Germany (Nehls and Schmidt 2004), and the US (Laffont and Garcia 1977; Maddala and Nelson 1974; Sealey 1979) or for groups of countries such as the US, UK, Germany and Switzerland (Kugler 1987) and Latin America (Barajas and Steiner 2002). For the recent crisis, Erdogan (2010) applies a static disequilibrium model for Germany estimated by maximum likelihood method. He finds a significant supply-sided restriction of the credit volume at the beginning of 2007, before the escalation of the economic crisis.

In summary, the empirical evidence suggests that supply-sided restrictions of loans occurred in Germany during the recent financial crisis. However, the empirical results differ in the magnitude of these restrictions. While some studies find significant economic effects, others failed to find signs of a significant supply-sided restriction of the credit market.

### 3. Empirical Approach

In order to get additional information about the state of the German credit market during the recent financial crisis we use a new approach to estimate disequilibrium models for the whole banking sector as well as for banking groups taken separately. In this way, it is possible to see whether differences in lending behavior can be observed within the economy. In a disequilibrium model equations for credit supply and demand are estimated simultaneously and a minimum restriction identifies the side of the market that determines the volume of credit. Thus, applying the minimum restriction reveals whether the realized credit volume equals credit demand (excess of supply), credit supply (credit crunch) or both credit demand and supply (equilibrium).

Disequilibrium models can be modeled either in a static or in a dynamic way. To account for the fact that estimation results of disequilibrium models are not very robust, we compare the results of a two-equation equilibrium model estimated with OLS and a static disequilibrium model with the outcome of a dynamic disequilibrium model estimated with Maximum Likelihood (ML) and Bayesian methods respectively. The static disequilibrium model developed by Maddala and Nelson (1974) includes the following equations

$$\begin{aligned}
 d_t &= x_{1t}'\beta_1 + u_{1t} \\
 s_t &= x_{2t}'\beta_2 + u_{2t} \\
 q_t &= \min(d_t, s_t)
 \end{aligned} \tag{1}$$

where  $d_t$  is credit demand,  $s_t$  credit supply,  $x'_{it}$ , with  $i=1,2$ , are vectors of exogenous variables determining credit demand and supply. For identification it is crucial that these vectors differ in at least one variable.  $u_{1,t}$ ,  $u_{2,t}$  are independent stochastic disturbances. However, applying the static model includes the assumption that the credit volume of former periods does not influence the actual credit volume. This is highly restrictive because

the outstanding credit volume is a stock variable with only relatively small changes in each period (Lee 1997).

Therefore, in this paper we prefer to apply the dynamic version of a disequilibrium model which also includes past observations of the dependent variable. In particular, we use the model developed by Bauwens and Lubrano (2007)<sup>3</sup>

$$\begin{aligned}
 d_t &= \rho_1 q_{t-1} + x_{1t}' \beta_1 + u_{1t} \\
 s_t &= \rho_2 q_{t-1} + x_{2t}' \beta_2 + u_{2t} \\
 q_t &= \min(\rho_1 q_{t-1} + x_{1t}' \beta_1, \rho_2 q_{t-1} + x_{2t}' \beta_2) + \delta_t u_{1t} + (1 - \delta_t) u_{2t}
 \end{aligned} \tag{2}$$

where credit demand ( $d_t$ ) and credit supply ( $s_t$ ) are again determined by a vector of exogenous variables  $x_{it}'$ , with  $i=1,2$ , but also by the lagged credit volume  $q_{t-1}$ . Furthermore,  $u_{1,t}$ ,  $u_{2,t}$  are independent error terms with  $u_{1t} \sim N(0, \sigma_1^2)$  and  $u_{2t} \sim N(0, \sigma_2^2)$  and  $\delta_t$  is an indicator variable allowing for different variances between the regimes.

However, estimation of this model by Maximum Likelihood is no longer feasible as the dimension of the integral increases enormously and the use of simulated Maximum Likelihood would be relatively computer intensive (Bauwens and Lubrano 2007). Instead, Bauwens and Lubrano propose to use Bayesian inference to solve their model. This also avoids numerical problems associated with Maximum Likelihood. First, likelihood functions of high-dimensional models often contain discontinuities as for example “walls” or “cliffs” (Dejong and Dave 2011). In this case the estimates of the parameters depend strongly on the starting values of the algorithm. Furthermore, it is possible that the algorithm does not find any solution. In contrast, in the Bayesian approach prior assumptions about the distribution of parameters reduce this problem.

