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

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# **Leveraging and risk taking within the German banking system: Evidence from 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 within 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 procyclically. Second, the study provides some empirical evidence that banks increasing their leverages during periods of extraordinary high returns provided in the financial markets preferred funding their assets by short-term lending in the interbank market. Third, the study clarified that banks, preferring high leverages, can apparently be characterized by a high volatility of return on assets and low distances to default over the observation period. Finally, the examined regression models provide some empirical evidence that requirements on countercyclical capital buffers should be considered by regulatory authorities in the context of macroeconomic indicators.

**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

## **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

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balance sheets of five large 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 providing extraordinarily high returns, and vice versa: This means, that actively leveraging by banks results in procyclicality. Furthermore, Adrian and Shin (2010) demonstrate that an adjustment of balance sheet size is mostly done by collateralized borrowing and lending 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, as seen 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]).<sup>3</sup> As Rajan (2006) suggests this procyclical behavior of banks should be discussed within the context of remuneration 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 procyclically by increasing the leverage if asset markets are providing extraordinarily high returns and market risk appears to be relative low. Therefore it seems fairly reasonable for legal authorities and regulators to pay high attention to principal-agent problems and moral hazard within certain sectors of the banking industry, particularly during periods of invitingly high returns provided in the asset markets.<sup>4</sup>

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

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

<sup>4</sup> Further information on agency problems with respect to funding behavior of banks in capital markets is provided, for example, by Stein (2003).

from non-banks or collateralized or unsecured borrowings from other banks in the global interbank market. Such behavior is related 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.<sup>5</sup> 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) develops 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.<sup>6</sup>

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 19<sup>th</sup> and early 20<sup>th</sup> century. In general, bank runs are characterized by the fact that the holders of short-term liabilities refuse to fund banks for certain reasons. But in contrast to these classic panics that have been 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

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<sup>5</sup> For further details on the chronology and reasons of financial crises see, for example, Morris and Shin (2004) or Brunnermeier (2009)

<sup>6</sup> See also Brunnermeier and Pedersen (2009)

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. Either all consumers believe that other consumers will withdraw their deposit 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 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 reasons of panics are not random but a response on information on deteriorating economic conditions.<sup>7</sup> 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 banks which are hit by 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.<sup>8</sup>

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

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<sup>7</sup> This theory is consistent with empirical work, for example, done by Gorton (1988) or Allen and Gale (1998).

<sup>8</sup> 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.

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 by 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.<sup>9</sup> Finally, a failure to implement the optimal interest rate could lead to bank runs since the satisfaction of patient consumers is directly depending on interbank rates if banks have needs 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 extent. Therefore, in recent years, there has been an increasing amount of literature on the underlying mechanism of such risk of contagion in financial

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<sup>9</sup> 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.

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 as a result of contagion effects induced by one insolvent bank.<sup>10</sup> 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 exogenously 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 roll-over risk is high, since the debt must be rolled over frequently, the debt capacity will be lower than the 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

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<sup>10</sup> 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.



the subprime crisis, which means that these assets had not debt capacity at all and might subsequently induced a tremendous incline of funding liquidity risk within the banking system. Such phenomena were observable during the recent crisis since 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 empiric 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 for 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 high volatile during the financial markets turmoil (Abassi and Schnabel [2009]). By showing that repo spreads were subsequently declining in response to liquidity provisions by central banks Abassi and Schnabel (2009) underscore that central bank operations were successfully. 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.<sup>11</sup>

A second strand of research papers is based on the assumption of indirect linkages between banks` balance sheets that might strengthen 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 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]).<sup>12</sup> The importance of asset price changes within a spillover mechanism is consistent with

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<sup>11</sup> 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.

<sup>12</sup> 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.

