

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

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Abstract

This study intends to examine whether the German banking system displays pro-cyclical behavior during 2000 to 2011, and to what extent specific sectors of the German banking system show significant balance sheet operations to increase their leverage during years of booming asset prices. The results of this study demonstrate that different sectors of the German banking system did operate their business more or less pro-cyclical. It also provides empirical evidence that certain banking sectors did favor refinancing their assets by short-term borrowing in the interbank market to increase their leverage during periods of extraordinary high returns in financial markets. Moreover, this study shows that banks, which operate above average leverages, tend to report a high volatility of return on assets and low distances-to-default.

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

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1. Introduction

My paper focuses primarily on the leverages of banks, as examined, for example, by Adrian and Shin (2010), whose study of quarterly balance sheets of the five largest

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investment banks from 1991 to 2008 demonstrates the positive relationship between changes in leverage and balance sheet size. Within this context, *leverage* is defined as the ratio of the total assets to the amount of equity on the liability side of the banks' balance sheet. I propose the hypothesis that leveraging plays a central role in relation to different aspects of idiosyncratic and aggregate liquidity risk. My study begins with a brief literature survey to introduce the benchmarks, which frame my empirical studies of the German banking system.

Due to banks' continuously marking their balance sheets to market, leverage is by definition also continuously changing. Adrian and Shin distinguish between *passive* banks and *active* banks, i.e. banks that actively adjust the size of their balance sheet in accordance with leverage fluctuations. Active banks typically operate 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, resulting in a kind of pro-cyclicality. Adrian and Shin also demonstrate that banks usually adjust their balance sheet size by collateralized borrowing and borrowing in the interbank market.³

In order to illustrate the pro-cyclical balance-sheet operation by banks, let assume an initial balance sheet of a bank that reports a leverage of 10 ($\text{Leverage} = \text{Total Assets} / \text{Equity} = 100 / 10 = 10$):

Assets	Liabilities
Securities, 40	Equity, 10
Other Assets, 60	Debt, 90

Now, suppose the bank is behaving passively during a period of booming assets. In this case, the leverage equals 8.5 ($\text{Leverage} = \text{Total Assets} / \text{Equity} = 102 / 12 = 8.5$):

Assets	Liabilities
Securities, 42	Equity, 12
Other Assets, 60	Debt, 90

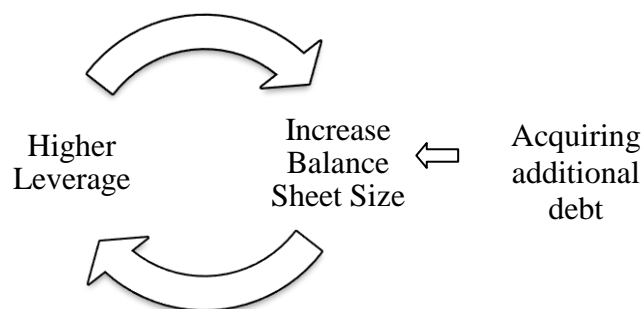
³ The volume of residual mortgage backed securities (home mortgages) alone increased from about 500 billion USD in 2004 up to more than 2200 billion USD in 2007 (OECD [2008]). The S&P 500 reported gains of 68.08% from 2003 to 2007 (extracted from Bloomberg).

By contrast, a bank keeping the leverage on a constant level will adjust its balance sheet by appropriate balance sheet operations. In this case, the leverage equals 10 although assets are booming ($\text{Leverage} = \text{Total Assets} / \text{Equity} = 120 / 12 = 10$):

Assets	Liabilities
Securities, 60	Equity, 12
Other Assets, 60	Debt, 108

Thus, passive banks will report decreasing leverage ratios during periods of asset growth. By contrast, banks that are actively adjusting their balance sheets are reporting increasing leverage ratios over the same period. As Adrian and Shin (2010) demonstrate, banks tend to adjust their balance sheets and report higher leverages during periods of booming assets. As the authors illustrate, leverage targeting would entail upward-sloping demands and downward-sloping supplies: *'The perverse natures of the demand and supply curves were even stronger when the leverage of the financial intermediary is pro-cyclical - that is, when leverage were high during booms and low during busts'* (for further details see Adrian & Shin [2010]):

Figure 1: Pro-cyclical leveraging during periods of asset growth (see also Adrian and Shin [2010])



As Rajan (2006) or Schmielewski and Wein (forthcoming) suggest, the pro-cyclical behavior of banks should be discussed within the context of numeration schemes and principal-agency problems of the banking system. In circumstances that encourage agents to invest in risky long-term assets it seems more likely that they will behave pro-cyclically by increasing leverage during periods when asset markets are providing

