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Leveraging and risk taking within the German banking system: Evidence of the financial crisis in 2007 and 2008

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Abstract

The present study is centered primarily on determining whether the German banking system is to be characterized by procyclical behavior from 2000 to 2011 and to what extent specific sectors of the German banking system showed significant balance sheet operations to increase their leverage during years of booming asset prices. First, the results of this study show that the different sectors of the German banking system operate their business more or less procyclical. Second, the study provides some empirical evidence that banks to increase leverage during periods of extraordinary high returns in financial markets favor funding their assets by short-term borrowing in the interbank market. Third, the studies elucidate that banks that prefer above average leverages, can apparently be characterized by a high volatility of return on assets and low distances to default. Finally, the examined regression models provide some empirical evidence that regulatory authorities in the context of requirements on countercyclical capital buffers should consider current interest rate levels and indicators reflecting developments in the interbank market and the global capital market.

JEL Classification Numbers: G01, G12, G14, G28, G15, G32

Keywords: Liquidity and leverage; financial crises, asset pricing; information and market efficiency; government policy and regulation, international financial markets, funding policy; financial risk and risk management; capital and ownership structure; countercyclical capital buffers; distance to default

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Introduction

The focus of this paper is centered primarily on the dependence between liquidity and leverage, as examined, for example, by Adrian and Shin (2010), who study the quarterly balance sheets of five largest investment banks from 1991 to 2008 in order to emphasize the positive relationship between changes in leverage and balance sheet size. Within this context, the leverage is defined as the ratio of the sum of assets to the amount of capital on the liability side of the bank´s balance sheet. Because the balance sheets of banks are continuously marked-to-market, the leverage is by definition continuously changing as well. Adrian and Shin (2010) distinguish between passive banks and banks, which actively adjust their balance sheet size subsequently when the leverage tends to be low. Such active banks are commonly operating their balance sheets in a way that their leverage is high during episodes of global asset market booms that are providing extraordinarily high returns, and vice versa: This means, that actively leveraging by a bank results in procyclicality. Furthermore, Adrian and Shin (2010) demonstrate that an adjustment of balance sheet size is mostly done by collateralized borrowing and borrowing in the interbank market. With respect to banks` behavior during periods of actively leveraging it appears that banks take more debt with short-term maturities on the liability side of the balance sheet and look for potential returns by lending this money to borrowers, who are willing to pay above-average interest rates. This was evident, for instance, during the financial crisis in 2008 in the event of subprime mortgage-backed securities. Moreover, rising leverages within the financial system are closely linked to the overall Value-at-Risk (VaR) of banks, which is one of the major risk measures concerning banks` assets (Adrian and Shin [2010]).[3] As Rajan (2006) suggests this procyclical behavior of banks should be discussed within the context of numeration schemes and agency problems of the banking system. However, under the assumption that agents obtain sufficient incentives to invest in risky long-term assets it seems more likely that they will behave procyclical by increasing the leverage if asset markets are providing extraordinarily high returns and market risk appears to be relatively low. Therefore, it seems reasonable for legal authorities and regulators to pay high attention to principal-agent problems and moral hazard within certain sectors of the

[3] Calculating the Value-at-Risk (VaR) is the preferred measurement of market risk within the Basel II accord; see Bank for International Settlement (2005).

banking industry, particularly during periods of invitingly high returns provided in the asset markets.[4]

To carry out leverage adjustments during periods of increasing asset prices banks need to acquire additional short-term debt such as by looking for additional borrowings from non-banks or collateralized or unsecured borrowings from other banks in the global interbank market. Such behavior relates to an increasing interconnectivity and funding liquidity risk of the banking system. Therefore, the procyclicality of banks` leverage is widely accepted as one important reason for the fragility of the banking system (Arian and Shin [2010] or Cifuentes, Ferrucci and Shin [2005]).

As seen during a number of financial crises over the past decades relative small shocks in asset markets can induce systemic crises for two reasons, that are well-examined by different research groups.[5] First, a number of research papers are focused primarily on the role of asset prices during episodes of tumbling markets with respect to the aggregated and idiosyncratic liquidity of financial intermediaries. Cifuentes, Ferrucci and Shin (2005) underscore that asset sales by distressed financial institutions will lead to a further decline of asset prices if the demand of financial markets for illiquid assets is not perfectly elastic. This is consistent with Adrian and Shin (2010) who emphasize that the deleveraging of banks under tensioned market conditions by selling assets might induce a further decline of asset prices. Brunnermeier (2009) developed a theoretical model that explains the dynamics during the financial crisis in 2007/2008. It is based on two major self-accelerating spirals of market liquidity risk and funding liquidity risk with their amplifying interdependencies. As Brunnermeier demonstrate, a decline of asset prices is one major component of these spirals that might have caused an unforeseen fragility of the banking system during several financial crises, such as the subprime crisis in 2007/2008.[6]

Second, as argued, for example, by Brunnermeier (2009) or Gorton (2008), particularly high leveraged banks bear a tremendous funding liquidity risk. As Gorton (2008) highlights, for that reason bank runs are actually observable similar that during periods of the classic panics of the 19th and early 20th century. In general, bank runs are

[4] Stein (2003) provides further information on agency problems with respect to funding behavior of banks in capital markets, for example.
[5] For further details on the chronology and reasons of financial crises see, for example, Morris and Shin (2004) or Brunnermeier (2009)
[6] See also Brunnermeier and Pedersen (2009)

characterized by the fact that the holders of short-term liabilities refuse to fund banks for certain reasons. In contrast to the classic panics that have been the object of intensive research work, 'modern bank runs' seem to involve the funding opportunities in the interbank market instead or in addition to withdrawals of deposits by non-bank clients. Previous research papers can generally be assigned to two different theories explaining the origin of such panics. One strain of publications suggests that panics are caused by random events, such as unexpected withdrawals of deposits without any relation to changes in the real economy. Diamond and Dybvig (1983) do some influential work on bank runs as self-fulfilling prophecies with two different equilibriums. All consumers believe either that other consumers will withdraw their deposits and redeem their claims as well and cause a panic by showing such a coordinated behavior, or everybody relies on the patience of all other consumers and will withdraw their deposits in the case of consumption needs only. From the industry's point of view, there is no need of costly liquidation of assets as long as all producers can meet their obligations. Allan, Babus and Carletti (2009) point out that the use of this theory is difficult since it remains quite unclear what kind of signals on these two equilibriums are observable by consumers. Moreover, these researchers highlight that the theory formulated by Diamond and Dybvig (1983) provides not any predictive power since it assumes that consumers' beliefs are self-fulfilling and mostly coordinated by 'sunspots'.