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 simultaneously borrowing and lending each other to a great extent. Finally, Jorion and Zhang (2009) find some evidence that contagion effects would be observable in the event of increasing counterparty risk.<sup>13</sup>

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 emphasizes that institutional guarantees may reduce contagion within the German banking systems but cannot avoid it at all. Their empiric work show 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, the influence of asset prices under strained market conditions on aggregate or idiosyncratic liquidity, the role of the interbank market for distribution of liquidity and monetary policy as well as risk of contagion during financial markets crises and their underlying mechanisms. 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 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 empiric studies conducted so far on the fragility of the

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<sup>13</sup> 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 main focus of Shin (2009) lies on the credit risk transfer by means of securization and Allen and Carletti (2006) develop a model which 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.

German banking system due to 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.<sup>14</sup> 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.<sup>15</sup> 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.<sup>16</sup> 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 by requiring banks to hold additional capital buffers and/or to ensure sufficient minimum distances to defaults.<sup>17</sup>

The paper proceeds as follows. Section 2 describes the origin and structure of the examined data and applied methodologies. Section 3 subsequently 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.

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<sup>14</sup> Adrian and Shin (2010) examine such high leverages over the subprime mortgage crisis in 2007/2008 in the event of globally operating investment banks.

<sup>15</sup> Brunnermeier and Pedersen (2009), for example, highlight the dependency between market and funding liquidity risk.

<sup>16</sup> Seminal research on the role of withdrawals of deposits by early and late consumers is provided by Diamond and Dybvig (1983).

<sup>17</sup> This commonly accepted so-called Z-Score was proposed by Boyd and Graham (1986).

## **Data and Methodologies**

The examined sample consists of data provided by 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.<sup>18</sup> 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 shed some light on the so-called 'distance to default' of different banking sectors that is a widely accepted measurement of the probability of a bank's default.

[Insert Table 1 here]

## **Results**

The following results are obtained from descriptive statistics and regression models examined 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 the leverage of balance sheets, which 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 fairly constant values during the observation period with peaks in 2000/2001 and 2005. The observed

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<sup>18</sup> All regressions are conducted with STATA 11 software.

maximum value in 2000 and decline of leverages from 2001 to 2003 can be assigned to the so-called ‘internet bubble’ and the subsequent crisis in financial markets as a consequence 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 lowest values in 2008 compared to other banking sectors. Furthermore, it is noteworthy that ‘Landesbanken’ which 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 which 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 upsizing 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 upsizing 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 procyclically by upsizing the volume of total assets during periods of booming asset prices.

[Insert Table 3 here]

Within the context of upsizing 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 markets 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 by 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 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 observable 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 fairly 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 for 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, a number of ordinary least square (OLS) regressions are examined in order to clarify influences on leverages over the observation period in more detail. Table 7 shows the result of a regression of certain macroeconomic and financial markets indicators as independent variables on the leverage as dependent variable.<sup>19</sup> In addition, a factorized variable 'banking group' is introduced to the regression model with 'international bank holdings' as the basis. 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 as reflected by an r-squared of 0.6060. Among the macroeconomic and financial markets indicators 'repos' and 'current yield' of bonds with a maturity of 10 years enter the regression with positive and statistically significant coefficients. This provides some evidence that repurchase agreements and high yields quoted in capital markets force banks to increase their leverages by conducting applicable balance sheet operations. This observation is fairly interesting particularly as repurchase agreements that allow secured money lending in

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<sup>19</sup> Independent variables are completely listed in Table 1.

the interbank market get a growing attention by the industry over the last years. However, beyond that the different banking sectors obtained negative and statistically significant coefficients. Among banks that show the highest standard beta coefficients are German ‘major banks’, ‘regional banks’ and ‘cooperatives’. Therefore, it seems likely that there is a strong relationship between the leverage of banks and their assignment to the specific banking sectors whereas ‘Landesbanken’ enter the regression with the lowest standard beta coefficient. This is consistent with the observation that ‘Landesbanken’ apparently operated their business at a high level of leverages as suggested by the results displayed in Table 2. At this stage, one may keep in mind that ‘international bank holdings’ are defined as the base of the considered factorized variable because they showed the highest leverages during the period from 2000 to 2011 (for further details see Table 2).