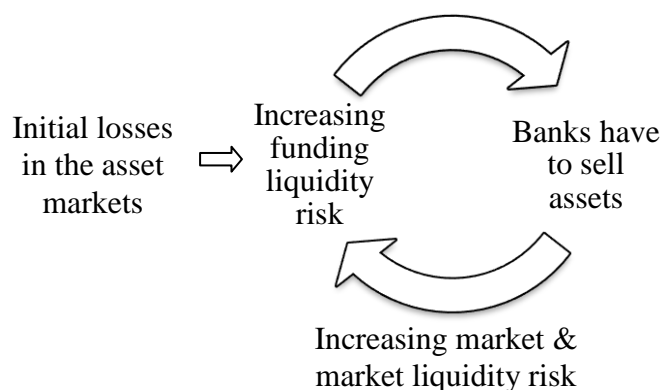
extraordinarily high returns, and market risk appears to be relatively low. Furthermore, the business models of distinguishable banking sectors should relate to the leverage ratio during booming asset markets. Banks that are focusing on investment banking activities to a greater degree and that are reporting global activities in the asset markets appear to tend showing a more pro-cyclical behavior than banks that are mainly involved in regional project-financing activities (Fonteney [2007], Cihák and Hesse [2007]). The German banking system, for instance, grounds on different clearly distinguishable pillars with different business models. While German major banks are globally operating investment activities, other sectors of the German banking systems, e.g. *Sparkassen*, regional banks or cooperatives, are exclusively focusing on financing of projects of locally operating firms and retail clients. A clarifying showcase for the influence of the preferred business model on the risk-taking behavior of banks provides the sector of German *Landesbanken*. These banks constitute one major pillar of the German banking system by holding a significant part of the total assets reported by German banks. *Landesbanken* had completely to adopt their business model due to legislative changes of the so-called ‘Gewährträgerhaftung’ reflecting a guarantee by the public founding entity in the case of a default (see, for example, Hübner [2010] or Hardy and Howarth [2009]). In one of the most recent studies, Binici and Köksal (2012) confirm the relationship of the business model to leverages for the Turkish banking system by showing that the leverages of participation banks are counter-cyclical, whereas the leverages of commercial banks and development/investment banks are pro-cyclical. Another important influencing factor on the leverage of the different banking sectors appears to be the change from traditional local GAAP to International Financial Reporting Standards (IFRS), as suggested, for example, by Bushman and Williams (2009).

Moreover, the illustrated balance sheet arithmetic and figure 1 demonstrate that during periods of actively leveraging, banks tend to take on an increasing amount of 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 case of sub-prime mortgage-backed securities. Adrian and Shin (2010) also show that

rising leverages within the financial system closely relate to the Value-at-Risk (VaR) of banks, and that this represents one of the major risk indicators of banks' assets.⁴

In more detail, 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, and collateralized or unsecured borrowings from other banks in the global interbank market. Such behavior relates to increasing interconnectivity, and funding liquidity risk of the banking system as a whole. The pro-cyclical nature of leverage is therefore an important cause of the fragility of the banking system, as both Arian and Shin (2010) and Cifuentes, Ferrucci and Shin (2005) have established. As seen during a number of financial crises over the past decades, relative small shocks in asset markets can induce systemic crises, that are well-examined by a number of research papers.⁵ These papers are focusing primarily on the role of asset prices during episodes of tumbling markets with respect to the aggregate 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), Gorton (2008), and Brunnermeier (2009) who emphasize that de-leveraging of banks by selling assets under tensioned market conditions can result in further declines of asset prices.

Figure 2: Increasing funding and market liquidity risk of highly leveraged banks during periods of busting asset markets (see also Brunnermeier [2009])



⁴ Calculating the Value-at-Risk (VaR) is the preferred measurement of market risk within the Basel II accord; see Bank for International Settlement (2005).

⁵ For further details on the chronology and reasons of financial crises see, for example, Morris and Shin (2009) or Brunnermeier (2009).

Both Brunnermeier (2009) and Gorton (2008) argue that highly leveraged banks in particular bear a tremendous funding liquidity risk that may enforce a self-amplifying spiral in the asset markets that is illustrated in figure 2. As Gorton highlights, increasing funding liquidity risk results in banks actually facing bank runs similar to the classic panics of the 19th and early 20th centuries. These researchers characterize bank runs by the fact that the holders of short-term liabilities refuse to fund banks. In contrast to the classic panics that have been the object of intensive research work, ‘modern bank runs’ seem to involve the refinancing opportunities in the interbank market instead of, or in addition to, withdrawals of deposits by non-bank consumers.