In particular, the estimation approach is to apply the data augmentation principle by Tanner and Wong (1987) and the Gibbs sampler for iterations to receive posterior distributions of the parameters as well as an indicator variable for supply-sided restrictions. Two iteration steps are conducted to receive the posterior distributions. First, values of the unobservable variables (credit supply and demand) are generated based on a given value of the

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<sup>3</sup>Bauwens and Lubrano kindly provided their GAUSS code to us.

parameters. For this purpose, it is checked for each quarter of the period analyzed by which market side the credit volume is determined. If the inequality

$$\rho_2 q_{t-1} + x'_{2t} \beta_2 < \rho_1 q_{t-1} + x'_{1t} \beta_1 \quad (3)$$

is fulfilled, the supply side determines the credit volume and the indicator variable for supply-sided restrictions is set to one. Therefore the observed value  $q_t$  is allocated to the vector  $y_s$ , while a simulated value is allocated to the vector  $y_d$ . The simulated value is drawn from

$$d_t \sim N_{d_t > s_t} (d_t | \rho_1 q_{t-1} + x'_{1t} \beta_1, \sigma_1^2) \quad (4)$$

On the other hand, if the inequality is not fulfilled,  $q_t$  is allocated to the vector  $y_d$  and for the supply regime the value is drawn from

$$s_t \sim N_{s_t > d_t} (s_t | \rho_2 q_{t-1} + x'_{2t} \beta_2, \sigma_2^2) \quad (5)$$

Thus, two vectors are generated that include observed and simulated values of the endogenous variable. In the second iteration step, the parameters of the model are estimated again based on the vectors  $y_s$  and  $y_d$ .

To start the algorithm, we need a set of starting values for the parameters of the model. As proposed by Bauwens and Lubrano we first run an OLS regression. It is assumed that the credit market is in equilibrium ( $y_s = y_d = q$ ). For the Gibbs sampler we set the number of draws to 60 000. This should be sufficient to receive accurate estimates for the moments of the parameter distributions. However, to guarantee convergence, a burn-in-phase of 15 000 iterations is included. Furthermore, for the prior distributions normality is assumed. In order to guarantee identification of both regimes an informative prior is used, which imposes the restriction that the number of observations has to be at least as high as the number of parameters. After the posterior distribution has converged, the coefficients of the exogenous variables correspond to the posterior mean of the parameters' distribution. In addition, the value of the indicator variable for supply-sided restrictions as a share of the number of iterations can be interpreted as a probability of a credit crunch for each period.

For our analysis of the German credit market we use quarterly data from the first quarter of 1990 to the second quarter of 2011. All series are made available by the German Bundesbank, except for industrial production which we take from the German Federal Statistical Office, and are reported in nominal terms. We construct the volume of loans to enterprises and self-employed persons from a series of quarterly changes because this series is corrected for structural breaks. Industrial bonds, for which we use the amounts outstanding of debt securities issued by residents, are employed as a proxy for alternative instruments of financing. In order to consider the lending capacity of banks we include the sum of the bank's equity as well as savings, demand and time deposits. As a measure of the profitability of banks we include the spread between the interest rate (we use the yields on debt securities outstanding issued by residents, a measure that is most often used as a proxy for interest rates) and the money market rate, which is the money market rate for three-month funds reported by Frankfurt banks on a monthly average. For industrial production as a measure of economic activity, the seasonally adjusted series is employed. Finally, the share price index, for which we use the CDAX index, is included in order to consider unrealized gains or losses of banks.

#### 4. Results

For all four models of the German credit market we use the same specification of demand and supply. The specification of credit demand is quite common in the literature. We include the lagged value of industrial production as an indicator for economic activity. This variable is positively associated with credit demand, as with an improving economic activity investments will increase and hence the demand for credit to finance these investments. Regarding the timing of effects, the German Bundesbank reports bank credits to lag economic activity substantially. This pattern might be explained by the preference of firms for internal financing in the first phase of recovery as well as by the use of spare capacity during this time (Deutsche Bundesbank 2011:71-74). Therefore we use a lag of four quarters of industrial production.