[Insert Table 7 here]

In order to test the sample on collinearities the Variance Inflation Factors (VIF) are displayed in Table 8. The reported results confirm the assumption that the independent variables are characterized by 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]

Next, regression models on each single banking sector are examined to enlighten the relationships between leverages and certain macroeconomic and financial markets indicators. The results reported in Table 9 generally confirm that obtained standard beta coefficients are depending on the examined banking sectors to a certain extent. In detail, the volume of repurchase agreements (‘Repo’) is reported to be positively and statistically significantly related to the leverage in the case of German ‘major banks’ whereas ‘international banking holdings’ and ‘Landesbanken’ obtained negative and statistically significant coefficients. German ‘major banks’ seem to refund high leverages by increasing their volume of repurchase agreements whereas ‘international banking holdings’ and ‘Landesbanken’ tend to prefer this kind of money market deals at low levels of leverages. This may be related to interest rates in the interbank market (‘Libor3m’) as suggested by the positive and statistically significant standard beta



coefficients in the case of German ‘major banks’ and ‘Landesbanken’. Particularly ‘Landesbanken’ appear to upsize their asset side of balance sheets in dependency of the 3 month Libor rate, since they obtained the highest standard beta coefficients of all considered banking sectors. In contrast, it is likely that ‘cooperatives’ and ‘saving banks’ reduce their leverage with increasing 3-month Libor rates since they obtained negative and statistically significant coefficients. In contrast, the relationship between the current yields of bonds with a ten-year maturity (‘CY10y’) seems to be an inverse one for the majority of banking sectors. As is to be expected, leverages of banks are depending on short-term as well as long-term interest rates to a great extent. This evidence may be of major interest from the perspective of central banks since the results suggest that some categories of banks are operating procyclically in dependence of interest rate policies conducted by central banks.

The considered financial markets indicators (‘MSCI’ and ‘GBI’) show if any only a weak relationship with the dependent variable. The German gross domestic product (‘BPI’) enters the regression with positive and statistically significant coefficients in the case of German ‘major banks’ and ‘Landesbanken’, whereas ‘international bank holdings’, ‘cooperatives’ and ‘regional banks’ obtained negative and statistically significant coefficients. This may be of major interest from the macroeconomic perspective since German ‘major banks’ and ‘Landesbanken’ significantly contributes to the German gross domestic product in term of total assets. Moreover, the reported dependences between leverages and return on assets (‘ROA’) are characterized by high and statistically significant standard beta coefficients for German ‘major banks’ and ‘Landesbanken’. This relationship might reflect the relative high percentage of risky assets within their portfolios since the ‘ROA’ is negatively related with the leverages of such banks. Finally, accordingly to the variable reflecting the amounts of bond bearing funding instruments (‘logBB’) Table 9 provide fairly confusing results since German ‘major banks’ and ‘regional banks’ obtained negative and statistically significant coefficients whereas ‘international bank holdings’ and ‘saving banks’ enter the regression with negative and statistically significant coefficients. Therefore any interpretation of this variable seems quite difficult.

In summarizing so far, it can be underscored that the leverage of a bank is apparently related to its assignment to a certain banking sector. Furthermore, it can be pointed out

that each banking sector is operating its leverage fairly differently depending on various macroeconomic and financial markets indicators. This fact might be due to the varying business models of the special banking sectors as well as the different ownership structures within the German banking system.

