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Case Study of Three German Banks Stuck in the Subprime Crisis

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Abstract. This paper is aimed at finding banks' destabilizing behaviors that explain why the impact of the crisis is so serious in the banking system. By comparing three German banks stuck in the crisis, I find that: I) the leverage is a common destabilizing factor and, ii) the banks were highly interconnected to other financial institutions and had a large maturity mismatch were more seriously affected by the crisis.

Keywords: Systemic crisis, Leverage, Maturity mismatch, Banking regulation
J.E.L Classification: G01, G14, G21, G28

1.Introduction

This case study of three German banks stuck in the subprime crisis, IKB, Hypo Real Estate (HRE) and Dresdner Bank, is aimed at bringing out the impact of banks' destabilizing behaviors (high leverage ratio, high interconnection with other financial institutions and large maturity mismatch) on banks' difficulties.[1]

My work just concentrated on the German banking system for two reasons. On the one hand, the first banking system touched by the subprime crisis is the German banking system in which IKB was the first European bank completely affected by the crisis. The second one is to avoid to study the influence at a macro level (e.g. the difference in the macroeconomic policy and the banking regulation across the countries). Moreover, I chose IKB, HRE and Dresdner Bank as representative banks[2] for 2 reasons: firstly, the external intervention in these banks was significant; secondly, all of these 3 banks are private banks. In other words, the external intervention in these banks (especially in the case of public interventions) means that it was not required by the public status of the bank but driven by the seriousness of their potentially systemic problems. Note that in this case shareholders profit from the public rescue while the loss is assumed by the public. Furthermore, the data in this study is collected by myself from banks' annual reports.

Many academics are interested in the transmission mechanism of the subprime crisis. Hellwig (2009) emphasizes the systemic elements in this crisis. Brunnermeier (2009) explains the economic mechanisms that caused losses in the mortgage market and described common economic threads that explain the mess in the financial system during the crisis. Moreover, several economists tried to reveal risky behaviors of banks before the crisis by studying in the special case, e.g. the case of Northern Rock studied by Shin (2009) and Yorulmazer (2008) who show that the fragile funding structure was

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[1] The panorama described in the first appendix can help us to understand their difficult situation.

[2] Among the German banks in problem in the crisis, there are Deutsche Bank and Dresdner Bank as the commercial bank, Hypothekenbank and Hypo Real Estate as the Pfandbrief bank (mortgage bank), IKB as the specialized and Pfandbrief bank, SachsenLB and WestLB as the Landesbank.

a destabilizing factor for banks. Different from their case studies focused on one distressed bank, I concentrated on the comparison among three German distressed banks in the subprime crisis. Notice that the degree of difficulty of these banks is different,[3] this study is aimed at finding the main factors which determine the extent of banks' difficulties.

The research of these factors is conducted by observing three variables: banks' capitalization level, interconnection with other institutions and maturity mismatch. The justifications for choosing these variables is as follows.

The first investigation in the capitalization level is inspired by the idea of Gennote and Pyle (1991) who show that a sufficient level of capital gives banks incentives to fulfill their social obligation, that is to say, screening and monitoring industrial projects. Other theoreticians were also interested in this subject, such as Giammarino, Lewis and Sappington (1993), Rochet (1992), Bensaid, Pagès and Rochet (1993). These people develop the theories on capital regulation by the incentive approach. In this study, for the purpose of investigating the capitalization level, I used both the regulatory capital level, and non-regulatory leverage level which is inspired by the study of Brunnermeier et al. (2009) and Adrian and Shin (2008) who point out that leverage ratio is a better indicator for investigating the capitalization level of banks.

According to the argument of Rochet and Tirole (1996) which proves that the interbank funding is vulnerable in the systemic crisis so that the banks that largely depend on interbank funding are less stable, I examine whether these banks were highly interconnected to other banks for the second investigation in the interconnection. Moreover, on the ground of the fact that banks can be affected by non-bank financial institutions in problem just like what happened in this crisis, I also examine whether these banks are interconnected to other non-bank financial institutions.

As Morris and Shin (2004) indicate that the behavior of short horizon traders will form

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3   See the appendix 1 for details about the difference in their difficulties.

the liquidity black holes in the market, in my opinion it could also happen in banks. In addition, Brunnermeier and Pedersen (2009) argue that market liquidity drying up the impact of maturity mismatches on the banks' problem. Then I make the last investigation in maturity mismatch for these German distressed banks.

Three results obtained from the investigation in these aspects:

1) All three banks were well capitalized in terms of regulatory requirement, but not in terms of simple leverage ratio. Then the leverage is a common factor to explain these banks' difficulties in the crisis.

2) The interconnection with other financial institutions (bank or non bank) and maturity mismatch are two main factors which can explain the difference in the extent of the difficulty of three German banks stuck in the crisis.

3) In the systemic crisis, a large maturity mismatch can amplify the impact of the interconnection on banks in problem. The reason is that the banks with a large maturity mismatch need to face the problem that both their non bank financial creditors and bank creditors want to withdraw their funding or refuse the renewal.[4]

As this paper is a case study, the sample size (only three banks) took in my study is limited. However, concentrating on the special cases may help us to capture the main destabilizing factors of banks. Furthermore, the different business model of these banks, which could partially explain the difference in maturity mismatch of these banks, is always used by banks as an excuse for avoiding banking regulation.[5] In my opinion, it's the same problem on the regulation perimeter as the argument that investment banks should be equally regulated like commercial banks.

The paper is structured as follows. Section 2 analyzes the capitalization level of these banks. Section 3 is invested in the interconnection factor. Section 4 is focused on

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[4] Generally, the funding of non-bank financial creditors are more stable than it of bank creditors. Nevertheless, the first may be equally excited as the latter in time of the systemic crisis.

[5] As IKB and HRE are Pfandbrief banks that finance their real estate loans by asset backed liabilities, their maturity mismatch is generally larger than commercial banks.

maturity mismatches. According to the results of previous sections, Section 5 proposes policy implications for regulatory reforms. Then section 6 concludes. The appendix highlights the panorama of the difficulties of these banks and explains how the approximate maturity mismatch is computed.