As a second variable we include the outstanding volume of industrial bonds to take into account that, although credit financing is still the most important external finance instrument, the volume of alternative financing possibilities has increased in the last years. Here, we expect a negative effect on credit demand reflecting the substitution effects of

bonds. In many specifications of credit demand, the interest rate is also considered to control for the price of credit to the borrower. We tried to include this variable as well but we could not find a significant effect on credit demand in our model. Due to the fact that the calculations of the regime probabilities are quite sensitive to the specification of the equations we drop all insignificant variables.

One important factor when modeling credit supply is the lending capacity of banks. For this variable we expect a positive sign as an increasing lending capacity strengthens the opportunities for banks to lend. Furthermore, we include the share price index in order to grasp not only the capital that is available for the banks directly but also unrealized gains and losses that determine the ability of banks to lend as well. Thus, this variable should be positively correlated with credit supply. As a third factor of credit supply we consider an interest rate spread as a profitability measure. If banks are able to lend for a higher rate than they have to pay for refinancing, they will probably be more willing to make loans to the private sector increasing credit supply. Therefore, we expect a positive influence on credit supply. Finally, in both specifications the lagged value of credit volume is included – except for the static disequilibrium model - to consider the dynamic effects of the credit market.

**Table 1: Estimation results for different models of the German credit market**

	OLS	Static disequilibrium model (ML)	Dynamic disequilibrium model (ML)	Dynamic disequilibrium model (Bayesian)
<b>Credit demand</b>				
Constant	<b>-0.434</b> (0.147)	<b>6.593</b> (0.818)	<b>-0.851</b> (0.586)	<b>-0.350</b> (0.097)
Lagged Loans	<b>0.927</b> (0.021)		<b>0.875</b> (0.070)	<b>0.923</b> (0.018)
Industrial production (lag of 4 quarters)	<b>0.354</b> (0.065)	<b>0.067</b> (0.184)	<b>0.405</b> (0.042)	<b>0.317</b> (0.039)
Industrial Bonds (Level)	<b>-0.023</b> (0.003)	<b>0.129</b> (0.008)	<b>-0.026</b> (0.003)	<b>-0.021</b> (0.002)
<b>Credit supply</b>				
Constant	<b>0.632</b> (0.060)	<b>4.755</b> (0.181)	<b>-0.182</b> (0.231)	<b>1.062</b> (0.34)
Lagged Loans	<b>0.748</b> (0.027)		<b>0.892</b> (0.055)	<b>0.516</b> (0.141)
Lending capacity (annual change)	<b>0.314</b> (0.133)	<b>-0.005</b> (0.003)	<b>-0.002</b> (0.001)	<b>0.906</b> (0.266)
Interest rate spread	<b>0.004</b> (0.001)	<b>0.075</b> (0.009)	<b>-0.005</b> (0.004)	<b>0.017</b> (0.007)
Share prices	<b>0.056</b> (0.014)	<b>0.392</b> (0.033)	<b>0.192</b> (0.056)	<b>0.162</b> (0.042)
Log Likelihood	-	119.08	205.78	-

Standard errors (posterior standard deviations for the Bayesian model) are documented in parentheses.

### The German credit market

The estimation results presented in Table 1 show that the specification for credit demand is quite robust: all coefficients – except those for the static disequilibrium model – are similar in their size. Furthermore, most of the coefficients have the expected sign. However, it is difficult to make statements about the significance of the coefficients of the first three models as the distribution is unknown. In contrast, for the Bayesian approach the posterior distributions are known although they do not have to be normally distributed. Therefore, to test for significance the p-values are calculated from the posterior distributions of the coefficients. All presented coefficients of the model are significant at the one percent level. In particular, the lagged-dependent variable has a strong positive influence on credit demand. Industrial bonds, in contrast, have a small negative impact, indicating the substitution effect of this alternative financing instrument.

At the same time Table 1 also shows that the coefficients of credit supply are less robust as they vary strongly between the different models. For example, in the Bayesian dynamic model the coefficient of lending capacity is much larger than in the OLS model, while this