[Insert Table 9 here]

A considerable amount of literature has been published on principal agent problems observable 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’. In Table 11 this risk measure is reported 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 fairly low compared with other banking sectors. In contrast, ‘saving banks’ and ‘cooperatives’ operated their business at significantly higher distances to default over the entire observation period. A similar situation was observable in the case of ‘regional banks’ from 1999 to 2007 but with a significant drawdown of distances to default from 2008 to 2010. 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 observable over the entire observation period the apparent difficulties of German banks in 2008 and 2009 were not so surprisingly. 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.<sup>20</sup> 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.<sup>21</sup>

First, the results of this study show that the different sectors of the German banking system operated their business more or less procyclically: 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 extraordinary high returns provided in the financial markets preferred funding their assets by short-term lending 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 fairly important during tensions of the financial markets in 2007/2008 since an increasing distrust in the interbank market caused severe liquidity shortages of banks that had refunded their assets in the interbank market to a great extent.<sup>22</sup>

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 observation provides an indirect measurement of risk taking behavior.<sup>23</sup> Both high leveraging by targeted balance sheet operations and high dispersion of return on assets resulted in low distances to default that reflects the vulnerability of such banks during crises periods as seen, for example, over the subprime mortgage crisis in 2007/2008. As a consequence of such observable risk behavior from the perspective of regulatory authorities it seems fairly reasonable to introduce a countercyclical capital buffer.<sup>24</sup> This means that bank will be obliged to lower their leverage during periods of excessive

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<sup>20</sup> See for example Adrian and Shin (2010) or Brunnermeier (2009).

<sup>21</sup> This commonly accepted so-called Z-Score was proposed by Boyd and Graham (1986).

<sup>22</sup> Abassi and Schnabel (2009) for example examined contagion effects in the interbank market during the subprime mortgage crisis in 2007/2008.

<sup>23</sup> See for example Barry et al. (2008).

<sup>24</sup> A countercyclical capital buffer is part of the 'International regulatory framework for banks (Basel III)'; see Bank for International Settlements (2011).

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’.<sup>25</sup> 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 fairly distinguishable way. Such selective regulatory requirements may be of major interest for the German banking industry since regulatory affairs are fairly 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 requirements on countercyclical capital buffers should be considered by regulatory authorities in the context of macroeconomic indicators such as interest rates or the gross domestic product since some banking sectors appear to respond procyclically depending on interest rates and a positive economic climate by targeted balance sheet operations that may lead to lower distances to default in the event of increasing volatility of return on assets. Additional future research may clarify the dependency between such risk taking behavior and other macroeconomic indicators in more detail.<sup>26</sup>

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<sup>25</sup> Refunding behavior is taken into account by the so-called ‘Net Stable Ratio’ within the Basel III framework; see Bank for International Settlements (2011).

<sup>26</sup> 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 German banking system as defined by 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 month repurchase agreements	extracted from Bloomberg <sup>27</sup>
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 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 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

<sup>27</sup> Bloomberg PLC is one of the leading providers of financial market information

**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	25.68%	30.84%	43.55%	12.32%	50.10%	57.12%	29.84%
2001	24.66%	32.40%	37.87%	11.49%	46.94%	54.49%	28.76%
2002	25.53%	32.37%	39.42%	12.25%	49.16%	56.66%	28.99%
2003	26.11%	32.61%	41.85%	11.73%	50.26%	57.59%	25.49%
2004	27.50%	38.09%	42.62%	12.26%	51.19%	58.76%	30.40%
2005	28.01%	40.52%	42.91%	13.41%	51.36%	58.77%	31.37%
2006	27.80%	40.21%	43.35%	13.15%	51.85%	59.62%	32.02%
2007	28.05%	39.76%	45.64%	14.96%	50.90%	57.99%	33.61%
2008	28.89%	41.22%	48.41%	15.25%	51.15%	57.67%	36.21%
2009	30.36%	41.89%	49.04%	17.88%	52.97%	58.13%	42.78%
2010	31.99%	45.03%	51.75%	18.77%	56.23%	58.84%	44.89%
2011	31.07%	31.35%	53.16%	18.84%	59.35%	62.18%	43.24%

**Table 7: Ordinary least square (OLS) regression**

This table shows the results of ordinary least square (OLS) regressions over the period from 2001 to 2009. The leverages are defined as the dependent variable. 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. The regression provides an r-squared of 0.6060, an adjusted r-squared of 0.5990, and a root MSE of 2.398.