Upper and Worms (2004), for example, have established the domino-effect that is created when banks which are hit by a liquidity shock try to meet their liquidity needs by withdrawing their deposits from other banks, rather than liquidating long-term assets under strained market conditions.⁶ In the scientific literature, little attention has been paid so far to the role of the interbank market as a contributory factor in times of financial crisis over the past years. Following the financial crisis of 2007/2008, however, research papers are increasingly beginning to investigate the consequences of freezes in, or the drying up of, the interbank market during financial crises, when banks stop trading with each other (Abassi and Schnabel [2009]). Allen, Carletti and Gale (2009), for example, propose a model of the interbank market that explains the excess volatility of prices, which occurs particularly when banks are failing to hedge their extraordinary aggregate and idiosyncratic liquidity demands in circumstances of financial crises.

By contrast, very little research has so far been undertaken that examines the possibility of leverages as a contributing factor in the German banking system. Of the few pertinent publications, Upper and Worms (2004) have investigated the connection between 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 entirely. Their empiric work shows that the failure of a single bank could lead to a significant

⁶ 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.

breakdown of the German banking system on the grounds that it could induce a loss of up to 15% of total assets of the German banking system.

In conclusion, it can be stated that there is a number of studies published, which examine 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 the distribution of liquidity and monetary policy, as well as the risk of contagion during financial markets crises and their underlying mechanisms are also all the subject of major on-going research. On the other hand, however, little work has been undertaken so far that addresses the pro-cyclical behavior of German banking sectors, taking into account the leverage of the balance sheets of different categories of banks. Apart from Upper and Worms (2004), who explain the danger of contagion across the whole of the German banking system, no empirical studies have been conducted so far that examine the susceptibility of German banking sectors due to the pro-cyclical behavior of banks and the role of different refinancing sources, particularly over the course of the financial crisis of 2007/2008.

To fill this knowledge gap, the focus of my study is primarily on determining whether the German banking system does indeed display evidence of pro-cyclical behavior between 2000 and 2011. In particular, I intend to show that specific sectors of the German banking system engaged in significant balance sheet operations to increase their leverage during years of booming asset prices while other banking sectors do not trust on a pro-cyclical behavior. This hypothesis primarily grounds on the assumption that the degree of pro-cyclical leveraging might relate to the different business models, ownership structures or the market environment of the different German banking sectors. In other words, I expect that globally operating banking sectors, like German major bank, subsidiaries of international banking holdings or *Landesbanken*, showed a pro-cyclical behavior between 2000 and 2011 while other banking sectors, for example *Sparkassen*, regional banks or cooperatives, preferred a passive strategy that is reflected by low leverages during years of booming asset markets. In addition, my study highlights some of the consequences of pro-cyclical leveraging during the sub-prime

crisis of 2007/2008.⁷ Finally, I aim to analyze the available empirical data for evidence of readily discernible refinancing policies among specific sectors of the German banking system that have resulted in directly increasing the funding liquidity risk within these banking sectors.⁸ As stated earlier, the significant liquidity demands of the banking sector during 2007 and 2008 were caused primarily by ‘modern bank runs’ that involved weakening refinancing opportunities in the interbank market instead of, or in addition to, withdrawals by non-bank depositors. For this reason, I am also examining the role of banks’ preferred non-bank and institutional refinancing policies within specific sectors of the German banking system.⁹ This aspect of my study will have significant impact for the industry, because refinancing in the interbank market remains one of the most important channels of contagion risk within the global banking industry.

In Section 2, following, I will outline the sources and structure of the examined data, as well as the applied methodologies. Section 3 will summarize the data, compile the results and assess those results within the scope of my proposed hypothesis.

2. Data

The data, on which this study is based, has been provided by the Bundesbank Statistics Department. It covers several balance sheet items submitted by German banks between 2000 and 2010 on a monthly basis. In order to test my hypothesis I have used data, which has been aggregated, at the level of the various German banking sectors including those typical for this country alone (German major banks, regional banks, *Landesbanken*, *Sparkassen*, cooperatives). Although the aggregated data examined within my study do not allow any conclusions on risk-taking behavior of an individual bank the results appear to be helpful to characterize the different sectors of the German banking industry (German major banks, *Sparkassen*, cooperatives, *Landesbanken*, regional banks and International bank holdings).

In order to prepare the ground for my study I am first of all showing a number of descriptive statistics to introduce the structure and dynamics of leverages within the German banking system from 2000 to 2010, whereas my study focuses primarily on the

⁷ Adrian and Shin (2010) have examined such high leverages over the sub-prime mortgage crisis in 2007/2008 in the event of globally operating investment banks.

⁸ Brunnermeier and Pedersen (2009), for example, highlight the dependency between market and funding liquidity risk.

⁹ Diamond and Dybvig (1983) provide seminal research on the role of withdrawals of deposits by early and late consumers.

changes that occurred immediately prior to, and during the financial crisis of 2007/2008. In order to prove my theory that banking specific variables and financial market indicators can both affect the leverage of banks' balance sheets I apply a number of least square regressions. Table 1 describes the independent variables that have been applied to these regressions.¹⁰ I further intend to establish the so-called 'distance-to-default' of the different banking sectors as a recognized probability indicator of the likelihood of a bank defaulting.