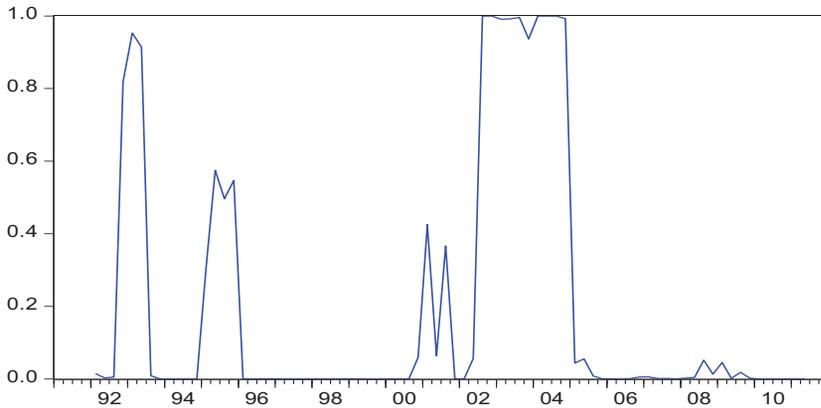
variable has even the wrong sign in the other two models. Furthermore, the coefficient of the lagged-dependent variable in our preferred model indicates, in contrast to the dynamic disequilibrium model estimated with ML, that the impact of former credit volume differs between credit demand and credit supply. This is sensible as banks can adjust credit supply relatively easily and quickly, whereas the adjustment of the financing structure of firms to changing environment takes more time.

Our presumption that a dynamic disequilibrium model might be preferable to a static model, since the current volume depends on the credit volume of former periods, is confirmed by the empirical results. The static model does not lead to reasonable estimates, this pertains especially to the demand side. Moreover, comparing the static and the dynamic model estimated by Maximum Likelihood (ML) the log likelihood value is much larger for the dynamic specification indicating that this model should be preferred. Concerning the dynamic model the Bayesian approach leads to more convincing results. Thus, for further analysis, we base our arguments on the dynamic disequilibrium model estimated by Bayesian methods. Nevertheless, as known from the literature estimation results of disequilibrium models in general are quite sensitive.

In order to identify a credit crunch, we calculate the probability of a supply-constrained credit volume by applying the minimum restriction. Figure 3 reports this probability of excess demand for the years 1991 to 2011. First of all, the German credit market is not rationed because credit demand does not exceed credit supply permanently but only in infrequent events. This might be explained by the high proportion of "Relationship Banking" in Germany. This kind of relationship between firms and banks is typically long and exclusive and reduces the information asymmetry between both partners (Friderichs and Körting 2011).

However, our estimates suggest the existence of transitory phases of large excess demand. First of all, our model supports the findings from Nehls and Schmidt (2004) concerning a credit crunch in Germany at the beginning of the 21<sup>st</sup> century. Furthermore, the results indicate also a high probability of a restrictive supply regime in the early nineties. This might be explained by the recession which took place in Germany during these years. In fact, several papers found that credit contractions often coincide with recessions (e.g. Eckstein and Sinai 1986, Claessens, Kose and Terrones 2009).

**Figure 3: Probabilities of excess demand for all banking groups**



Source: Calculated from the estimated dynamic disequilibrium model.

With these results in mind it is quite surprising that the probability of a credit crunch during the recent financial crisis is very low. Even following the Lehmann bankruptcy this probability was lower than 10%. However, this result is in line with the findings of other papers analyzing the recent economic crisis. It is also sensible since our results show that one important factor for credit supply is the lending capacity of banks. And during the crisis the ECB provided substantial liquidity to the banking sector through extending the term maturity, reducing the base interest rate and extending the pool of acceptable securities (Sachverständigenrat 2009). Additionally, the German Federal Government established the “Special Fund for Financial Market Stabilization” in order to strengthen the capital basis of German banks. Although the use of this fund was not very high because banks could use it voluntarily and had to follow strict rules, for example concerning the remuneration of their directors, the establishment helped to reduce the negative consequences of the financial crisis for the banking sector as well as for the real economy. Thus, the measures taken by policy-makers and the central bank obviously supported the stabilization of credit financing in Germany.