Another strand of research papers has revealed that panics could be interpreted as a natural outgrowth of business cycles. As suggested by Jacklin and Bhattacharya (1988), consumers will withdraw their deposits if they receive information on economic downturns and the possibility that banks might not meet their commitments. By means of this behavior, consumers anticipate difficulties in the banking system and therefore the reasons of panics are not random but a response to information on deteriorating economic conditions.[7] To summarize so far, it can be said that 'modern bank runs' might be related to a drying up of the interbank market. Upper and Worms (2004), for example, underscore that there is a pecking order such as that the banks which are hit by

[7] This theory is consistent with empirical work, for example, done by Gorton (1988) or Allen and Gale (1998).

a liquidity shock try to meet their liquidity needs by withdrawing their deposits from other banks before liquidating long-term assets under strained market conditions.[8]

However, far too little attention has been paid to the interbank market in scientific literature over the past years. But due to experiences from the financial crisis in 2007/2008 an increasing number of research papers have recently been published trying to shed some light on freezes or drying up of the interbank market during financial crises, when banks stop trading with each other.

Allen, Carletti and Gale (2009) suggest a model of the interbank market that explains the excess volatility of prices in the interbank market, particularly observable if opportunities for banks are missing to hedge extraordinary aggregate and idiosyncratic liquidity demands under circumstances of financial crises. Furthermore, Allen, Carletti and Gale (2009) reviewed the role of central banks in fixing the short-term interest rate over episodes that are characterized by uncertainty about the liquidity demands of banks, and explain that interventions of central banks in the interbank market by conducting open market operations could improve the efficiency of the interbank market.

Within this context Freixas, Martin and Skeie (2010) consider two different types of liquidity shocks, which demand different central bank actions. First, central banks should reduce interbank interest rates during periods of distributional liquidity-shocks characterized by a great disparity in the liquidity held among banks. Second, central banks should intervene in financial markets by providing liquidity in order to manage the aggregated liquidity volume during periods of aggregate liquidity-shocks. Moreover, failures in cutting interest rates during financial crisis might erode the financial stability by increasing the risk of bank runs (Freixas, Martin and Skeie [2010]). Furthermore, Freixas, Martin and Skeie (2010) develop a model that covers the different states of liquidity needs and supports their hypothesis that central banks should lower interbank rates to increase the redistribution of liquidity within the banking system.[9] Finally, a failure to implement the optimal interest rate could lead to bank runs since the

[8] Such 'modern bank runs' might be caused on information asymmetries about counterparty risk, as pointed out, for example, by Heider, Hoerova and Holthausen (2009). This is consistent with Freixas and Holthausen (2005), who explain that market imperfections such as liquidity shortages or interest rate differentials could mainly be contributed to asymmetric information between different countries.

[9] These arguments are quite contrary to Goodfriend and King (1997) who argue that the interbank market are efficient at any stage and can distribute liquidity optimally. In contrast, Diamond and Rajan (2009) follow the hypothesis that interbank rates should be low during episodes of financial crisis and high under regular circumstances.

satisfaction of patient consumers directly depends on interbank rates if banks have needed to borrow in the interbank market (Freixas, Martin and Skeie [2010]).

So far, it is clear that global interconnections of banks have grown steadily as more and more banks participate in the interbank market. This development has subsequently increased risk of contagion that was currently observed during the financial crisis in 2007/2008 to a great degree. Thus, in recent years an increasing amount of literature has been published on the underlying mechanism of such risk of contagion in financial markets that generally follows two different directions: direct linkages and indirect linkages. Allan and Gale (2000) examine the interconnections of banks by exchanging interbank deposits as an insurance against liquidity shocks. By means of a theoretical model Allan and Gale (2000) demonstrate that the banking systems will be exposed a lower risk of contagion if the structure of interconnections is complete. This argument is consistent with Freixas, Parigi and Roche (2000) who demonstrate that banks are realizing such an insurance against liquidity shock by relying on committed credit lines to a great extent. However, systemic risks in the interbank market are particularly bearing the risk of coordination failures among depositors even if all banks are solvent. As pointed out by Freixas, Parigi and Roche (2000), there is some evidence that inefficient liquidation of solvent banks occurs because of contagion effects induced by one insolvent bank.[10] The question whether the banking system could find the optimal degree of interconnectivity is today among the most frequently discussed aspects within the context of interconnectivity of the banking system. Kahn and Santos (2010), for example, examine the optimal degree of insurance against liquidity shocks. They underscore that banks will not find the optimal degree of interconnectivity as long as there is a general shortage of liquidity within the banking system due to missing exogenous provision of liquidity.

Acharya, Gale and Yorulmazer (2010) propose a model that can explain a sudden freeze in the market for short-term borrowing. Their model is based on the rollover risk implied with repurchase agreements or asset-backed commercial papers as instruments of collateralized borrowing. The authors maintain that if the rollover risk is high, since the debt must be rolled over frequently, the debt capacity will be lower than the

[10] Furthermore, Freixas, Parigi and Roche (2000), examine the role of central banks in preventing systemic interbank market failures in the event of the closure of an insolvent bank and justify the too-big-to-fail policy that was one major object of discussions over the course of the financial crisis in 2007/2008.

fundamental value of the underlying assets. This theory could explain the tremendous haircuts of asset backed securities when used as collaterals in overnight repo borrowing during the subprime crisis. At the worst case, the debt capacity converges to the minimum possible value of the asset that reflects the freeze of the interbank market for secured lending. Such a drying up of the interbank market particularly shows a deep impact on funding liquidity risk in the event of extreme maturity mismatches. For example, some of the collateralized debt obligations reported a haircut of 100% during the subprime crisis, which means that these assets had not debt capacity at all and might subsequently induce a tremendous incline of funding liquidity risk within the banking system. Such phenomena were observed during the recent crisis since the arrival of good news was slower than the rate at which debts were rolled over (Acharya, Gale and Yorulmazer [2010]).