Table 1: Dependent and independent variables

Variable	Definition	Calculation formula/Source
Leverage (dependent variable)	Ratio of total assets to capital	$\text{leverage} = \frac{\text{total assets}}{\text{bank capital}}$
Banking sector	Sectors of the German banking system as defined by the Deutsche Bundesbank	Cooperatives Landesbanken Regional banks Sparkassen German major banks International bank holdings
Repospread	Monthly spread between interest rates of repurchase agreements (with a three month maturity) and monthly libor rate	extracted from Bloomberg ¹¹
ROA	Ratio of return to total assets	$\text{ROA} = \frac{\text{return}}{\text{total assets}}$
Libor3m	Monthly libor rate (three month maturity)	extracted from Bloomberg
MSCI	Monthly percentage changes of the MSCI World	extracted from Bloomberg
GBI	Monthly percentage changes of the Global Bond Index	extracted from Bloomberg
Current yield 10y	Monthly current yield of 10 year benchmark bonds	extracted from Bloomberg

To test the sample for collinearities I am providing the calculations pertaining to the Variance Inflation Factors (VIF) in Table 2. The Variance Inflation Factors demonstrate that the independent variables show only weak collinearities, if any.

¹⁰ I have conducted all regressions with STATA 11 software.

¹¹ Bloomberg PLC is one of the leading providers of financial market information.

Table 2: 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 collinearities, 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	

3. Analysis and Results

The following sections illustrate the calculations, based on descriptive statistics and regression models that I have used to examine the risk-taking behavior of German banks over the period 2000 to 2011, with particular focus on refinancing strategies and leveraging of the balance sheets.

Table 3 provides an overview of the annual leverages of selected sectors of the German banking system over the period under examination. Column 1 of Table 2 exhibits the leverages of the entire German banking system. The data show that the German banking system generally reported persistent values during the analysis period, with peaks in 2000/2001 and 2005. The highest value of leverages occurred in 2000; the indicated decline of leverages in the period 2001 to 2003 can be put down to the bursting *internet bubble*, and the subsequent crisis in financial markets because of the breakdown of this new economy.

To be more precise, the German major banks have tended to increase their leverage from 2000 to 2005, returning only slightly lower values between 2005 and 2007, with a significant reduction of leverages in 2008 and 2009. Regional banks, *Sparkassen* and

cooperatives appear to have reduced their leverage consistently over the entire period in question, showing lower values in 2008 than any of the other banking sectors.

It is interesting to note that *Landesbanken* as banks controlled by federal state authorities, report the highest level of leverages in 2008. Table 3 indicates significant increases in leverages between 2003 and 2008 by corresponding balance sheet operations. This pattern reveals that during this period *Landesbanken* operated their business at the same level of leverages that can be observed as major banks or international bank holdings.

This observation is of major significance, especially in light of the fact that the Financial Market Stabilization Fund, or SoFFin established by the German Government in 2008, had to bail out several *Landesbanken* in order to stabilize the German banking industry in the aftermath of the financial crisis of 2008.

Table 3: 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=Sparkassen, 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 4 compares the increases in leverages with the contemporaneous growth on the asset side of banks' balance sheets between 2000 and 2008. In general terms, this table demonstrates the important role played by German major banks and *Landesbanken* within the German banking system due to their high volume of total asset. In more detail, Table 4 illustrates that both German major banks and International bank holdings increased their total assets at above average levels. A similar increase can also be observed in the case of the regional banks. In this case, however, this trend is less

significant than it would be in other banking sectors because regional banks only hold a small section of the entire volume of assets of the German banking system.

In the case of international bank holdings, the significant increase of total assets could be seen as a reflection of the increasing globalization of the international banking system, which recent literature has repeatedly cited as one reason of the increased risk of contagion over the last decade. In contrast to all of the above, the exclusively locally operating cooperatives and *Sparkassen* distinguish themselves by showing the lowest increase in the asset side of their balance sheets.

Generally speaking, my data in Table 3 and in Table 4 confirm that certain sectors of the German banking systems, the German major banks, *Landesbanken*, and International bank holdings did manage their balance sheets pro-cyclically by increasing the volume of total assets during periods of booming asset prices.

Table 4: Volumes of total assets reported by German banking sectors

This table reports volumes and annual changes (Chg %) of total assets reported by 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=Sparkassen, GEN=cooperatives, AB=international bank holdings).