	Coef.	Std. Err.	t	P>t	Beta
repos	0.0000	0.0000	6.7100	0.0000***	0.2842
libor3m	-0.1477	0.1202	- 1.2300	0.2200	- 0.0531
MSCI	-0.7739	2.1873	- 0.3500	0.7240	- 0.0099
GBI	-3.6014	4.8559	- 0.7400	0.4590	- 0.0197
BIP	3.2599	3.9719	0.8200	0.4120	0.0201
current yield 10y	1.4340	0.1992	7.2000	0.0000***	0.2872
return on assets (ROA)	-0.3106	0.4312	- 0.7200	0.4720	- 0.0225
log(bearer bonds)	0.4190	0.6502	0.6400	0.5190	0.0456
cooperatives	-7.2406	0.3800	-19.0600	0.0000***	- 0.7165
Landesbanken	-3.7012	0.5965	- 6.2000	0.0000***	- 0.3663
regional banks	-7.4467	0.3053	-24.3900	0.0000***	- 0.7369
saving banks	-4.8925	0.3369	-14.5200	0.0000***	- 0.4842
German major banks	-8.7823	0.4934	-17.8000	0.0000***	- 0.8691
cons	18.1100	3.3311	5.4400	0.0000***	.

**Table 8: Ordinary least square 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 (for further information on Variance Inflation Factors see Belsley et al. 1980).

Variable	VIF	1/VIF
libor3m	3.58	0.279624
current yield 10y	2.71	0.369185
return on assets (ROA)	1.82	0.548364
log(bearer bonds)	1.57	0.637126
MSCI	1.54	0.65062
repos	1.50	0.666698
GBI	1.40	0.716656
BIP	1.16	0.860307
Mean VIF	1.91	



**Table 9: Ordinary least square (OLS) regressions of different banking sectors**

This table shows the results of ordinary least square (OLS) regressions over the period from 2001 to 2009. The leverages are defined as the dependent variable. 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
repos	0.8502***	-0.9380***	- 0.0740	- 0.4090***	-0.0456	
libor3m	0.5015***	0.0033	- 0.2164*	1.2904***	0.1054	-0.5910***
MSCI	0.0120	-0.0417	- 0.0332	0.0576	-0.2221**	0.0037
GBI	- 0.0394	-0.0535	0.0019	0.0535	0.0578	-0.0033
BIP	0.1654**	-0.1287**	- 0.2110***	0.1927***	-0.4422***	0.0728
current yield 10y	- 0.2699**	-0.0796	0.9744	- 0.1647	0.4445***	0.9798***
return on assets (ROA)	- 0.4358***	0.1066	0.0008***	- 0.8312***	-0.1714	0.1381**
log(bearer bonds)	- 0.2007***	0.1754***	- 0.4764	- 0.0632	-0.3496***	0.2706***

**Table 10: Profit and Losses after tax of banking sectors from 1996 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	0.20	0.20	0.45	0.13	0.24	0.21	0.15
2000	0.19	0.24	0.30	0.10	0.25	0.19	0.57
2001	0.20	0.18	0.18	0.11	0.38	0.35	0.22
2002	0.15	-0.12	0.41	0.08	0.35	0.46	0.28
2003	-0.05	-0.44	0.11	-0.17	0.18	0.26	0.10
2004	0.07	-0.10	0.11	-0.02	0.23	0.27	0.10
2005	0.31	0.56	0.31	0.17	0.27	0.47	0.21
2006	0.29	0.33	0.27	0.31	0.24	0.47	0.23
2007	0.18	0.57	0.36	0.03	0.21	0.30	1.17
2008	-0.32	-0.76	0.10	-0.39	0.11	0.23	-0.29
2009	-0.08	-0.31	-0.06	-0.34	0.23	0.28	0.10
2010	0.15	0.08	0.07	-0.05	0.38	0.45	0.23

**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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