2. Capitalization Level

2.1 Regulatory Capitalization Level

Figure 1 illustrates 2 important results: 1) all three banks had a higher risk-based capitalization ratio than the regulatory requirement (both core capital ratio and total capital ratio, 4% and 8% respectively). 2) Dresdner Bank (DB in figure 1) was better capitalized relative to IKB and HRE.

Figure 1
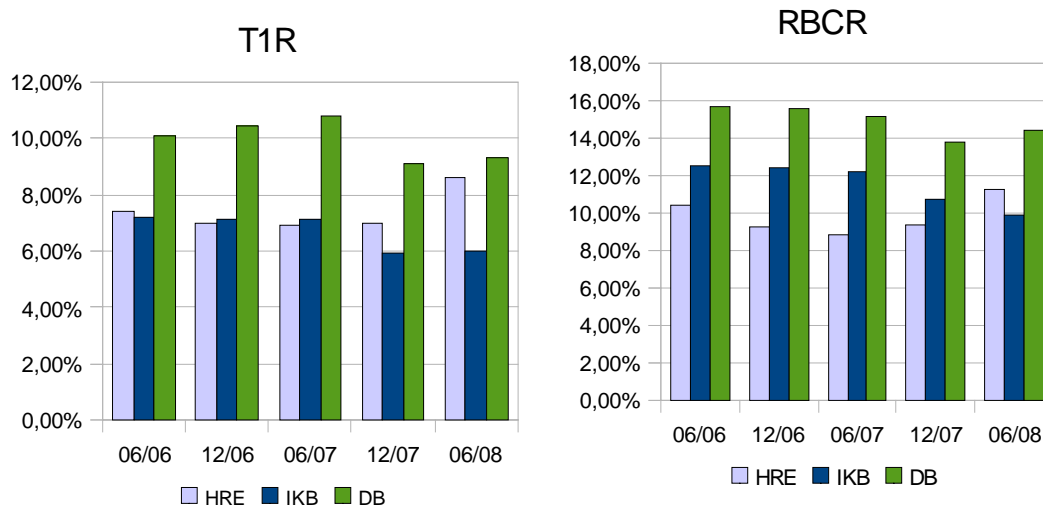
Risk-based capital ratios (T1R & RBCR) of HRE, IKB & Dresdner Bank, June 2006 to June 2008
Source: HRE, IKB & Dresdner Bank, annual and interim reports, 2006-2008

Even though three banks were well capitalized according to Basel norms, they were affected by the subprime crisis. This result justifies the arguments on the drawback of the risk-based capitalization regulation in the banking system. Theoretically, Blum

(1999) explains the perverse effect of the capital requirement on the risk taking; Heid (2007) highlights that Basel II is more procyclical than the old regime. Empirically, Rime (2001) provides evidence of Swiss banks for the limited effect of regulatory risk-based capital requirement on reducing banks' risk taking. Ayuso et al. (2004) concentrate on Spanish banks in order to prove the procyclicality of risk-based capital requirement. Therefore, the regulatory capitalization level is not a good indicator to measure banks' real risk level. Nevertheless, could it remain a good factor permitting a differentiation in the degree of seriousness of the distress of these banks?

The answer is no. The famous cases, such as Northern Rock and UBS, showed that there were many banks which had a much higher regulatory risk-based capitalization level than these German banks were also seriously affected by the crisis. For instance, Northern Rock's core capital ratio (T1R) and total capital ratio (RBCR) were 11.3% and 18.2%[6] respectively in June 2007, but cleaning up the mess of this bank made the British government raise 25 billion of pounds. These evidences show that we cannot conclude that the difficulties of IKB and HRE were more serious than those of Dresdner Bank because of worse capitalization according to Basel norms.

2.2 Leverage Ratio

Brunnermeier et al. (2009) argue that the systemic shock has had a considerable volume effect on banks' balance sheet so that banks that were well capitalized in accordance with Basel norms could not escape the systemic risk. As the regulatory capitalization level cannot correctly reveal the potential systemic risk that could affect banks, they propose the use of the leverage ratio to measure banks' risk level. Moreover, Adrian and Shin (2008) indicate that the leverage ratio has a negative impact on the credit cycle. According to the above-mentioned arguments, I investigate in this subsection whether the leverage ratio is a factor that explains the difficulties of these banks as well as the difference between their problems.

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6   Northern Rock's interim report of June 2007

Figure 2 shows the evolution of leverage of these German banks.[7] Here I used the *asset to equity* ratio in order to measure the leverage ratio of these banks. As these banks didn't issue preferential actions during this period, the leverage ratio applied here can be considered as *leverage on common equity* as well as *leverage on shareholder equity*. Before the subprime crisis breaking out, HRE, IKB and Dresdner Bank had a leverage ratio around 50, 36, 36,5 respectively. Indeed the rise of their leverage ratio during the crisis is explained by the fact that they had to use their equity to absorb losses.

Figure 2

Leverage of HRE, IKB & Dresdner Bank, June 2006 to June 2008
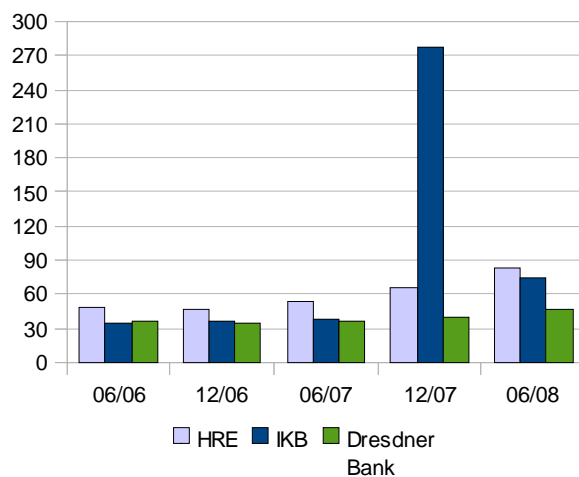
Source: HRE, IKB & Dresdner Bank, annual and interim reports, 2006-2008

How should we interpret these figures? Are they high or low? Two examples on banks' leverage (without taking into account off-balance sheet activities) may help us in answering this question.