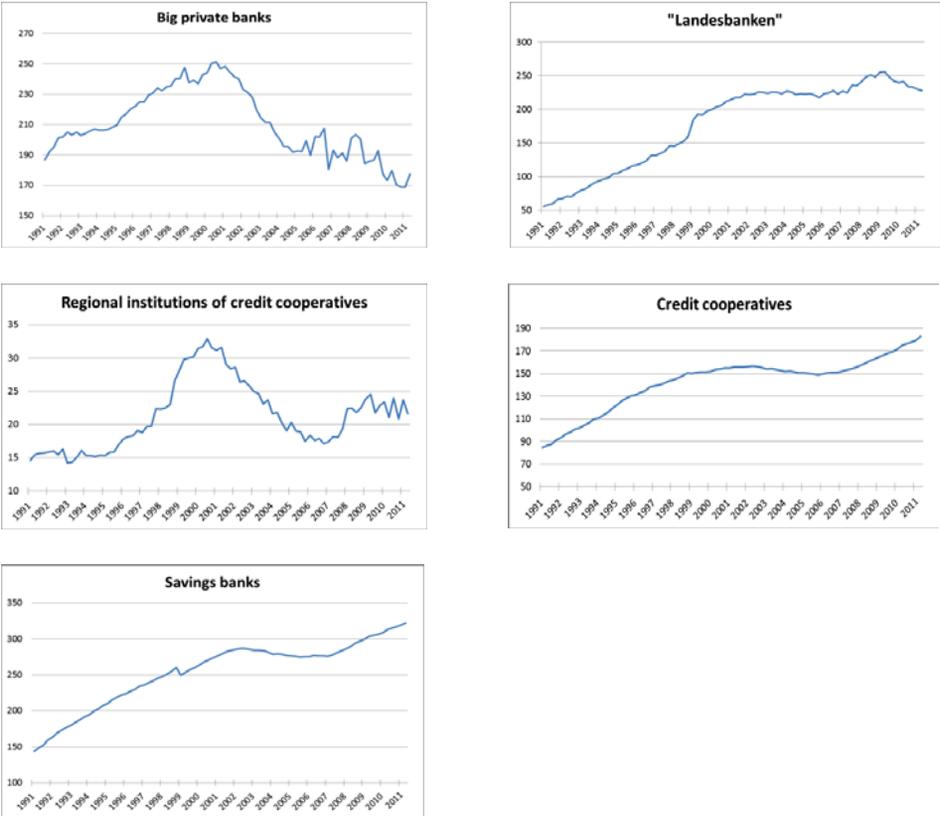
Furthermore, two factors concerning the demand side came into play which probably also reduced the risk of excess demand. First, the volume of industrial bonds went up enormously starting from the third quarter of 2008. Obviously, in times of crisis firms tend to revert to other external sources of financing to compensate the lower volume of bank credits. Second, during the early phase of recovery in 2010 the demand for credits might

have been lower, since in this situation firms tend not to start investing directly but first use their spare capacity. Moreover, firms prefer their own resources to finance investments during this phase (Deutsche Bundesbank 2011:74).

Banking groups

In addition to the question of an overall credit crunch in Germany we analyzed – again applying the dynamic disequilibrium model of Bauwens and Lubrano (2007) – whether certain groups of banks have been more restrictive in their lending behavior than others. Since 1990 a different development of the volume of loans to enterprises and self-employed workers can be observed between the banking groups analyzed that might indicate a different lending behavior (Figure 4).

**Figure 4: Loans to enterprises and self-employed workers of banking groups (Billion Euro)**



Source: Deutsche Bundesbank.

While the volume of credits of savings banks and of credit cooperatives has increased steadily since 1990, that of “Landesbanken” has slowed down since 2000. In contrast, the volume of credits of big private banks and of regional institutions of credit cooperatives has even decreased since 2000.

The estimation results are shown in Table 2. The specifications of credit demand and supply are based on their respective specification for the whole banking sector. However, they slightly differ because of institutional differences that cause differences both in lending behavior and in the demand for loans. Industrial bonds, for example, are not included in the specification of credit demand in the case of savings banks as we did not receive significant results. Probably most of the customers of savings banks are small and medium-sized firms that have no access to the capital market. Therefore it is plausible that this alternative external financing instrument has no significant impact on credit demand in this case. Turning to the supply side, we include the ratio of loans to lending-capacity for big private banks as well as for regional institutions of credit cooperatives in order to account for the higher activity in other business areas by these banks. The lending capacity seems to have less impact on credit supply of “Landesbanken” and regional institutions of credit cooperatives than of the other three groups of banks.