Furthermore, there are a number of empirical research papers addressing on global contagion effects in the course of the financial crisis in 2007/2008. Abassi and Schnabel (2009) find some empirical evidence of spillover effects by examining the spreads between unsecured and secured money market rates. These interbank market rates increased sharply during the crisis. Moreover, the US, UK and Euro repos spreads became highly correlated within a short-time period. It is worth noting that the repo spread is a leading indicator of uncertainty within the banking system since it reflects the willingness to lend unsecured money in the interbank market for multiples of the rates of collateralized lending. In detail, the repo spread reached more than 100 basis points at maximum and became highly volatile during the financial market turmoil (Abassi and Schnabel [2009]). By showing that repo spreads subsequently declined in response to liquidity provisions by central banks Abassi and Schnabel (2009) underscore that central bank operations were successful. Moreover, the authors assume that liquidity and solvency were closely related during the crisis and that liquidity provisions by central banks efficiently avoided fire sales of assets by banks.[11]

A second strand of research papers is based on the assumption of indirect linkages between banks` balance sheets that might strengthen the effects of contagion under crisis circumstances. Cifuentes, Ferrucci and Shin (2005) explain that banks are strongly connected via their portfolio holdings. If all banks hold the same assets there will be a

[11] Abassi and Schnabel (2009) assume that liquidity and solvency were closely related during the crisis and that liquidity provisions by central banks avoided fire sales of assets by banks.

high risk of contagion if asset prices erode significantly. Therefore, an important role concerning undesirable spillover effects is played by mark-to-market rules, which might enhance transparency of balance sheets but introduce an additional source of contagion risk. Under particular circumstances, more interconnected systems might be riskier than systems with a lower degree of connectivity (Cifuentes, Ferrucci and Shin [2005]).[12] The importance of asset price changes within a spillover mechanism is consistent with Kiyotaki and Moore (2002) who highlight that spillover effects are observable if firms hold similar assets that are used as collaterals under borrowing contracts and are object of significant price changes under strained market conditions. Beyond such indirect balance sheet contagion, Kiyotaki and Moore (2002) maintain direct balance sheet spillover effects in the case of simultaneous borrowing and lending each other to a great degree. Finally, Jorion and Zhang (2009) find some evidence that contagion effects would be observed in the event of increasing counterparty risk.[13]

Only little research work has been done so far for the German banking system. Upper and Worms (2004) discuss the linkage of credit risk and interbank lending as a potential source of contagion risk within the German banking system by estimating bilateral relationships on the basis of banks` balance sheets. The authors emphasize that institutional guarantees may reduce contagion within the German banking systems but cannot avoid it at all. Their empiric work shows some evidence that the failure of a single bank could lead to a significant breakdown of the German banking system since it could induce a 15% loss of total assets of the German banking system.

To summarize it can be said, that there is a large volume of published studies describing the relationship between leverage and liquidity and corresponding balance sheet operations of banks. Moreover, the influence of asset prices under strained market

[12] Cifuentes, Ferrucci and Shin (2005) also point out the role of liquidity and capital buffers that may help to reduce systemic risk under tensioned circumstances.

[13] Other researchers examine the role of financial innovations within the context of contagion. Parlour and Winton (2008), for example, consider the role of credit default swaps. The focus of Shin (2009) lies on the credit risk transfer by means of securization and Allen and Carletti (2006) develop a model that explains the dependencies between available liquidity and credit risk transferring in the event of aggregate or idiosyncratic liquidity shocks. Borio (2008) underscore that the reason for the recent financial turmoil is best seen as a natural consequence of a prolonged period of generalized and aggressive risk-taking that has been a basis in the accelerating development of financial innovations. McGuire and von Peter (2009) analyze the longer-term build up of banks´ international balance sheets and their debt security claims on the US non-bank sector to shed some light on the spillover effects over the episode of the financial markets turmoil in 2007/2008. The authors state out that one driving force of the contagion from the sector of US subprime mortgages to Europe are large dollar funding needs of European banks with significantly expanded claims on US non-banks since 2000, which could no longer be covered by borrowing in the interbank market without disturbances since the second half of 2007.

conditions on aggregate or idiosyncratic liquidity, the role of the interbank market for distribution of liquidity and monetary policy as well as the risk of contagion during financial markets crises and their underlying mechanisms are major objectives of research work. As pointed out above, there is only little research work done so far on the procyclical behavior of German banks that takes into account the leverage of the balance sheets of different categories of banks. Apart from Upper and Worms (2004), who examine the danger of contagion across the German banking system, there are no empirical studies conducted so far on the fragility of the German banking system due to the procyclical behavior of banks and the role of different funding sources particularly over the course of the financial crisis in 2007/2008.

Therefore, the present study is centered primarily on determining whether the German banking system is to be characterized by procyclical behavior from 2000 to 2011 and to what extent specific sectors of the German banking system showed significant balance sheet operations to increase their leverage within years of booming asset prices. Second, the current study is carried out to enlighten the consequences of such procyclically leveraging during the period of the subprime crisis in 2007/2008.[14] Third, the available empirical data is used to find some evidence for distinguishable funding policies among specific sectors of the German banking system that result in an increased funding liquidity risk within these banking sectors.[15] Following the hypothesis that tremendous liquidity demands of banks in 2007 and 2008 were reasoned primarily by 'modern bank runs', which involved weakening funding opportunities in the interbank market instead or in addition to withdrawals by non-bank depositors, the present study is additionally focused on the role of banks' non-bank and institutional funding preferences with respect to specific sectors of the German banking system.[16] This is of major interest from the perspective of the industry because funding in the interbank market to a great extent is one of the most important channels of contagion within the global banking industry. Finally, the results of this study provide valuable advice for regulatory authorities and policy-makers on how to avoid such contagion risk

[14] Adrian and Shin (2010) examine such high leverages over the subprime mortgage crisis in 2007/2008 in the event of globally operating investment banks.
[15] Brunnermeier and Pedersen (2009), for example, highlight the dependency between market and funding liquidty risk.
[16] Diamond and Dybvig (1983) provide seminal research on the role of withdrawals of deposits by early and late consumers.

by requiring banks to hold additional capital buffers and/or to ensure sufficient minimum distances to defaults.[17]

The paper proceeds as follows. Section 2 describes the origin and structure of the examined data and applied methodologies. Sector 3 subsequent reports the results and their assessment with respect to the constructed hypothesis. The paper finishes with a conclusion and gives an outlook on further research work.

Data and Methodologies

The examined sample consists of data provided by the Bundesbank's Statistics Department. The present study includes several balance sheet items of German banks that were reported to Deutsche Bundesbank from 2000 to 2010 on a monthly basis. These data are aggregated on the level of different banking sectors (German major banks, regional banks, Landesbanken, saving banks, cooperatives, international bank holdings) and cover 'total assets', 'capital', 'bank deposits with a maturity less than one year', 'non-bank deposits with a maturity less than one year', 'bank deposits with a maturity less longer one year', 'non-bank deposits with a maturity longer than one year', 'bearer bonds', 'repurchase agreements', 'other liabilities', and 'earnings before tax'. Several statistic assessments are conducted in order to describe the structure and dynamics of the German banking system from 2000 to 2010 with a primary focus on changes before and during the financial crisis in 2007/2008. Moreover, a number of ordinary least square regressions are applied in order to find some evidence on the relationship between the leverage of banks' balance sheets and different independent variables that are listed in Table 1.[18] Within this context, the leverage is calculated as the ratio of the sum of assets to the amount of capital on the liability side of the bank´s balance sheet. Finally, the study sheds some light on the so-called 'distance to default' of different banking sectors that is a widely accepted measure of the probability of a bank's default.