1) According to the interim report of Lehman Bros.,[8] the latter had a leverage ratio around 28 for two quarters before the crisis. Moreover, Lehman isn't the unique case in US, most of investment banks in US held a leverage ratio around 25 to

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7 The regulatory capitalization level of IKB was stable while the leverage ratio soared in the end of 2007, because IKB received in September 2007 a public rescue fund, which is included in the calculation of regulatory capitalization ratio but excluded in the computation of leverage ratio.

8 Lehman Bros.'s interim report of the first quarter in 2008, http://www.lehman.com/press/qe/docs/031808_1q08.pdf#financials

30 before the crisis breaking out. As everyone knows, all of these American investment banks were gravely affected by the crisis.

2) Another example is the Spanish banking system recognized as one of the best for resisting the crisis. Here I chose several large Spanish banks to verify their leverage ratio in the eve of the subprime crisis. Banco santander had a leverage ratio around 20. The leverage ratio of Banco Popular Espanol was 20. Banco Sabadell had 17 as leverage ratio. BBVA's leverage ratio was 19,6.[9]

On the one hand, it is clear that three German banks in the study even had a higher leverage than American investment banks that were the most shocked by the systemic risk. On the other hand, the good example of Spanish banks shows that a lower leverage ratio could help banks to resist to the systemic risk. Figure 2 seems to show that it's not the case of these German banks. Therefore, the leverage ratio should be considered as a common factor for explaining their difficulties.

Table 1

Test of the compatibility between leverage ratio and degree of difficulty

	HRE (1)	Dresdner Bank (2)	Comparison
Leverage*	50	36,5	(1)>(2)
Resolution	Public intervention	Private intervention	(1)>(2)
Result	Coherent		

* mean of leverage ratio one year before the crisis

	HRE (1)	IKB (2)	Comparison
Leverage	50	36	(1)>(2)
Resolution	Public intervention & amounted to 26% of balance sheet*	Public intervention & amounted to 9.4% of balance sheet	(1)>(2)
Result	Coherent		

* % of balance sheet in time of their difficulties

9 Quarterly reports in June 2007 of Banco Santander, Banco Popular Espanol, Banco Sabadell, and BBVA.

	IKB (1)	Dresdner Bank (2)	Comparison
Leverage	36	36,5	(1)≤(2)
Resolution	Public intervention	Private intervention	(1)>(2)
Result	**Incoherent**		

Nevertheless, Table 1 illustrates that we can't affirm that the leverage is the reason why these banks are different in terms of the degree of difficulty. HRE had a highest leverage ratio among three banks, then it consumed a large amount of public rescue funds. It's consistent with my initial conception that is to say, the higher their leverage is, the more they have serious difficulties. However, the comparison between IKB and Dresdner Bank seems that we can't conclude this relationship between the leverage and the degree of difficulty as above.

3. Interconnection

I investigate in this section whether a bank is interconnected to other banks and to non-bank financial institutions. To measure the first type of interconnection, I use the net position of banks in the interbank market.[10] It's reasonable that measuring the second type of interconnection need the investigation in banks' total position vis-a-vis non bank financial institutions.[11]

Figure 3 shows the net position of three German banks in the interbank market. Even

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10 Net position means that loans to other banks minus liabilities to other banks is not equal to zero. When a bank has a negative position in the interbank market, this bank is a net borrower vis-a-vis other banks. Then, this bank could have to face the problem of withdrawal of its bank creditors. In a systemic crisis, it is more possible to happen. The more closely a bank is dependent upon other banks, the less stable its funding structure in the systemic crisis.

11 In contrast to the interconnection with other banks, the interconnection with non bank financial institutions affects the stability of bank in different ways. On the one hand, non bank financial institutions have a role as creditor. In this situation, as soon as these institutions are touched by the systemic risk, they will be jittery as well as banks regarding withdrawing their funding. On the other hand, some non bank financial institutions play another role as securitization entities, which are partially financed by banks' financial investment or off balance sheet commitments, and invest in structured products. When these entities are affected by the liquidity crisis, the banks that provided funding for these entities is not able to be well out of the crisis.

though all of three banks had a negative net position in the interbank market before the crisis breaking out, there is a difference between Dresdner Bank and two others. I use the data in the eve of their difficulties that is to say, in June 2007 for IKB and Dresdner Bank, and in June 2008 for HRE. In fact, both HRE and IKB had a negative net position around 20% of their total balance sheet (loans to banks as percentage of total balance sheet minus liabilities to banks as percentage of total balance sheet), while Dresdner Bank only had a net position of -3,3% of its total balance sheet. In other words, IKB and HRE were more negatively interconnected to (dependent on) other banks than Dresdner Bank. It seems to be a factor that distinguishes these banks in terms of degree of their difficulties.

Figure 3

Dresdner Bank, IKB & HRE's interbank position, June 2006 to June 2008
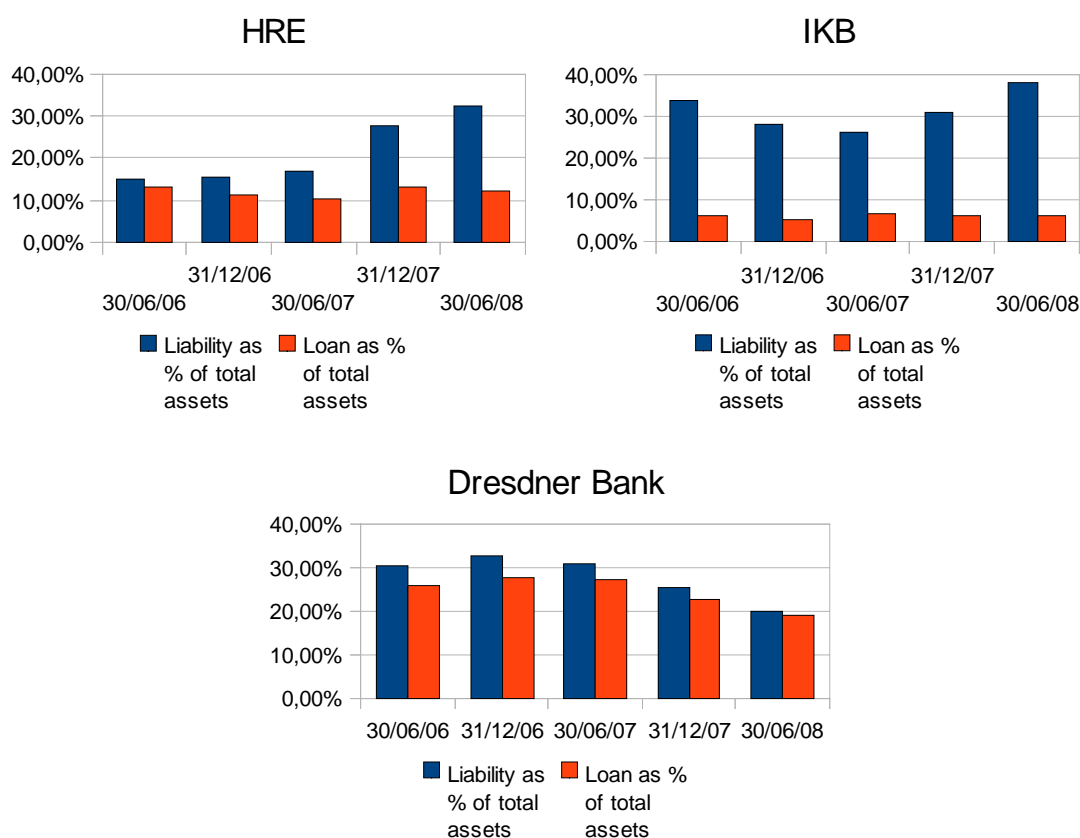
Source: Dresdner Bank, IKB & HRE, annual and interim reports, 2006-2008