Year	Total	Chg %	GB	Chg %	RB	Chg %	LB	Chg %
2000	5,767,212		849,872		523,144		1,138,990	
2001	6,126,775	6.23%	993,401	16.89%	607,252	16.08%	1,207,151	5.98%
2002	6,336,457	3.42%	1,012,261	1.90%	633,227	4.28%	1,271,535	5.33%
2003	6,420,338	1.32%	1,058,460	4.56%	662,252	4.58%	1,312,725	3.24%
2004	6,487,954	0.42%	1,057,574	0.49%	676,702	1.82%	1,361,423	1.66%
2005	6,718,976	3.95%	1,251,463	18.41%	576,110	-14.99%	1,280,280	-4.84%
2006	6,981,158	3.90%	1,265,120	1.09%	603,185	4.70%	1,368,351	6.88%
2007	7,226,573	3.52%	1,313,293	3.81%	623,436	3.36%	1,454,463	6.29%
2008	7,628,615	5.56%	1,438,948	9.57%	686,427	10.10%	1,563,074	7.47%
2009	7,970,371	4.48%	1,482,739	3.04%	786,113	14.52%	1,578,219	0.97%
2010	7,525,485	-5.58%	1,308,947	-11.72%	724,028	-7.90%	1,449,849	-8.13%
2011	8,232,993	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%

Table 4: continued

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%

Within the context of expansion of the asset side of banks' balance sheets it is important to assess the different refinancing sources of banks, particularly with regards to the tensions in the interbank market as a refinancing channel during the financial market turbulences in 2008 as examined, for instance, by Abassi and Schnabel (2009). Thus, Table 5 differentiates the percentage of short-term refinancing in the interbank market in the different banking sectors between 2000 and 2011. With respect to the whole of the German banking system, the percentage of short-term refinancing appears persistent from 2000 to 2009 at around 28%, with a sharp decline in 2010 and 2011 resulting from the increasing distrust in the interbank market. As the table shows, German major banks, *Landesbanken* and International bank holdings report the highest percentage of short-term refinancing in the interbank market, while locally operating *Sparkassen*, regional banks and cooperatives make relatively little use of this refinancing channel.

Table 5: Short-term refinancing in the interbank market by German banking sectors

This table shows the percentages of short-term refinancing 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=Sparkassen, 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%

Table 5: continued

Year	Total	GB	RB	LB	SPK	GEN	AB
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 6 summarizes the uptake of an additional source of banks' refinancing in the form of short-term refinancing raised by acquiring savings or short-term deposits from the non-banking sector. This shows the locally operating *Sparkassen*, regional banks and cooperatives as relying on this type of refinancing to a higher degree than German major banks and International bank holdings did. It is interesting to note that *Landesbanken* show the lowest percentages of short-term non-bank refinancing uptake over the entire observation period, but with a significant increase from 2008 to 2011. The growing importance of non-banks as a refinancing source for *Landesbanken* during those years can be explained by the necessary change in their refinancing policies as a result of the increasing distrust of the interbank market.

Table 6: Short-term non-bank refinancing by German banking sectors in percentage of total assets

This table reports the short-term non-bank refinancing by German banking sectors in percentage of total assets from 2000 to 2011 as of January each year (GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=Sparkassen, 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%

To summarize so far, I have established that refinancing sources have two dimensions which are closely related to the distinguishable sources of funding liquidity risk that are the kind of fundraising (non-bank refinancing or refinancing in the interbank market) and the time horizon of refinancing. Therefore, Table 7 compares the total percentages of non-bank refinancing in a short term and refinancing in the interbank market by the various banking sectors. My results demonstrate a general increase in short-term

refinancing from 2000 to 2011 with greater recourse to this type of refinancing in 2008 to 2011. Some researchers explain this significant expansion of short-term refinancing particularly from 2008 to 2011 by reminding of the increasing distrust in the interbank market (see Abassi and Schnabel [2009] or Acharya, Gale, and Yorulmazer [2010]). This hypothesis seems to relate to the presumption of decreasing creditworthiness of banks by financial market participants that during periods of shrinking confidence only accept to borrow money on a short-term basis, particularly in a strained interbank market. Such a trend should be of major interest to regulatory authorities, because the risk of maturity mismatches increases in correspondence with the percentage of short-term refinancing of a bank.

More precisely, *Landesbanken*, German major banks and International bank holdings appear to rely on short-term refinancing to a growing extent, while regional banks, *Sparkassen* and cooperatives show consistently high percentages of short-term refinancing from 2000 to 2008. These differing funding policies coincide with the different business models of German banking sectors that I discussed in section 1 of this paper. *Landesbanken*, German major banks and International bank holdings are focusing on global investment activities while regional banks, *Sparkassen* and cooperatives are mainly targeting on financing regional projects of firms and retail clients.

Table 7: Short-term refinancing by German banks in percentage of total assets

This table shows the yearly short-term refinancing by German banks in percentage of total assets from 2000 to 2011 as of January each year, where GB=German major banks, RB=regional banks, LB=Landesbanken, SPK=Sparkassen, 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%

My next calculation applies the ordinary least squares regressions with the purpose of clarifying influences on banks' leverages over the observation period in more detail.