[Insert Table 1 here]

[17] Boyd and Graham (1986) proposed this commonly accepted so-called Z-Score.
[18] All regressions are conducted with STATA 11 software.

Results

The following sections illustrate descriptive statistics and regression models performed to shed some light on risk taking behavior of German banks over the period from 2000 to 2011 with a major focus on funding strategies and leverage of banks' balance sheets, that is defined as the ratio of total assets to total capital.

First, Table 2 provides an overview of the leverages of specific sectors of the German banking system over the period from 2000 to 2011 on a yearly basis. Column 1 of Table 2 illustrates leverages of the entire German banking system. It is apparent from this data that the German banking system is generally characterized by constant values during the observation period with peaks in 2000/2001 and 2005. The observed maximum value in 2000 and the decline of leverages from 2001 to 2003 can be assigned to the so-called 'internet bubble' and the subsequent crisis in financial markets because of a breakdown of the new economy. In detail, the German 'major banks' tend to increase their leverage from 2000 to 2005 providing only slightly lower values between 2005 and 2007 but a significant deduction of leverages in 2008 and 2009. 'Regional banks', 'saving banks' and 'cooperatives' appear to have reduced their leverages over the entire observation period resulting in lower values in 2008 compared to other banking sectors. Furthermore, it is noteworthy that 'Landesbanken' that are controlled by federal state authorities are among banks with the highest leverages. Table 2 indicates that 'Landesbanken' increased their leverages from 2003 to 2008 to a great extent by related balance sheet operations and apparently operated their business on a level of risk taking quite similar those of 'major banks' or 'international bank holdings'. This observation is of major interest since a number of 'Landesbanken' were among banks that have to be supported by the 'Financial Market Stabilization Fund (Sonderfonds für Finanzmarktstabilisierung, or SoFFin)' founded in 2008 by the German Government to stabilize the German banking industry.

[Insert Table 2 here]

Table 3 provides some evidence that increasing leverages are due to a tremendous enlarging of the asset side of banks' balance sheets during the period from 2000 to 2008. It can generally be ascertained that, because of their high volume of total asset, German 'major banks' and 'Landesbanken' play an important role within the German

banking system. In detail, Table 3 reports the above-average increase of total assets in the case of German ‘major banks’ and ‘international bank holdings’. This increase of total assets is quite comparable to the trend observed in the event of ‘regional banks’. However, ‘regional banks’ are less significant within the German banking system since they hold only a small part of the entire volume of assets of the German banking system. In the case of ‘international bank holdings’ the significant increase of total assets might reflect the increasing globalization of the international banking system that is frequently discussed as one reason of increasing risk of contagion over the last decade. In contrast, the exclusively locally operating ‘cooperatives’ and ‘saving banks’ are characterized by the lowest enlarging of the asset side of their balance sheets. Overall, it is apparent that special sectors of the German banking systems such as German ‘major banks’, ‘Landesbanken’ or ‘international bank holdings’ are operating their balance sheets procyclical by enlarging the volume of total assets during periods of booming asset prices.

[Insert Table 3 here]

Within the context of enlarging the asset side of banks` balance sheets it is of great interest to assess different funding sources especially with regards to the significant role of the interbank market as a funding channel during the financial market turbulences in 2008. Therefore, Table 4 compares the percentage of short-term funding in the interbank market by the examined banking sectors from 2000 to 2011. With respect to the entire German banking system these funding ratios were fairly constant from 2000 to 2009 at around 28% but characterized by a sharp decline in 2010 and 2011 as a result of increasing distrust in the interbank market. Apparently, German ‘major banks’, ‘Landesbanken’ and ‘international banking holdings’ show the highest percentage of short-term funding in the interbank market, whereas locally operating ‘saving banks’, ‘regional banks’ and ‘cooperatives’ show relatively low usage of this funding channel.

[Insert Table 4 here]

Table 5 presents a second source of banks` funding that is the short-term funding raised by acquiring savings or short-term deposits within the non-banking segment. Not surprisingly, locally operating ‘saving banks’, ‘regional banks’ and ‘cooperatives’ report higher percentages of short-term funding through non-banks than German ‘major

banks' and 'international bank holdings'. It is noteworthy that 'Landesbanken' show extremely low percentages of short-term non-bank funding over the entire observation period but with a significant increase from 2008 to 2011. The growing importance of non-banks as a funding source in the case of 'Landesbanken' from 2008 to 2011 can be explained by the necessarily changing of funding policies of 'Landesbanken' as a result of increasing distrust of such banks in the interbank market.

[Insert Table 5 here]

To summarize so far, it can be ascertained that the two dimensions of funding sources are worth to be examined in detail, that are the kind of funding source (non-bank funding or funding in the interbank market) and the terms of funding. Therefore, Table 6 compares the total percentages of short-term non-bank funding and funding in the interbank market raised by specific banking sectors. In Table 6 the entire German banking system reports a general increase of short-term funding from 2000 to 2011. The observed significant increase of short-term funding particularly from 2008 to 2011 might be explained by increasing distrust in the interbank market as well. This hypothesis is consistent with the presumption of decreasing creditworthiness of banks by participants in financial markets who accept to borrow money on a short-term basis only during periods of shrinking confidence, particularly in the tensioned interbank market. Such a trend is of major interest to regulatory authorities since the higher the percentage of short-term funding of a bank the higher the risk by maturity mismatches. In detail, 'Landesbanken', 'German major banks' and 'international bank holdings' appear to rely on short-term funding to a growing extent whereas 'regional banks', 'saving banks' and 'cooperatives' show fairly constant high percentages of short-term funding from 2000 to 2008.

[Insert Table 6 here]

Next, I conducted various ordinary least square (OLS) regressions in order to clarify influences on banks' leverage-ratios over the observation period in more detail. Table 7 shows the result of a regression of several financial market indicators on the leverage-ratios reported by the different banking sectors from 2000 to 2010.[19] In addition, a

[19] Independent variables are completely listed in Table 1.

factored variable is used for ‘banking sectors’ (‘regional banks’ are chosen as the basis) and dummy variables are introduced to the regression models for each single year from 2003 to 2010. To compare obtained coefficients in an efficient way the corresponding standardized beta coefficients are additionally reported in Table 7. The displayed regression model is well fitted providing a r-squared of 0.6390. Table 7 illustrates that ‘leverages’ of German banks are apparently depending on the related banking sector. Apart from ‘cooperatives’ the different banking sectors obtained positive and statistically significant coefficients. Among banks that show the highest standard beta coefficients are ‘international bank holdings’ and ‘Landesbanken’, while ‘German major banks’ and ‘saving banks’ obtain statistically significant but relatively low coefficients. Thus, we find some evidence that ‘international bank holdings’ and ‘Landesbanken’ conduct their business highly leveraged. In contrast, ‘saving banks’, ‘German major banks’ and ‘cooperatives’ display statistically significant and negative coefficients and thus are characterized by low leverages. These results are largely consistent with the observations reported in Table 2. At this stage, one may keep in mind that I choose ‘regional banks’ as the base of the factored variable for ‘banking sectors’ because these banks show relatively low leverages during the period from 2000 to 2011 (for further details see Table 2).