Another information brought by Figure 3 is that liabilities to banks of all three banks were more than 25% of their total liabilities. As knowing that liabilities to banks belong to the wholesale funding, this type of funding source is less stable than the retail funding such as retail deposits. Indeed, the ratio of their liabilities to banks, one part of wholesale funding, to the whole funding is higher than the ratio of Northern Rock' total wholesale funding to the whole funding (Figure 4). Recalling the last result about the net position in the interbank market, the funding structure of IKB and HRE was really unstable before the crisis.

Figure 4

Northern Rock's wholesale funding as proportion of total liabilities, June 2006 to June 2007
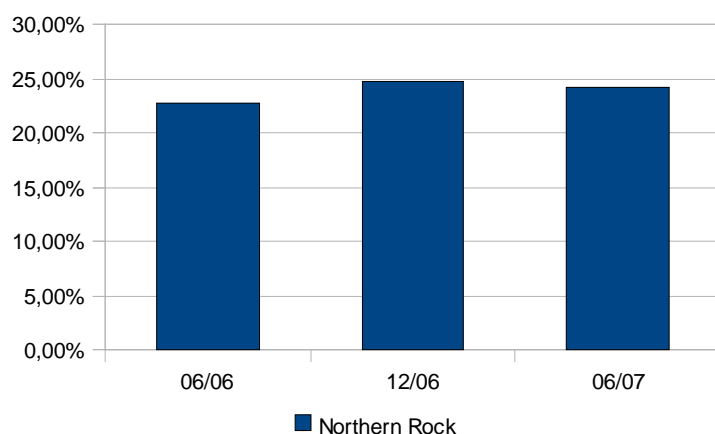

Source: Northern Rock, annual and interim reports, 2006-2007

Regarding the interconnection with non-bank financial institutions, I concentrated on securitized liabilities, financial investment and off balance sheet items in order to measure whether these banks were interconnected with other financial institutions. When banks profit the low cost of funding from issuing securitized liabilities, they bear the risks. The reason is that the relationship between banks and their institutional creditors is less stable than the relationship between banks and their traditional clients. This unstable relationship is more significant in a systemic crisis like the subprime crisis, because of the contagion effect among the financial system. When the subprime crisis extended from the banking system to the whole financial system after the great

11

difficulties of Lehman and AIG, all financial institutions feared the contagion effect so that the most of them refused to lend to others. Moreover, liquidity drying-up made the situation worse. These institutions did everything they can do to protect themselves, for instance running on their debtors. The only constrain for them is the maturity limit that is to say, when their loans will be matured. If it's a short term loan, it is clear that they will not renew this loan. Therefore, the banks that had more short term funding were more unstable in the crisis.

Figure 5 illustrates that IKB and HRE considerably relied on securitized liabilities before the crisis breaking out relative to Dresdner Bank. Moreover, 29% and 53% of this type of liabilities are short horizon for IKB and HRE respectively. As described by Figure 5, HRE had a dangerous funding structure that have destabilized this bank during the crisis. Coupling the result of Figure 5 with the result of the net position in the interbank market, we could obtain the interesting result about the funding structure of these banks justified the importance of retail funding. Highly depending on interbank liabilities and securitized liabilities means that HRE and IKB used little retail funding which is deemed as the most stable source of funding. As a consequence, unstable funding structure made HRE and IKB be more seriously affected by the systemic shock than Dresdner Bank of which funding structure was more solid.
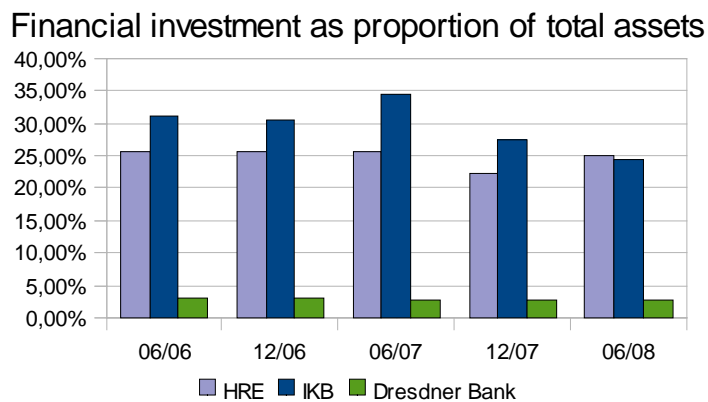
Figure 5
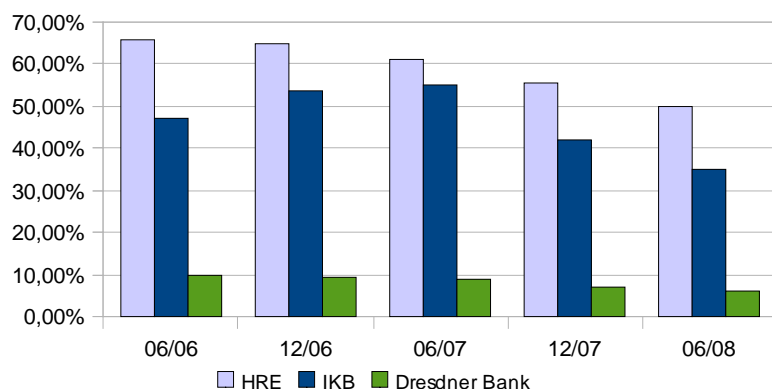
Securitized liabilities as proportion of total liabilities