Table 8 displays the result of a regression of several financial market indicators on the leverages of the different banking sectors from 2000 to 2010. Additionally, I apply a factored variable for the distinguishable banking sectors (regional banks are the basis of the factored variable), as well as introducing dummy variables in the regression model for every single year from 2003 to 2010. To facilitate comparison, I am also including the corresponding standardized beta coefficients in this table.

Table 8: Ordinary least squares (OLS) regression

This table shows the results of an ordinary least square (OLS) regression on leverages over the period from 2001 to 2009. The sample covers 804 monthly observations. Significance levels are marked with *** ($P > |t| \leq 0.01$), ** ($P > |t| \leq 0.05$) and * ($P > |t| \leq 0.1$). The regression provides an r-squared of 0.6188, an adjusted r-squared of 0.6094, and a root MSE of 0.1886.

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

My regression confirms that leverages of German banks do relate to their corresponding banking sectors. Apart from cooperatives, the different banking sectors enter the regression with positive and statistically significant coefficients. Not surprisingly, International bank holdings and *Landesbanken* record the highest standard beta coefficients, while German major banks and *Sparkassen* return statistically significant, but relatively low coefficients. This would indicate that International bank holdings and *Landesbanken* operated their business highly leveraged. Conversely, the sectors of *Sparkassen*, German major banks and cooperatives display statistically significant and negative coefficients. These observations are consistent with the results illustrated in Table 3, which have already shown the relatively low tendency of *Sparkassen*, German

major banks and cooperatives towards leverage. Particularly, if I keep in mind that I have chosen regional banks as the basis of the factored variable for ‘banking sectors’ the results appear to be plausible.

The analysis has established a strong relationship between the dummy variables for every single year, and leverages of German banking sectors especially for the period from 2005 to 2010. Surprisingly, the obtained standard beta coefficients indicate a significant decrease of leverages from 2006 to 2010. When taking into account the leverages of the entire German banking system as illustrated in Table 3, however, it becomes apparent that the risk-taking behavior of German banks is diverse, and depends entirely on the individual banking sector. By contrast, this regression model provides only weak support for the supposition that leverages of banks correlate with the financial market indicators. Only the global bond index (‘GBI’) shows a statistically significant influence on banks’ leverages, even though the obtained coefficient is relatively low.

The next table analyzes the regression models for every single banking sector, including a dummy variable, for every single year from 2003 to 2010, in order to illuminate further the pro-cyclical behavior of the German banking sectors, and their relationship to the variety of financial market indicators. The results reported in Table 9 underline the counter-cyclical behavior of *Sparkassen* and cooperatives by reducing their leverages over the period 2003 to 2010 and reporting a strong growth of assets during the same period that is listed in Table 4. German major banks, on the other hand, appear to have increased their leverage, since this banking sector report statistically significant and positive standard beta coefficients, particularly between 2005 and 2007 with a significantly increasing volume of total assets. In the case of International bank holdings and regional banks, the regression models suggest that these banking sectors significantly expanded their leverage in 2005 and in 2004 respectively, and de-leveraged their balance sheets between 2006 and 2010 while reporting a significant growth of assets. By contrast, *Landesbanken* show pro-cyclical behavior in 2004 to 2005 and counter-cyclical behavior from 2008 to 2009, because the related dummy variables obtain statistically significant and positive standard beta coefficients for the period 2003 to 2005, while these variables enter the regression with statistically significant but negative coefficients for the period 2006 to 2007.

In addition, financial market indicators and the return on assets appear to influence the leverage of the different banking sectors in a distinguishable direction, and to a different degree. The ‘return on assets’ (ROA) appears to be influencing the leverages of International bank holdings, *Landesbanken*, and regional banks in a positive manner. Particularly International bank holdings and *Landesbanken* achieve a relatively high standard beta coefficient, which appears to support my hypothesis that return on assets represents a significant factor in the expansion of their balance sheets (see also Binici and Köksal [2012]).

Moreover, the variable that is representing the global bond markets (‘GBI’) seems to show significant influence on the leverage of *Landesbanken*, while the global stock market indicator (‘MSCI’) would appear to stand in significant relation to the leverage of regional banks and International banking holdings.

Interestingly, the leverages of German major banks, International banking holdings, *Landesbanken*, cooperatives and *Sparkassen* are closely tied to the independent variables for interest rates such as the libor 3 month deposit rate (‘libor3m’), while the current yield of bonds with a 10 year maturity (‘current yield 10y’) relates to cooperatives, regional banks, and *Sparkassen*. Finally, the spread between secured repurchase agreements and unsecured interbank borrowing (‘repospread’) show a significant influence on leverages of cooperatives, regional banks, and *Sparkassen*. These inter-dependencies may be explained by the fact that the business strategies of the different banking sectors are spotlighted on attaining interest rate gains to a different degree.

