# The Impact of Mortgage Backed Securities on Bank Performance during the Financial Crisis

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**Abstract:** This paper examines the impact Mortgage Backed Securities on the performance of the Top 375 US banks during the financial crisis. Banks which were highly involved in the securitization process of mortgage loans tended to perform very poorly during the financial turmoil. Furthermore, Mortgage Backed Securities did not only affect bank performance but also had a positive correlation on the number of impaired loans. These findings were strongly related to mortgage and real estate banks and illustrate how Mortgage Backed Securities and mortgage loans had a strong impact on the performance of banks during the financial turmoil of 2007.

Keywords: Mortgage Backed Securities, mortgage loans, financial turmoil, Securitization, bank performance

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## I. Introduction

The number of Mortgage Backed Securities has grown tremendously over the past years and has proven to be a lucrative investment until the banking turmoil in 2007 (Barth, 2009). The strong growth in Mortgage Backed Securities is linked to bank incentives, which perceive this financial instrument of securitization as a great tool to enhance liquidity and diversify risk (Dell'Ariccia, Deniz and Laeven, 2008). In order to maintain a high liquidity ratio banks begin to securitize their issued mortgage loans and sell them to potential investors, simultaneously they diversify or even hand over the bearing default risk of mortgage loans within their portfolio by selling the Mortgage Backed Securities which consist of mortgage loans (Ashcraft and Schuermann 2008). Consequently, banks have to increase the number of mortgage loans in order to create additional Mortgage Backed Securities, which lead as according to Keys, Mukherjee, Seru and Vig (2010) to lax screening standards and moral hazard. Moreover, mortgage loan applicants which do not meet the financial conditions are still granted mortgage loans in order to fulfill the banks incentives (Ashcraft and Schuermann, 2008). Hence, numerous borrowers are unable to pay back their loans which in turn make Mortgage Backed Securities worthless. As a result bank performance drastically declined during mid-2007 and caused hundreds of banks to go bankrupt, report insolvency or appeal for government bailouts (Acharya and Richardson, 2009).

This paper investigates the effect of Mortgage Backed Securities on bank performance during the banking turmoil. The data which is used in this paper consists of the Top 375 US banks over the period 2005 until 2009. As measures for Mortgage Backed Securities, the paper will use Securities Available for Sale, Securities Held till Maturity and Off-Balance Sheet items as independent variables. To measure bank performance, the variable Return on Average Assets is used.

The data in this research paper gives some insight on the different variables which are linked to Mortgage Backed Securities and their trends over the studied period 2005-2009. As Mortgage Backed Securities are not directly stated on a bank's balance sheet and requires a large amount of research it is not possible to obtain the exact required data. Therefore, variables have to be found that best represent and are closely related to Mortgage Backed Securities to conduct this research and give empirical evidence on their effect on bank performance and their significance on the banking turmoil. The data collected consists of the Top 375 banks within the US ranked by their Total Assets. The reason the data consists of the Top banks is that they were most heavily involved in the turmoil and had the capabilities as well as the resources to also greatly affect the entire banking sector. The list of those Top 375 banks also includes the major players within this turmoil and gives a reasonable sample size to obtain sufficient significant results.

The results show that most of the variables have a trend that decreases during the period, whereas other variables tend to fluctuate on a less severe basis and have a more stable tendency. Furthermore, regressions, which include the variables that are linked to Mortgage Backed Securities and are transformed into a regression equation, investigate if and how they correlate with the bank performance measure and how well they explain their impact on it. Several regressions are performed by including and excluding different variables to control for differences and obtain more robust results. The regressions illustrate that there is a reasonable amount of correlation among the variables as well as a high statistical significance[1] which explains to a certain degree the variable association with the bank performance measure.

This paper is organized into several sections; Section II explains what a Mortgage Backed Security is and reviews the related literature. Section III discusses the data and explains the variables which are incorporated into the analysis and illustrates some trends from some of those variables over the studied period to gain some further insight on how they relate to this study and the bank performance measure. Section IV presents the results of the regressions and their analyses on how the variables correlate with the dependent variable and how well they explain the model. Section V concludes this research paper and summarizes what has been observed and investigated. Furthermore, some constraints are outlined and discussed for further research conducted on this given topic. Overall, this paper concludes that the bank performance has been affected by the variables; therefore, the hypothesis that Mortgage Backed Securities are one of the causes of weak bank performance is to a great extent valid.

[1] When referring to variables being statistical significant, it obtained a value of at least 0.10.

## II. Literature Review

Many papers exist which analyze and investigate the cause(s) of the banking turmoil in the early 21st century. Taylor (2009) argues that governmental actions are the main cause of the crisis and that their interactions as well as interventions were poorly conducted to stop the bubble from bursting. Others argue that lax screening standards are the cause of the turmoil and gave banks the opportunity to grant loans to mortgage loan applicants not fulfilling the prerequisites (Keys et al., 2009). Dell'Ariccia (2008) relates the increase in credit to more lenient lending standards which are the factors that triggered the increase in the delinquency rate of mortgage loans and are the origins of the turmoil. However, Acharya and Richardson (2009) argue that the cause of the banking turmoil is the securitization process of mortgage loans and the misguiding of investors in relation to their investments in Mortgage Backed Securities.