Source: Dresdner Bank, HRE & IKB, annual and interim reports, 2006-2008

As I mentioned above, a bank can also be affected by the institutions it financed. It happens because sometimes banks are not able to early detect the danger in their debtors, especially off balance sheet entity (e.g. SPV). Figure 6 indicates that HRE and IKB had more financial investments in comparison with Dresdner Bank. More precisely, the first had more assets that depended on the financial market performance. Evidently, these market-relative assets are more volatile than traditional assets (loans to non financial firms). As soon as financial markets decline, these banks' portfolio value will decrease as well.
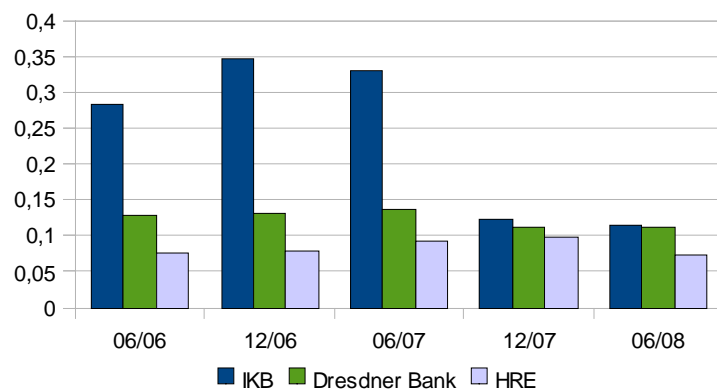
Figure 6

Financial investment as proportion of total assets, June 2006 to June 2008

Source: IKB, HRE & Dresdner Bank, annual and interim reports, 2006-2008

Figure 7

Ratio of contingent liabilities & commitments to assets, June 2006 to June 2008

Source: IKB, HRE & Dresdner Bank, annual and interim reports, 2006-2008

Moreover, contingent liabilities and commitments can be considered as a good indicator that capture the impact of other financial institutions on banks. In fact, banks provide SPVs with credit facilities. If these credit lines were not used, banks will receive commissions. However, when these SPVs are attacked by the crisis, banks that signed commitments with these entities have to refinance them. Therefore, the problem of reintermediation emerges. That is the case of IKB illustrated by Figure 7 (see the appendix for details).

The analysis in this section showed that HRE and IKB were more interconnected with other financial institutions so that their difficulties were more serious than Dresdner Bank. Indeed my work illustrates an idea about the importance of interconnection between financial institutions. Several academic have concentrated on this point, for example, Adrian and Brunnermeier (2008) propose a method to measure the systemic risk by taking account of the interdependance between financial institutions.

4. Maturity Mismatch

As mentioned above, the impact of interconnection can be amplified by maturity mismatches. More precisely, banks are more fragile while they are highly interconnected to other institutions and when their liabilities' maturity is short. By contrast, a bank with a stable funding structure (less financial creditors or small

maturity mismatches) is more able to resist to the crisis.

By supposing a simple system, I make a example in this section in order to understand why maturity mismatches have an impact on the difficulties of banks, especially for banks which are highly interconnected to other financial institutions.

It is a two-date (0, 1, 2) and zero-interest-rate system. In this system, there are three types of agents, a continuum of firms which need funding to finance their project, only one bank (for simplicity), and a continuum of investors which are only willing to finance the bank because of risk-aversion. To simplify the analysis, I assume that at date 0 and 1 the only rational capacity for the bank of collecting deposits and then granting to firms is two units. For example, if the bank collected two units of deposits at date 0, and if its investors withdraw the deposits, one or two units, the only one thing the bank can do is to find other sources in order to keep its funding pool at two units. Moreover, for firms (and investors of the bank), there are two strategies, the long-term funding (resp. investment) that comes to maturity at date 2 and the short-term funding (resp. investment) which comes to maturity at date 1. Furthermore, if the investors of the bank agree, the short-term funding offered by them can be renewed for a period (for instance, after being renewed, a short-term deposit matured at date 1 will mature at date 2).

In this context, as the bank would collect two units of deposits and then grant to firms, it has to choose at date 0 its funding and investment structure among three strategies for funding (two units of long-term funding, two units of short-term funding, or one unit of each type) and three strategies for investment (the same choices as funding structure). As a consequence, the bank has nine options (three categories according to funding-structure choice) described as follow to construct its portfolio. It is clear that the bank's level of riskiness at date 1 will be different across these options.

A. The bank chose two units of short-term funding:
A-1. Suppose that the bank at date 0 granted two units of long-term loans to firms. In this case, the bank will be in trouble if it cannot renew the old deposits or cannot find

other sources.

A-2. If the bank at date 0 granted one unit of long-term loan and one unit of short-term loan to firms, it will face the similar situation as above. The reason is that in this case it has to find one unit of funding source to refinance its long-term investment.

A-3. If the bank at date 0 chose two units of short-term investments, it will not be stuck in trouble by the withdrawal of its investors at date 1.

B. The bank chose one unit of short-term funding and one unit of long-term funding:

B-1. If the bank granted two units of long-term loans to firms at date 0, there is a risk that the bank couldn't find one unit of funding source (renewing the old one or finding another one) to refinance its long-term investments at date 1.

B-2. Assume that the bank invested at date 0 one unit of long-term loan and one unit of short-term loan. In this case, there will not be difficulties for the bank at date 1, because maturity mismatches don't exist.

B-3. If the bank granted two units of short-term loans to firms at date 0, it will be safer than the second situation.

C. The bank chose two units of long-term funding (C-1, C-2, C-3):

As all the bank's funding sources are over two periods, there is not the risk of investors withdrawing. Then whatever the bank chose the investment structure at date 0, it will be safe at date 1.