Moreover, I find a strong relationship between the dummy variables for each single year and leverage-ratios of German banking sectors particularly for the period from 2005 to 2010. Surprisingly, the obtained standard beta coefficients suggest a significant decrease of leverage-ratios from 2006 to 2010. Nevertheless, this observation seems rather plausible if one takes into account the entire German banking system as also confirmed by leverage-ratios reported in Table 2. Apparently, risk-taking behavior of German banks is rather diverse and depends on the considered banking sector to a great degree.

In contrast, this regression model provides only weak support for the assumption that leverages of banks are correlated with certain financial market indicators. No more than the global bond index (‘GBI’) shows a statistically significant influence on banks’ leverages even though the obtained coefficient is relatively low.

[Insert Table 7 here]

In order to test the sample on collinearities Table 8 displays the Variance Inflation Factors (VIF). The reported results confirm my assumption that used independent variables show only weak collinearities, if any. Some other robustness checks on the regression models are done as well whose results are consistent with the listed Variance Inflation Factors.

[Insert Table 8 here]

To shed some more light on procyclical behavior of German banking sectors and the relationship to the variety of financial market indicators, I analyze regression models for every single banking sector including a dummy variable for each single year of the period from 2003 to 2010. The results reported in Table 9 underscore a countercyclical behavior of 'saving banks' and 'cooperatives' by reducing the leverage-ratios over the period from 2003 to 2010. German 'major banks' contrarily appear to increase their leverage-ratios, since this banking sector report statistically significant and positive standard beta coefficient particularly for the period from 2005 to 2007. In the case of 'international bank holdings' and 'regional banks' my regression models provide a piece of evidence, that these banking sectors increase their leverage-ratios in 2005 and deleverage their balance-sheets from 2006 to 2010. In contrast, 'Landesbanken' show a procyclical behavior from 2003 to 2005 and during the period from 2008 to 2009 since the related dummy variables obtained statistically significant and positive standard beta coefficients whereas these variables for the period from 2006 to 2007 enter the regression with statistically significant but negative coefficients.

In addition, financial market indicators appear to influence the leverage-ratios of the variety of the banking sectors in a distinguishable direction and to a different degree. The 'return on assets' (ROA) look as if influencing leverage-ratios of 'international bank holdings' and 'regional banks' in a positive direction while particularly 'international bank holdings' obtained a relatively high standard beta coefficient that provide strong support for our assumption that those enlarging of balance-sheets is driven by 'return on assets'. Moreover, among the tested financial market indicators 'GBI' that is representing the global bond markets appear to show significant influence on the leverage-ratios of 'Landesbanken', 'regional banks', 'cooperatives' and 'saving banks', while the global stock market indicator 'MSCI' is apparently not related to

leverage-ratios of the various banking sectors. Interestingly, leverages of ‘cooperatives’ and ‘saving banks’ are significantly depending on independent variables for interest rates such as the libor 3 month deposit rate (‘libor3m’), the current yield of bonds with a 10 year maturity (‘current yield 10y’), and the spread between secured (repurchase agreement and unsecured interbank lending (‘repospread’). I can explain that dependencies to a great degree by the fact that business strategies of ‘cooperatives’ and ‘saving banks’ are centered primarily on attaining interest rate gains.

To summarize so far, I reasonably can emphasize that the leverage of a bank apparently relates to its assignment to a certain banking sector. Furthermore, it seems likely that each banking sector is adjusting its leverage to a different degree depending on various financial market indicators. This fact might be due to the varying business models of the considered banking sectors as well as different ownership structures within the German banking system.

[Insert Table 9 here]

A considerable amount of literature has been published on principal agent problems within the banking system that try to explain the relationship between ownership structures and risk behavior in terms of the so-called ‘distance to default’. Table 11 reports this risk measure taking into account the various banking sectors whereas the calculation of distances to default is based on profit and losses listed in Table 10. It is apparent from these tables that due to the higher volatility of profits and losses the distances of default calculated for German ‘major banks’, ‘Landesbanken’ and ‘international bank holdings’ were rather low compared with other banking sectors. In contrast, ‘saving banks’ and ‘cooperatives’ operate their business at higher ‘distances to default’ over the entire observation period. A similar situation was observed in the case of ‘regional banks’ from 1999 to 2006 but with a significant drawdown of distances to default in 2007 to 2008. In addition, Table 11 displays tremendous losses of German ‘major banks’ and ‘Landesbanken’ in 2008 and 2009 that significantly contributed to the severity of the crisis within the German banking system during the course of the global subprime mortgage crisis. Accordingly, it can be assumed that a number of banks within these sectors were de facto bankrupt in 2008 and 2009. Although the data coverage on this topic is fairly poor Table 11 provides some evidence that the leverage

of banks as well as the distance to default should get a high attention under such crisis circumstances. Since low distances to default were observed over the entire observation period the apparent difficulties of German banks in 2008 and 2009 were not so surprising. Quite the opposite, the results of this study emphasizes that higher leveraging and declining distances to default might be useful early warning signs for regulatory authorities and policy-makers.