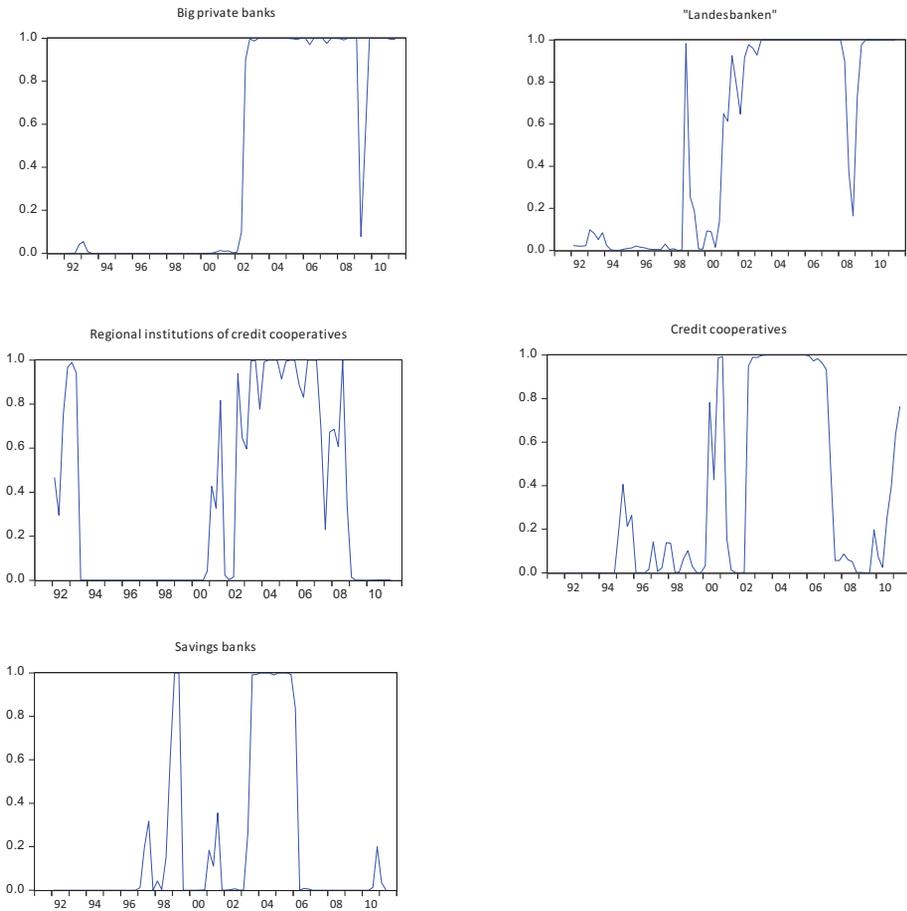
**Table 2: Estimation results for the banking groups**

	Big private banks	Landes- banken <sup>2</sup>	Savings banks	Regional institutions of credit cooperatives	Credit cooperatives
<b>Credit demand</b>					
Constant	<b>-0.191</b> (0.158)	<b>0.079</b> (0.304)	<b>0.140</b> (0.023)	<b>-1.333</b> (0.341)	<b>0.096</b> (0.035)
Lagged Loans <sup>1</sup>	<b>0.691</b> (0.067)	<b>0.815</b> (0.038)	<b>0.926</b> (0.008)	<b>0.933</b> (0.040)	<b>0.933</b> (0.010)
Industrial Production <sup>1</sup>	<b>0.497</b> (0.133)	<b>0.214</b> (0.180)	<b>0.024</b> (0.016)	<b>0.790</b> (0.181)	<b>0.030</b> (0.021)
Gross domestic product (Level)					
Interest rate (Long term)	<b>-0.006</b> (0.002)	<b>-0.015</b> (0.002)		<b>-0.013</b> (0.004)	
Industrial Bonds (Level)	<b>-0.017</b> (0.004)			<b>-0.042</b> (0.008)	
Industrial Bonds (Change)		<b>-0.071</b> (0.046)			<b>-0.032</b> (0.015)
<b>Credit supply</b>					
Constant	<b>1.663</b> (0.250)	<b>0.264</b> (0.106)	<b>-0.631</b> (0.286)	<b>-0.83</b> (0.348)	<b>0.006</b> (0.053)
Lagged Loans <sup>1</sup>	<b>0.162</b> (0.093)	<b>0.850</b> (0.043)	<b>0.369</b> (0.114)	<b>0.513</b> (0.165)	<b>0.937</b> (0.026)
Lending capacity (Level)			<b>0.740</b> (0.174)		
Lending capacity (annual change)	<b>0.764</b> (0.137)	<b>0.261</b> (0.059)		<b>0.246</b> (0.152)	<b>0.774</b> (0.126)
Ratio of loans to lending capacity	<b>0.559</b> (0.068)			<b>0.464</b> (0.127)	
Interest rate (Long term)		<b>0.004</b> (0.002)	<b>0.020</b> (0.004)		<b>0.005</b> (0.001)
Interest rate spread	<b>0.022</b> (0.005)			<b>0.074</b> (0.020)	
Share prices	<b>0.178</b> (0.043)	<b>0.028</b> (0.012)		<b>0.603</b> (0.147)	<b>0.042</b> (0.010)