As a consequence, the last three options are not risky at date 1 for the bank, however the probability of Category B and A at date 1 is 1/3 and 2/3 respectively. Moreover, three troublesome conditions (A-1, A-2, B-1) have a common feature that is to say, the average maturity of assets (AMA) is longer than the average maturity of liabilities (AML).[12] This gap between assets and liabilities' maturity measures the maturity mismatch of banks.

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12 A-1: $AMA = (2+2) / 2 = 2 > AML = (1+1) / 2 = 1$; A-2: $AMA = (1+2) / 2 = 1.5 > AML = (1+1) / 2 = 1$;
B-1: $AMA = (2+2) / 2 = 2 > AML = (1+2) / 2 = 1.5$

Now suppose that in each case the investors of the bank agree to renew their loans to the bank, however, only one unit of funding source. This assumption is interpreted as the amelioration of market conditions. In this case, Option A-2 and B-1 are not any more the risky option at date 1. Nevertheless Option A-1 is still risky for the bank due to the large maturity mismatch when it constructed its portfolio at date 0. Therefore, even if creditors are less jittery, the bank that has a large maturity mismatch cannot avoid the liquidity shock. From the opposed point of view, the maturity mismatch amplifies the impact of agitation of creditors on banks' funding conditions.

Regarding three German banks in my study, I checked whether they had a large maturity mismatch before the crisis breaking out. For this purpose, I calculated the approximate maturity mismatch for these banks in time of their difficulties.[13] The result is very interesting: HRE had an approximate maturity mismatch of 2.84, IKB's approximate maturity mismatch is 1.79, and Dresdner Bank's maturity mismatch is only 0.7. It seems that larger maturity mismatches of HRE and IKB, coupled with higher interconnection with other financial institutions rendered them fragile in the crisis. Thus they were more seriously affected by the subprime crisis.

5. Regulatory Reforms

The analysis in previous sections justified the impact of capitalization level (leverage), interconnection and maturity mismatch on banks' stability. Moreover, interconnection and maturity mismatch can be considered as the discriminative factors that explain the difference in these banks' problems during the crisis. Therefore, regulatory reforms in the light of these factors found in this study are necessary and pressing in the face of what happened in this crisis.

Indeed, regulatory reforms by using these factors could be implemented in two ways. The first is the *Early Warning System* proposed by Dewatripont and Rochet (2009). Regulators and supervisors can use these factors as indicators to detect banks' risk level.

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13 See the appendix for some details.

With suitable indicators, supervisors can choose the right time for interventions in order to reduce serious consequences of banks' difficulties. The second way is to integrate these factors in future micro and macro prudential regulations to limit individual banks' risk taking.

Several academics and central bankers propose to place importance on leverage ratio. For example, Blum (2008), Brunnermeier et al. (2009) and Hildebrand (2008). Moreover, Adrian and Shin indicate that leverage is procyclical with the result that there is a spill-over effect of a high leveraged institution to other institutions. Therefore, taking into account the leverage ratio is reasonable to verify whether a bank is susceptible to be affected by the systemic risk and whether it will generate externalities in the financial system.

The regulators and supervisors have effectively attached importance to the necessity of strengthening the existing capital requirement. According to the Basel III developed by the Basel Committee on Banking Supervision after the subprime crisis breaking out, there will be a package of reforms which are aimed at making the banking system more resilient. The most important measure of this package is to increase the equity requirement. For instance, the minimum common equity requirement will rise from 2% to 4.5% in 2015 when the Tier 1 capital requirement will have to be at least 6% against 4% at present. Moreover, even if the minimum total capital requirement will remain 8%, the capital conservation buffer which is considered as the countercyclical buffer will be phased between 2016 and 2018.[14]

Besides leverage, reducing banks' interconnection with other financial institutions is another way for future regulatory reforms. Nevertheless, it is hard to put into practice in comparison with leverage. In reality, interconnection between financial institutions is very complex, so it needs enormous data of all institutions in the financial system to measure the systemic risk's impact on each institution and contributions of each institution to the systemic risk. Then determining a proper level of interconnection for

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14 BIS Press release at its 12 September 2010 meeting.

each bank is a very hard work.

However, since my analysis about maturity mismatch showed that the latter can amplify the impact of interconnection on the banks' problem, we should try to limit maturity mismatches so as to reduce the impact of interconnection. Then, liquidity regulations should be putted into action with the purpose of decreasing maturity mismatches. It is remarkable that the liquidity regulation is not aimed at eliminating maturity mismatches, because we all know that the maturity transformation is an important and profitable activity of banks. In my opinion, the liquidity regulation could be aimed for attenuating the negative impact of maturity mismatches.

Actually, there are three ways for liquidity regulations. The first is the liquidity minimum requirement. It forces banks to hold minimum liquid assets or cash. It is a type of liquidity regulations that is totally based on assets. However, it is less effective for two reasons. On the one hand, holding liquidity minimum, especially cash, is costly for banks and the whole real economy. On the other hand, this requirement is not sufficient to cover a systemic risk.

The second way is *Core Funding Ratio*, actually putted into practice by the Reserve Bank of New Zealand. This requirement asks banks to hold sufficient solid funding, for example retail funding, in comparison to total assets. It is more effective than the first one because of taking account of the funding structure. However, it neglected the impact of assets composition on the stability of banks.

The third solution of liquidity regulations is *Liquid Assets to Liquid Liabilities Ratio*. The idea is that banks have to hold sufficient liquid assets to cover the risk related to unstable funding from jittery creditors. In the new Basel III, this type of liquidity requirement is proposed as the *Liquidity Coverage Ratio (LCR) which will require banks to have sufficient high-quality liquid assets to withstand a 30-day stressed funding scenario that is specified by supervisors. Besides, it is complemented by the Net Stable Funding Ratio (NSFR) which is a longer-term structural ratio designed to*

address liquidity mismatch.[15] In fact, the Deutsche Bundesbank has put into effect this type of liquidity regulation in 2007. Nevertheless, since the one applied by Bundesbank is only a simple ratio[16] without distinguishing different assets and liabilities, its effect is very limited. That's why IKB and HRE which respected the liquidity requirement of Bundesbank were still affected by the liquidity risk.