In summary, it can be stated that there does appear to be a link between the leverage of a bank, and the banking sector it operates in. Furthermore, it seems likely that each banking sector is adjusting its leverage to a different degree depending on various financial market indicators. This variation in risk-taking behavior is likely to be due to the varying business models of the banking sectors in question, and the corresponding ownership structures of banks (see Schmielewski and Wein [forthcoming]).

Table 9: Ordinary least squares (OLS) regressions for 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. 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***
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
Intercept	13.18	33.32	20.17	13.78	17.42	24.04

A considerable amount of literature is focusing on principal-agent problems within the banking system. Some papers have tried to define the relationship between ownership structures and risk behavior in terms of the so-called z-score (distance-to-default, DD), as described, for example, in Boyd and Graham's seminal paper of 1986 as an appropriate measure of a bank's probability of default. The distance-to-default (DD) is calculated from the annual return-on-assets (ROA), the ratio of common equity to total assets (CAR) and the standard deviation of return-on-assets (σ ROA):

$$DD = \frac{CAR+ROA}{\sigma ROA}, \text{ whereas } ROA = \frac{\text{yearly return}}{\text{total assets}} \text{ and } CAR = \frac{\text{common equity}}{\text{total assets}}.$$

Thus, the somewhat intuitive z-score estimates the number of standard deviations the annual return-on-assets figures can fall, before the common equity of a bank turns negative. Table 11 applies this risk measure to the various banking sectors; the distances-to-default calculations are based on the profit and losses listed in Table 10.

From these tables it becomes apparent that the distances-of-default calculated for German major banks, *Landesbanken*, and International bank holdings are lower as those of the other banking sectors, due to the higher volatility of their profits and losses. By contrast, *Sparkassen* and cooperatives consistently operated their business at higher distances-to-default over the entire period. A similar pattern has developed in the case

of regional banks from 1999 to 2006, but with a significant reduction in the distances-to-default in 2007 to 2008. In addition, Table 10 illustrates the enormous losses suffered by German major banks and *Landesbanken* during 2008 and 2009, and which significantly contributed to the severity of the crisis within the German banking system during the course of the global sub-prime mortgage crisis. Although based only on aggregated data, Table 11 clearly highlights the need for regulatory authorities to pay greater attention to the leverage of banks, as well as their distances-to-default, in crises. Since low distances-to-default, in particular, are evidenced for the duration of the entire observation period, the apparent difficulties of German banks in 2008 and 2009 are no longer surprising. On the contrary, the results of this study emphasize that increased leveraging and diminishing distances-to-default can be useful early warning signs for regulatory authorities and policy-makers as suggested, for instance, by D`Hulster (2009).

Table 10: Return on assets 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= Sparkassen, 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	0.20	0.20	0.45	0.13	0.24	0.21	0.15

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=Sparkassen, 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

4. Conclusion

The results of my study as presented above prove that the elements of the German banking system did operate their business on a pro-cyclical basis, and that pro-cyclicality was sector-dependent. Within this context pro-cyclicality do not relate to general economic conditions but is characterized by high actively adjusting leverages of banks during period of booming asset markets. German major banks and *Landesbanken* have been shown to increase their leverage during periods of booming asset markets, whereas cooperatives and *Sparkassen* indicated a reduction in their leverage during the same period. These findings coincide with the distinguishable business models of the German banking sectors.

My study also provides some empirical evidence that banks that increased their leverages during periods of extraordinarily asset growth also tended to refinance their assets through short-term borrowing in the interbank market, whereas other sectors such as *Sparkassen* or cooperatives relied on non-bank refinancing to a higher degree. These refinancing patterns caused severe liquidity shortages of banks that had largely refunded their assets in the interbank market, because the tensions of the financial markets in 2007/2008 resulted in an increasing distrust in the interbank market.¹²

Moreover, my study confirms that throughout the observation period banks, which chose high leverages also, report a high volatility of return on assets, thus providing an

¹² Abassi and Schnabel (2009), for example, examine contagion effects in the interbank market during the sub-prime mortgage crisis in 2007/2008.

indirect measurement of risk-taking behavior.¹³ Both the high leveraging of corresponding balance sheet operations, and the high dispersion of returns on assets have been shown to be the cause of low distances-to-default, and these can reflect the vulnerability of such banks during crisis periods, as the sub-prime mortgage crisis in 2007/2008 has illustrated.

From the perspective of regulatory authorities, such risk-friendly behavior suggests the need for the introduction of a reasonable counter-cyclical capital buffer.¹⁴ In real terms, this would mean that banks could be compelled to reduce their leverage ratios during periods of excessive credit growth in order to prevent high losses when asset prices are significantly turning down as suggested, for example, by D`Hulster (2009).