[Insert Table 10 and 11 here]

Conclusion

The focus of this paper is primarily centered on the risk taking behavior of different sectors of the German banking system. As pointed out by Adrian and Shin (2010), risk-taking behavior is among others reflected by procyclical balance sheet operations that increase the ratio of total assets to capital.[20] Moreover, this leverage plays an important role concerning the bank`s distance to default that is widely accepted as an appropriate measurement of the bank`s probability of default.[21]

First, the results of this study show that the different sectors of the German banking system operated their business more or less procyclical: German 'major banks' or 'Landesbanken' increased their leverage during episodes of booming asset markets whereas 'cooperatives' or 'saving banks' appeared to reduce their leverage during the same period. Second, the study provides some empirical evidence that banks increasing their leverages during such periods of extraordinarily high returns provided in the financial markets preferred funding their assets by short-term borrowing in the interbank market whereas other sectors such as 'saving banks' or 'cooperatives' relied on non-bank funding to a higher degree. Such a funding behavior became important during the tensions of the financial markets in 2007/2008 since an increasing distrust in the interbank market caused severe liquidity shortages of banks that had largely refunded their assets in the interbank market.[22]

Third, the study clarified that banks, preferring high leverages, can apparently be characterized by a high volatility of return on assets over the observation period. This

[20] See for example Adrian and Shin (2010) or Brunnermeier (2009).
[21] Boyd and Graham (1986) proposed this commonly accepted so-called Z-Score.
[22] Abassi and Schnabel (2009) for example examined contagion effects in the interbank market during the subprime mortgage crisis in 2007/2008.

observation provides an indirect measurement of risk taking behavior.[23] Both high leveraging by targeting balance sheet operations and high dispersion of return on assets resulted in low distances to default that reflects the vulnerability of such banks during crisis periods as seen, for example, over the subprime mortgage crisis in 2007/2008. Because of such observable risk behavior from the perspective of regulatory authorities, it seems reasonable to introduce a countercyclical capital buffer.[24] This means that the bank will be obliged to lower their leverage ratios during periods of excessive credit growth that may lead to high losses when asset prices are significantly turning down. Moreover, the results of this study suggest that regulatory authorities are well advised to control the funding sources of banks sufficiently that could potentially face a drying out during crises episodes. As described by a number of publications tensions in the interbank market could actually be seen as a kind of 'modern bank run'.[25] Furthermore, it seems to make good economic sense to distinguish between different banking sectors concerning the application of regulatory requirements since the results of this study provide some empirical evidence that the considered banking sectors are operating their balance sheets in a distinguishable way. Such selective regulatory requirements may be of major interest for the German banking industry since regulatory affairs are expensive to handle and could decrease the competitiveness significantly in the case of certain banking sectors.

Finally, the examined regression models provide some empirical evidence that the requirements on countercyclical capital buffers should be considered by regulatory authorities in the context of financial market indicators and bank characteristics such as interest rates or return on assets. Some banking sectors appear in response procyclical depending on interest rates and a positive return on assets by targeting balance sheet operations that may lead to lower distances to default in the event of the increasing volatility of return on assets. The distinguishable business models appear to determine leveraging by the examined banking sectors to a great degree. Additional future research may clarify whether the dependency between such distinguishable risk taking behavior and the variety of banking sectors is related to the ownership structure and

[23] See for example Barry et al. (2008).
[24] A countercyclical capital buffer is part of the 'International regulatory framework for banks (Basel III)'; see Bank for International Settlements (2011).
[25] Refunding behavior is taken into account by the so-called 'Net Stable Ratio' within the Basel III framework; see Bank for International Settlements (2011).

compensation schemes of banks in more detail (see for instance Schmielewski and Wein [2012]).[26]

[26] Referring to the Basel III framework 'The countercyclical capital buffer aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate.' see Bank for International Settlements (2011) pp. 54-58.

Appendix

Table 1: Dependent and independent variables

Variable	Definition	Calculation formula/values/source
Leverage (dependent variable)	Ratio of total assets to capital	$leverage = \frac{total\ assets}{bank\ capital}$
Banking sector	Sectors of the German banking system as defined by the Deutsche Bundesbank	Cooperatives Landesbanken Regional banks Saving banks German major banks International bank holdings
Return on assets (ROA)	Ratio of returns to total assets	$ROA = \frac{return}{total\ assets}$
Capital asset ratio (CAR)	Ratio of capital to total assets	$CAR = \frac{capital}{total\ assets}$
Distance to default	Ratio of sum of capital asset ratio and return on assets to standard deviation of return on assets	$DD = \frac{CAR + ROA}{\sigma(ROA)}$
repos	Interest rate of three months repurchase agreements	extracted from Bloomberg
libor3m	Three month libor rate	extracted from Bloomberg
MSCI	MSCI World	extracted from Bloomberg
GBI	Global Bond Index	extracted from Bloomberg
BIP	German gross domestic product	provided by the Deutsche Bundesbank
current Yield 10y	Current yield of 10 year benchmark bonds	extracted from Bloomberg
log(bearer bonds)	Logarithm to base 10 of sum of bearer bonds	provided by the Deutsche Bundesbank

Table 2: Leverages of German banking sectors

This table shows leverages (defined as total assets/capital) of different German banking sectors from 2000 to 2011 as of January each year (GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=saving banks, GEN=cooperatives, AB=international bank holdings).

year	total	GB	RB	LB	SPK	GEN	AB
2000	24.10	15.60	18.34	26.36	23.94	20.18	22.47
2001	23.71	15.59	19.53	25.41	23.12	19.38	31.42
2002	22.91	15.39	18.84	23.52	22.70	19.64	28.49
2003	21.77	15.80	18.61	20.44	21.88	19.34	28.77
2004	22.28	18.81	18.12	21.52	21.31	18.58	29.30
2005	23.35	24.56	16.51	22.80	20.72	18.22	31.18
2006	21.65	24.22	15.45	22.60	20.10	17.81	25.12
2007	21.39	21.96	16.01	23.23	19.36	17.03	25.89
2008	21.61	22.44	16.81	24.38	18.82	16.57	23.85
2009	21.16	17.90	21.52	22.94	18.68	17.23	20.07
2010	20.37	18.80	18.60	19.61	18.46	17.31	18.83
2011	21.39	24.05	17.60	22.17	17.86	16.72	20.34

Table 3: Volumes of total Assets of German banking sectors
This table reports volumes of total assets of different German banking sectors in billions of Euro from 2000 to 2011 as of January each year (GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=saving banks, GEN=cooperatives, AB=international bank holdings).

year	total	chg %	GB	chg %	RB	chg %	LB	chg %
2000	5767212		849,872		523,144		1,138,990	
2001	6126775	6.23%	993,401	16.89%	607,252	16.08%	1,207,151	5.98%
2002	6336457	3.42%	1,012,261	1.90%	633,227	4.28%	1,271,535	5.33%
2003	6420338	1.32%	1,058,460	4.56%	662,252	4.58%	1,312,725	3.24%
2004	6487954	0.42%	1,057,574	0.49%	676,702	1.82%	1,361,423	1.66%
2005	6718976	3.95%	1,251,463	18.41%	576,110	-14.99%	1,280,280	-4.84%
2006	6981158	3.90%	1,265,120	1.09%	603,185	4.70%	1,368,351	6.88%
2007	7226573	3.52%	1,313,293	3.81%	623,436	3.36%	1,454,463	6.29%
2008	7628615	5.56%	1,438,948	9.57%	686,427	10.10%	1,563,074	7.47%
2009	7970371	4.48%	1,482,739	3.04%	786,113	14.52%	1,578,219	0.97%
2010	7525485	-5.58%	1,308,947	-11.72%	724,028	-7.90%	1,449,849	-8.13%
2011	8232993	9.40%	2,007,247	53.35%	740,621	2.29%	1,450,591	0.05%
2000-2008		38.20%		74.47%		50.27%		38.56%