Indeed, the third one is the best in terms of effectiveness. However, it is more complicated when regulators compute different balance sheet items' maturity. For this reason, regulators could put into practice hybrid liquidity regulations in the sequential manner. More precisely, regulators could define a threshold for each type of liquidity regulation or when each one will be applied for banks. For example, one bank perhaps is under *Core Funding Ratio* requirement on condition that its liquid assets are higher than the regulatory threshold. Otherwise, the *Liquid Assets to Liquid Liabilities Ratio* will be applied.

6. Conclusion

This case study highlights the high leverage is a common factor for explaining the difficulties of three German banks in the subprime crisis on the one hand; high interconnection with other financial institutions coupled with large maturity mismatches are the discriminative factors that explain the difference in the extent of difficulties of these banks on the other hand.

Moreover, the paper showed that in the light of difficulties of these German banks maturity mismatches could amplify the impact of interconnection with other financial institutions on the banks' stability. According to this result, it is necessary to reform the actual banking regulation by integrating liquidity regulations as complementarity of capital regulations. For future researches, the liquidity regulation based on assets and liabilities structure deserves the attention of economists.

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15 BIS Press release at its 12 September 2010 meeting.
16 Assets (maturity < 1 month) / Liabilities (maturity < 1 month) must be higher than 1.

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Appendix

1. Panorama of the subprime crisis and the difficulties of IKB, HRE and Dresdner Bank

The crisis breaking out in 2007 putted many banks in trouble. Even if the first banks affected are American banks, non-American banks were next targeted by the crisis. Serious consequences of this crisis are explained by the fact that in recent years banks have considerably involved in the securitization business which amplified the impact of the real estate bubble exploding on the financial system.

From the summer of 2007, the crisis started to spread its influence in the financial system. The shape of the crisis was manifest in time of the difficulties of Bear Stearn in March 2008. Then, the crisis reached its pike on the fifth September 2008, when Lehman Bros. failed. The failure of Lehman resulted in a series of difficulties in the financial system. From the moment, the crisis seemed to be systemic.

Figure 8
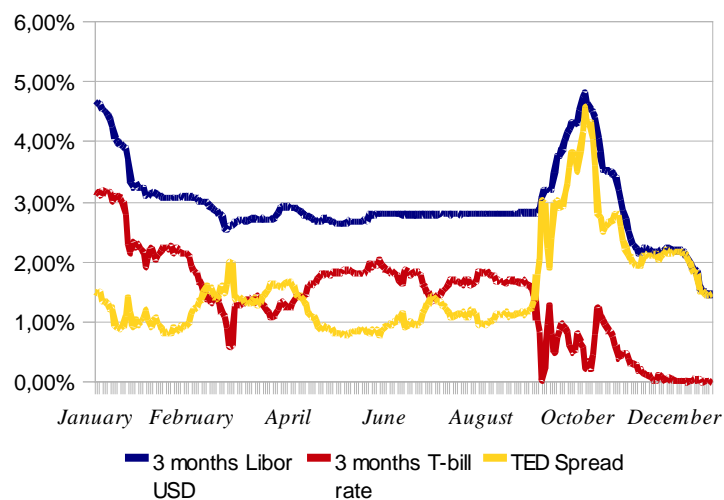
TED Spread, 02/01/2008 to 24/12/2008, daily

Source: Bulgarian National Bank, St. Louis Federal Reserve Bank

Following a large number of difficulties of financial institutions, the tension in the interbank market reached the new pike as illustrated by Figure 8. The interest spread between Libor and T-bill (TED Spread) attained to 4.58% on 10th October 2008. In other words, nobody wants to lend money to others for the purpose of self protection.

Like their American rivals, European banks didn't escape from the crisis, even though they didn't directly involve in American mortgage activities. Amongst European banks in trouble, the famous case is Northern Rock and UBS. Moreover, the market liquidity drying up due to the failure of Lehman jeopardized a great deal of European banks of which funding largely depended on short-term financial markets.

A) IKB Case

IKB Deutsche Industriebank is a German bank specialized in lending to small and medium-sized companies. In addition, IKB largely involved in real estate financing. On 27th July 2007, IKB was explicitly affected by the subprime crisis. To avoid the failure of IKB, the German government's financing bank, along with Bundesbank and three

bank associations (BdB, BVR and DSGV) formed a rescue fund which amounted to €3.5 billion to bail out IKB. In February 2008, a new rescue package which amounted to €1.5 billion was announced by the German government.

IKB was the first European bank touched by the subprime crisis. It didn't directly involved in American mortgage activities, but it had a large position in structured products related to American mortgage loans in direct or indirect ways as the below paragraph described.[17]

- Rhineland Funding which had €13.2 billion of investment consumed a credit facility which amounted to €8.1 billion provided by IKB.
- Credit lines granted to SPVs Havenrock I and Havenrock II made that IKB is exposed to a credit risk which amounted to €1.2 billion.
- IKB AG had a risky position resulting from the portfolio investment which amounted to €5 billion, and IKB International S.A. Luxembourg had a risky position of the portfolio investment which amounted to €1.3 billion
- IKB held €109 million of SIV Rhinebridge plc.'s equity that was a risky position during the crisis.

In comparison with IKB's total balance sheet (€53.17 billion) and equity (€1.38 billion) in time of its difficulties,[18] the above-mentioned risky exposure which amounts to €15.17 billion is not negligible. In other words, IKB needed the external power to help itself to cover these risks.
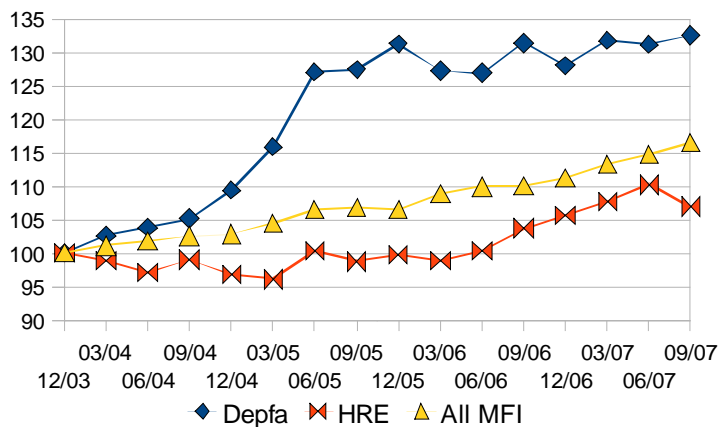
B) HRE Case