¹³ See for example Barry et al. (2008).

¹⁴ A counter-cyclical capital buffer is part of the 'International regulatory framework for banks - Basel III' (see Bank for International Settlements [2011]).

References

- Abassi, P., & Schnabel, I. (2009). Contagion Among Interbank Money Markets During the Sub-prime Crisis. *Working Paper Johannes Gutenberg University Mainz* .
- Acharya, V., Gale, D., & Yorulmazer, T. (2010). Rollover Risk and Market Freezes. *NBER Working Paper*. No. 15674 .
- Adrian, T., & Shin, H. S. (2010). Liquidity and Leverage. *Journal of Financial Intermediation*. Volume 19, Issue 3, July 2010, pp. 418-437.
- Allen, F., & Gale, D. (2000). Financial Contagion. *The Journal of Political Economy*. 2000, Vol. 108 , pp. 1-33.
- Allen, F., Carletti, E., & Gale, D. (2009). Interbank Market Liquidity and Central Bank Intervention. *Journal of Monetary Economics*. Volume 56, Issue 5 , pp. 639-652.
- Bank for International Settlements. (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems* - revised version June 2011.
- Bank for International Settlements. (2005). *International Convergence of Capital Measurement and Capital Standards*.
- Barry, A., Lepetit, L., & Tarazi, A. (2008). Bank Ownership Structure, Market Discipline and Risk: Evidence from a Sample of Privately Owned and Publicly Held European Banks. *Journal of Banking & Finance*. Volume 35, Issue 5, May 2011, pp. 1327–1340.
- Binici M., & Köksal, B. (2012). Is The Leverage of Turkish Banks Proccyclical? *Central Bank Review Vol 12*, pp. 11-24.
- Boyd, J., & Graham, S. (1986). Risk, Regulation and Bank Holding Company Expansion into non-banking. *Quarterly Review, Federal Reserve Bank of Mineapolis*.
- Brunnermeier, K. (2009). Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives*. Volume 23, Number 1 , pp. 77-100.
- Brunnermeier, K., & Pedersen, L. H. (2009). Market Liquidity and Funding Liquidity. *Review of Financial Studies*. 2009, 22(6), pp. 2201-2238.
- Bushman, R. M., & Williams, C. D. (2012). Accounting Discretion, Loan Loss Provisioning and Discipline of Banks' Risk-Taking. *Journal of Accounting & Economics (JAE)*, Forthcoming.
- Cifuentes, R., Ferrucci, G., & Shin, H. (2005). Liquidity Risk and Contagion. *Journal of the European Economic Association*. 2-3 (04/05) pp. 556-566.
- Cihák, M., & Hesse, H. (2007). Cooperative Banks and Financial Stability. *IMF Working Paper WP/07/2* .
- Diamond, D., & Dybvig, P. (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*. Vol. 91, no. 3 , pp. 401-419.
- D'Hulster K. (2009). The Leverage Ratio. *The World Bank Group*. Note Number 11, December 2009.
- Fonteyne, W. (2007). Cooperative Banks in Europe - Policy Issues. *IMF Working Papers*
- Freixas, X., & Holthausen, C. (2005). Interbank Market Integration under Asymmetric Information. *Review of Financial Studies*. 18 , pp. 459-490.
- Gorton, G. (2008). The Panic of 2007. *NBER Working Paper*. No. W14358.
- Heider, F., Hoerova, M., & Holthausen, C. (2009). Liquidity Hoarding and Interbank Market Spreads: The Role of Counterparty Risk. *European Banking Center Discussion Paper* No. 2009-40S.
- Hardie, I., & Horwarth, D. (2009). Die Krise but not La Crise? The Financial Crisis and the Transformation of German and French Banking Systems. *JCMS: Journal of Common Market Studies*, Volume 47, Issue 5 , 1017-1039.
- Hüfner, F. (2010). The German Banking System: Lessons from the Financial Crisis. *OECD Economics Department Working Papers*, No. 788 .
- Morris, S., & Shin, H. (2009). Illiquidity Component of Credit Risk. *Working Paper Princeton University*.
- OECD (2008). The Current Financial Crisis: Causes and Policy Issues. *OECD Financial Market Trends*. No. 95 Volume 2008/2.
- Rajan, R. G. (2006). Has Finance Made the World Riskier? *European Financial Management*. Volume 12, Issue 4, pp. 499–533.
- Schmielewski, F., & Wein, T. (forthcoming). Are private banks the better banks? An insight to the ownership structure and risk-taking behavior of German banks.
- Upper, C., & Worms, A. (2004). Estimating bilateral exposures in the German interbank market: Is there a danger of contagion? *European Economic Review*. Volume 48, Issue 4, pp. 827-849.