Standard errors are documented in parentheses. <sup>1</sup>Loans and Industrial production are included with different lags. <sup>2</sup>A dummy variable is included to control for the structural break in the first quarter of 1998.

Figure 5 presents the probability of excess demand for the groups analyzed. Since the last credit crunch at the beginning of the 21<sup>st</sup> century big private banks, “Landesbanken” and regional institutions of credit cooperatives seem to have rationed the credit market as a permanent excess of credit demand can be observed. This is also in line with the development of credit volume of these three groups of banks (Figure 4). Obviously, these banks revert to other investment opportunities. However, in contrast to the other two banking groups, regional institutions of credit cooperatives did not reduce credit supply during the recent crisis.

**Figure 5: Probabilities of excess demand for the groups of banks analyzed**



Source: Calculated from the estimated dynamic disequilibrium model.

For savings banks and credit cooperatives credit rationing cannot be observed. Although these two banking groups reduced their credit supply during the credit crunch at the beginning of the 21<sup>st</sup> century as well, this reduction was only temporarily. Savings banks started to restrict their lending in 2003 which is substantially later than other banking groups. It is therefore likely that the end of the new economy boom is not the main reason for the reduction of credit supply in this sector. Rather the fact, that in 2002 the abolition of public guarantees for public sector banks until 2005 was confirmed (Hüfner 2010). Savings banks as well as "Landesbanken" had to adjust their balance sheets.

Thus, savings banks and credit cooperatives played an important part in stabilizing credit financing in Germany, especially during the recent crisis. The results for the recent crisis are roughly in line with those of Reize (2010) who does not find a credit crunch for small and medium-sized firms to whom savings banks in general orientate their business model (Friderichs and Körting 2011).

## 5. Conclusion

In this paper we estimate a dynamic disequilibrium model for the German credit market as a whole and for five banking groups to detect whether a credit crunch occurred during the recent financial crisis. We use Bayesian methods proposed by Bauwens and Lubrano (2007) as they combine features of disequilibrium models that are found in the literature to be favorable for empirical studies.

The results suggest that in contrast to other countries a credit crunch did not occur in the overall German credit market during the recent economic crisis as well as during the following recovery starting in 2010. However, the analysis of the five banking groups reveals substantial differences. We find that the credit supply of big private banks, “Landesbanken” and regional institutions of credit cooperatives was restricted since the credit crunch of 2003/2004. In contrast, the other two banking groups under consideration also reduced their credit supply during the credit crunch but expanded their credit supply beginning in 2006. These banking groups as well as regional institutions of credit cooperatives show only little signs of a restrictive credit supply during the recent crisis.

This finding suggests that small and medium-sized firms were not substantially affected by the financial crisis due to credit restrictions because they are more often customers of savings banks and credit cooperatives. In addition, large firms avoid a shortage of external capital by issuing corporate bonds. These firms are usually customers of those banks that were heavily affected by the financial crisis through huge impairments and restricted their credit supply substantially<sup>4</sup> (big private banks and “Landesbanken”).

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<sup>4</sup>The reduced credit supply during the crisis by these groups of banks is also in line with the results of Rottmann and Wollmershäuser (2010) that especially those firms that negotiate with these banks reported a reluctance to lend.

Despite the vulnerability of the German banking system in crisis due to its relatively high leverage and low profitability (Hüfner 2010) the three pillar structure obviously helped to stabilize credit financing and to avoid an overall credit crunch as banking groups differ in their operating behavior as well as in their customers. However, issuing bonds by large firms was probably not the main reason for the avoidance of a credit crunch as there were also turbulences on the capital market. Thus, this alternative financing instrument could not have offset the reduced credit volume completely. Rather the fact that politics and central banks intervene by establishing stabilization measures in order to support the liquidity basis of banks and hence their lending capacity should have played an important part in stabilizing the German credit market.

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