Figure 9

Quarterly growth of balance sheet of Depfa, HRE & All monetary financial institutions, Dec. 2003 to Sep. 2007, Base: Dec. 2003

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17 IKB's annual report of 2007/2008
18 IKB's interim report of June 2007

Source: Depfa & HRE, annual and interim reports, 2003-2007; Bundesbank

Hypo Real Estate is a big German bank specialized in real estate financing. Its problem appeared in September 2008 when the crisis reached the pike. Indeed, HRE was putted in trouble by its subsidiary Depfa that rapidly developed in recent years (Figure 9) and highly depended on short-term or very-short-term funding, for instance, 28% of Depfa's liabilities were in the form of *repos* in 2007.[19] The business model of Depfa determined the unstable funding structure during the crisis of its parent company and itself.

In September and October 2008, The German government and Bundesbank announced two bailout plans which amounted to €50 billion in order to save HRE. Later, in February 2009, SoFFin granted a guarantee which amounted to € billion to HRE. By that date, the German public institutions' support for HRE had reached €102 billion. Knowing that HRE's total balance sheet in September 2008 was €392.5 billion, the amount of public rescue funds proved the gravity of its difficulties.

C) Dresdner Bank Case

Dresdner Bank is one of the biggest banks in Germany. After acquiring Kleinwort Benston in 1995, Dresdner Bank created the investment bank division named Dresdner Kleinwort. From the moment, Dresdner Bank became a big commercial bank that had

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19 Depfa's annual report of 2007

an important place in European banking system. However, this giant German bank didn't escape from the subprime crisis in the second half of 2007. For this reason, Allianz, its parent company from 2002, decided to sell this bank to others. Even though Allianz was refused by Lloyds TSB in July 2007, the former reached an agreement with the number 2 of German banks, Commerzbank in August 2008. Finally, the takeover of Dresdner Bank by Commerzbank, that put into effect in January 2009, amounted to €9.8 billion. From that date on, Dresdner becomes one part of its old rival.

Table 2

Net Profit Before Tax of Dresdner Bank's divisions, million €

	Corporate & Private Clients	Investment Banking	Buisiness Services	Corporate Function	Total
2006	698	422	-66	150	1204
2007	878	-759	-35	759	843
Change	26%	-280%	-47,00%	406%	-30%

Source: Dresdner Bank, annual report, 2007

In the case of Dresdner Bank, we should pay attention to its investment bank division. In fact, Dresdner Bank was affected by the crisis because its investment bank considerably involved in American mortgage activities. We can see Table 2 concerning the sharp decrease of Dresdner Bank's invest bank's profit between 2006 and 2007.

2. Calculation of approximate maturity mismatches

I calculated approximate maturity mismatches of these banks at different times, because they didn't encounter problems at the same time. Precisely, July 2007 for IKB and Dresdner Bank, and September 2008 for HRE. Because of the availability of data, I used the data at the moment of one year before their difficulties that is to say, the data in March 2007 (end of fiscal year 07/08) for IKB, the data in December 2006 for Dresdner Bank, and the data in December 2007 for HRE. Furthermore, for the same reason, I chose principal balance sheet items[20] to calculate approximate maturity mismatches.

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20 Liabilities to banks, securitized liabilities, liabilities to customers, loans to banks, financial

IKB

	Amount (million €) (A)	Average Maturity (AM)	Weighted Average Maturity PAM=(AM / Total A)*AM
Assets			
LoB	4441,9	0,68	0,05
LoC	29685	3,5	1,69
FI	27265	5,17	2,3
Total	61391,9	Total Average Maturity	4,04
Liabilities			
LiB	13912,5	2,91	0,7
LiC	4277,8	4,45	0,33
SL	39555,5	1,5	1,03
SC	3026,4	5,81	0,29
Total	57745,8	Total Average Maturity	2,24
		Maturity Mismatch	1,79

HRE

	Amount (million €) (A)	Average Maturity (AM)	Pondered Average Maturity PAM=(AM / Total A)*AM
Assets			
LoB	51975	3,13	0,46
LoC	213173	5,68	3,42

investments, loans to customers and subordinated liabilities.

FI	88851	5,95	1,49
Total	353999	Total Average Maturity	5,37
Liabilities			
LiB	111241	0,69	0,22
LiC	27106	3,07	0,23
SL	218080	3,33	2,04
SC	5616	5,06	0,08
Total	356427	Total Average Maturity	2,53
		Maturity Mismatch	2,84

Dresdner Bank

	Amount (million €) (A)	Average Maturity (AM)	Pondered Average Maturity PAM=(AM / Total A)*AM
Assets			
LoB	138947	0,6	0,25
LoC	187680	2,2	1,22
FI	11208	3,96	0,13
Total	337835	Total Average Maturity	1,6
Liabilities			
LiB	162455	0,75	0,31
LiC	182227	0,71	0,33
SL	45970	1,56	0,18
SC	6192	5,24	0,08
Total	390652	Total Average Maturity	0,9
		Maturity Mismatch	0,7

Notes:

1) Lob: Loans to banks; LoC: Loans to Customers; FI: Financial Investment; LiB: Liabilities to banks; LiC: Liabilities to Customers; SL: Securitised Liabilities; SC: Subordinated Capital;

2) There are three maturity categories, < 1 year, between 1 year and 5 years, and > 5 years;

3) For each category, I calculated the average between the lower and upper limit that is to say, 0.5 year, 2.5 years and 7.5 years by considering the upper limit for the last category as 10 years;[21]

4) The above balance sheet items chose for calculating maturity mismatch included 97% of assets and 97% of liabilities of IKB, 88% of assets and 92% of liabilities of HRE, and 68% of assets and 82% of liabilities of Dresdner Bank.[22]

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21 In fact, since the average value of each category is linearly related to the value of upper limit for all three banks, the value of the upper limit is less important.

22 Dresdner Bank had 27% of assets as trading assets and 15% of liabilities as trading liabilities.