year	SPK	chg %	GEN	chg %	AB	chg %
2000	914,212		527,803		236,237	
2001	932,721	2.02%	525,338	-0.47%	279,985	18.52%
2002	969,035	3.89%	543,791	3.51%	299,524	6.98%
2003	976,721	0.79%	554,933	2.05%	382,200	27.60%
2004	982,036	0.50%	561,602	1.14%	377,617	-2.64%
2005	988,201	0.40%	572,222	2.07%	432,370	13.21%
2006	1,000,474	1.24%	586,583	2.51%	732,858	69.50%
2007	1,009,455	0.90%	603,563	2.89%	802,269	9.47%
2008	1,023,036	1.35%	623,108	3.24%	858,363	6.99%
2009	1,058,231	3.44%	666,509	6.97%	891,500	3.86%
2010	1,064,855	0.63%	688,922	3.36%	812,448	-8.87%
2011	1,072,737	0.74%	700,216	1.64%	900,096	10.79%
2000-2008		15.75%		26.28%		277.38%

Table 4: Short-term funding in the interbank market by German banking sectors in % of total assets
This table shows the percentages of short-term funding in the interbank market of different German banking sectors from 2000 to 2011 as of January each year (GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=saving banks, GEN=cooperatives, AB=international bank holdings).

year	total	GB	RB	LB	SPK	GEN	AB
2000	28.42%	36.41%	32.58%	36.33%	22.14%	14.23%	49.39%
2001	28.63%	38.71%	30.76%	35.18%	23.77%	14.86%	48.55%
2002	28.37%	37.61%	29.41%	36.29%	22.97%	14.13%	45.22%
2003	28.62%	40.60%	28.65%	35.07%	22.42%	13.70%	35.85%
2004	28.05%	40.64%	29.70%	33.28%	22.50%	13.17%	36.80%
2005	28.07%	37.70%	31.20%	32.94%	21.89%	12.86%	36.14%
2006	28.25%	37.35%	29.24%	33.21%	21.95%	13.13%	32.33%
2007	28.21%	36.17%	27.22%	35.62%	20.80%	12.99%	33.33%
2008	28.55%	36.63%	22.92%	37.73%	19.45%	12.98%	33.51%
2009	28.48%	34.84%	24.58%	32.75%	19.53%	15.37%	36.83%
2010	27.00%	34.52%	20.69%	30.25%	18.66%	15.38%	33.21%
2011	23.80%	22.88%	19.98%	27.53%	17.40%	14.10%	30.95%

Table 5: Short-term non-bank funding by German banking sectors in % of total assets
This table reports the short-term non-bank funding in % of total assets of German banking sectors from 2000 to 2011 as of January each year (GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=saving banks, GEN=cooperatives, AB=international bank holdings).

year	total	GB	RB	LB	SPK	GEN	AB
2000	21.63%	22.68%	36.38%	7.37%	49.40%	56.72%	16.78%
2001	20.45%	21.85%	31.65%	7.66%	46.44%	53.93%	15.19%
2002	21.65%	23.58%	34.67%	7.74%	48.65%	56.35%	18.24%
2003	22.26%	23.48%	37.79%	7.15%	49.66%	57.16%	19.63%
2004	23.18%	25.80%	38.51%	7.63%	50.58%	58.40%	24.21%
2005	23.77%	30.94%	37.88%	8.16%	50.85%	58.61%	25.36%
2006	24.04%	32.00%	39.08%	8.81%	51.27%	59.19%	26.24%
2007	23.89%	31.37%	40.82%	9.49%	50.29%	57.49%	26.94%
2008	24.41%	31.73%	43.52%	10.51%	49.71%	57.00%	28.91%
2009	25.24%	30.72%	41.82%	14.05%	50.93%	57.52%	31.35%
2010	26.72%	30.72%	46.65%	14.32%	54.59%	58.35%	33.96%
2011	25.82%	21.14%	46.64%	14.00%	57.39%	61.55%	32.58%

Table 6: Short-term funding by German banks in % of total assets
This table shows the yearly short-term funding by German banks in % of total assets from 2000 to 2011 as of January each year, where GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=saving banks, GEN=cooperatives, AB=international bank holdings.

year	total	GB	RB	LB	SPK	GEN	AB
2000	50,05%	59,09%	68,95%	43,69%	71,54%	70,95%	66,17%
2001	49,08%	60,56%	62,41%	42,85%	70,21%	68,79%	63,74%
2002	50,02%	61,18%	64,07%	44,03%	71,62%	70,48%	63,47%
2003	50,88%	64,08%	66,44%	42,22%	72,08%	70,86%	55,48%
2004	51,23%	66,44%	68,22%	40,92%	73,08%	71,57%	61,00%
2005	51,84%	68,63%	69,08%	41,10%	72,74%	71,63%	61,50%
2006	52,29%	69,35%	68,31%	42,02%	73,22%	72,32%	58,56%
2007	52,10%	67,54%	68,04%	45,11%	71,08%	70,48%	60,28%
2008	52,96%	68,35%	66,44%	48,24%	69,16%	69,98%	62,42%
2009	53,72%	65,56%	66,40%	46,80%	70,46%	72,89%	68,18%
2010	53,72%	65,25%	67,34%	44,57%	73,25%	73,74%	67,17%
2011	49,62%	44,01%	66,62%	41,53%	74,79%	75,65%	63,53%

Table 7: Ordinary least squares (OLS) regression
This table shows the results of ordinary least squares (OLS) regressions on leverages over the period from 2001 to 2009. The sample covers 804 monthly observations. Significance Levels are marked with *** (P>t) <=0.01, ** (P>t) <=0.05 and ** (P>t) <=0.1. The regression provides a r-squared of 0.6394, an adjusted r-squared of 0.63, and a root MSE of 2.2997.

	Coef.	Std. Err.	t	P>|t|	Beta
ROA	0.13	0.47	0.27	0.7870	0.0091
MSCI	-1.04	2.16	-0.48	0.6320	-0.0132
GBI	-0.77	4.90	-0.16	0.8750	-0.0042*
Libor3m	0.35	0.20	1.79	0.0740	0.1244
Repospread	0.06	0.44	0.14	0.8880	0.0055
current yield 10y	-0.25	0.35	-0.73	0.4660	-0.0502
2003	-0.48	0.48	-1.01	0.3120	-0.0367*
2004	0.85	0.51	1.66	0.0980	0.0645
2005	0.68	0.63	1.08	0.2820	0.0516**
2006	-1.20	0.49	-2.43	0.0150	-0.0915***
2007	-1.51	0.42	-3.57	0.0000	-0.1148***
2008	-2.07	0.56	-3.67	0.0000	-0.1578**
2009	-1.84	0.77	-2.40	0.0170	-0.1400**
2010	-2.18	0.86	-2.52	0.0120	-0.1659***
GB	1.13	0.30	3.80	0.0000	0.1119***
AB	7.69	0.28	27.10	0.0000	0.7586***
GEN	-0.08	0.29	-0.29	0.7760	-0.0081***
LB	4.98	0.30	16.44	0.0000	0.4916***
SPK	2.37	0.28	8.34	0.0000	0.2334***
cons	18.80	1.63	11.53	0.0000	.

Table 8: Ordinary least squares regressions: Variance Inflation Factors (VIF)
This table reports the Variance Inflation Factors (VIF) to test the dependent variables on collinearities. The Variance Inflation Factors have an intuitive interpretation. Variance Inflation Factors less than 5 indicates that the independent variable shows only weak multicollinearity, if any.

Variable	VIF	1/VIF
ROA	2.39	0.4177
MSCI	1.62	0.6156
GBI	1.53	0.6541
Libor3m	9.54	0.1048
Repospread	3.31	0.3018
Current yield 10y	8.21	0.1218
2003	1.91	0.5248
2004	2.10	0.4767
2005	2.93	0.3418
2006	2.20	0.4542
2007	2.08	0.4799
2008	3.83	0.2609
2009	4.40	0.2270
2010	4.85	0.2060
GB	1.84	0.5421
AB	1.67	0.5986
GEN	1.70	0.5872
LB	1.90	0.5252
SPK	1.67	0.5995
Mean VIF	3.14	

Table 9: Ordinary least squares (OLS) regressions of different banking sectors
This table shows the results of ordinary least squares (OLS) regressions on leverages over the period from 2001 to 2009. The sample covers 804 monthly observations. The independent variables are completely described in Table 1. The sample covers 804 monthly observations. Significance levels are marked with *** (P>t) <=0.01, ** (P>t) <=0.05 and ** (P>t) <=0.1.

	GB	AB	GEN	LB	RB	SPK
ROA	-0.0042	1.1319**	-0.1954	4.0723	0.3608**	-0.2977
MSCI	0.0350	-0.0843	-0.0034	0.0399	-0.1088	-0.0041
GBI	-0.0318	-0.0297***	0.0111***	0.0194***	0.0080	-0.0015***
Libor3m	0.2715**	-0.2483	-0.3442***	1.1110	0.0548***	-0.1527*
Repospread	-0.0427	-0.0840**	0.1074***	-0.0125	0.3882	0.0381***
Curr. yield 10y	0.0216	-0.2231**	0.1353***	0.0847	0.0001***	0.1525***
2003	0.2175	-0.1117***	-0.1554***	0.0675***	-0.2529	-0.1430***
2004	0.5799	0.1911	-0.3926***	1.8474***	0.0684***	-0.4448***
2005	0.9627***	0.1116***	-0.4354***	1.0760**	-0.4241***	-0.4458***
2006	0.6371**	-0.2306***	-0.4570***	-0.3344***	-0.6035***	-0.4987***
2007	0.5476***	-0.1215***	-0.5872***	-1.3556***	-0.4929***	-0.6340***
2008	0.4068	-1.2625**	-0.6861	0.4629***	-0.3471**	-0.7185***
2009	0.3957	-0.2367***	-0.7710***	3.0900***	0.2326**	-0.9255***
2010	0.4866	-0.7218	-0.7303	2.8316	0.2282	-0.8158
cons	13.18	33.32	20.17	13.78	17.42	24.04
R-Squared	0.8803	0.9028	0.9740	0.8000	0.8410	0.9834
Adj. R-Squared	0.8660	0.8912	0.9709	0.7760	0.8220	0.9814
obs	132	132	132	132	132	132

Table 10: Profit and Losses after tax of banking sectors from 1999 to 2010
This table reports the return on assets (ROA) of different German banking sectors from 1999 to 2010. (GB=German major bank, RB=regional bank, LB=Landesbank, SPK=saving bank, GEN=cooperatives, AB=International bank holding).

Year	Total	GB	RB	LB	SPK	GEN	AB
1999	1.29	0.96	2.07	0.85	4.92	3.39	0.12
2000	1.23	0.67	2.43	0.86	4.64	3.10	0.09
2001	1.85	1.77	3.59	0.92	4.65	2.78	0.10
2002	1.18	0.64	3.21	0.90	4.37	2.69	0.52
2003	1.10	0.72	2.28	0.73	4.47	2.50	1.67
2004	1.17	0.54	1.53	0.78	6.55	4.16	0.70
2005	0.89	-0.19	3.03	0.63	6.12	5.30	0.89
2006	-0.24	-0.96	1.10	-0.64	3.55	3.28	0.38
2007	0.44	-0.14	1.08	0.11	4.33	3.39	0.40
2008	1.80	1.50	2.27	1.08	4.95	5.43	0.71
2009	1.69	0.93	2.06	1.82	4.50	5.42	0.78
2010	1.06	1.49	2.66	0.38	4.07	3.70	3.35

Table 11: Distances to default of German banking sectors from 1996 to 2010
This table shows the distances to default (DD) of different German banking sectors from 2001 to 2010. (GB=German major bank, RB=regional bank, LB=Landesbank, SPK=saving bank, GEN=cooperatives, AB=International bank holding).

year	total	GB	RB	LB	SPK	GEN	AB
1999	1.42	0.67	3.17	0.88	3.94	2.57	0.57
2000	1.35	0.77	2.22	0.71	4.04	2.39	1.75
2001	1.43	0.62	1.47	0.80	5.93	3.96	0.75
2002	1.15	-0.14	2.92	0.67	5.54	5.06	0.92
2003	-0.03	-0.98	1.04	-0.64	3.17	3.10	0.39
2004	0.66	-0.15	1.07	0.12	3.89	3.21	0.39
2005	2.09	1.52	2.36	1.12	4.47	5.20	0.72
2006	1.97	0.95	2.09	1.84	4.08	5.23	0.77
2007	1.33	1.55	2.64	0.37	3.68	3.56	3.49
2008	-1.60	-1.78	0.92	-1.81	2.29	2.85	-0.70
2009	-0.18	-0.65	-0.04	-1.51	3.98	3.34	0.45
2010	1.15	0.31	0.80	-0.03	6.10	5.04	0.81

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