This Paper takes the stand point that Mortgage Backed Securities are one of the main triggers that caused the turmoil and led to a drastic decrease in bank performance, resulting in bankruptcy, government bailouts and liquidation.

### *a. What are Mortgage Backed Securities*

The origination of Mortgage Backed Securities is to be found in the home loan and mortgage market. Increasing housing prices and a reduction in the long-term interest rate made it more attractive to invest in home capital and apply for mortgage loans, which in turn gave banks the opportunity to increase their liquidity by issuing more loans and convert them into Mortgage Backed Securities (Ben-David, 2007). According to Bajari (2008), a clear upward trend of Subprime Mortgage Loans which has increased from 5% in 1994 up to 20% in 2005 can be discerned. This in turn resulted in a massive increase in Subprime Mortgage Loans backed into Mortgage Backed Securities, namely from 31.6% all the way to 80.5% during 1995-2005 (Barth, 2009). To understand the concept of Mortgage Backed Securities and gain some further insight we will rely on the research conducted by Ashcraft and Schuermann (2008), Jobst (2008) and Keys et al., (2010).

Mortgage Backed Securities are securitized mortgage loans which enable banks who issued these mortgage loans to retain a relatively high liquidity and permit them to issue further mortgages (Ashcraft and Schuermann, 2008). Furthermore, by securitizing their issued mortgages banks can diversify, spread and hand over the risk to other parties who buy and securitize those mortgage loans (Jobst, 2008). Consequently, a bank or „originator" after issuing the mortgage loans creates a

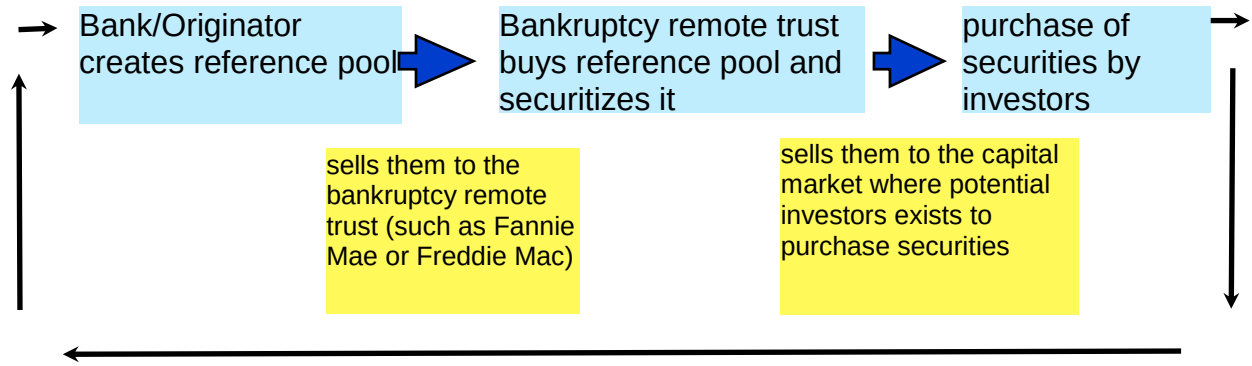


**Fig. 7**

so called „reference pool“ with those mortgages it wants to sell (Jobst, 2008). Next, it sells this pool of mortgages to a bankruptcy-remote trust, which is a special institution that securitizes those loans (Ashcraft and Schuermann, 2008). The pool of mortgages is splint into various tranches, or slices, which have different risk levels and are sold individually (Ashcraft and Schuermann, 2008). Those tranches are mostly divided into three categories: junior, mezzanine and senior tranche, with junior being the most risky and senior the least risky one (Jobst, 2008). The junior tranche has the lowest priority when it comes to the payout of principal and interest payments and the senior tranche is the first in line (Jobst, 2008). The investment risk in senior tranches is relatively low and investors are very sensitive to changes in the underlying mortgages of those senior tranches and this was one of the issues during the banking crisis which will be discussed in the following sections. After the securitization process of the pool of mortgages, credit rating institutions rate the created securities and in order for the bankruptcy-remote trust to subsidize the purchase of the pool of mortgages it sells them to the capital market where potential investors exists to invest in the securitized mortgage loans (Ashcraft, Schuermann, 2008). As this securitization process demonstrates, the Securitization of mortgage loans is a lucrative financial instrument for banks to sell mortgage loans and the bearing default risk to potential investors and maintain their liquidity. Fig. 7 illustrates the two phases of the securitization process.

### *b. How could Mortgage Backed Securities affect bank performance*

As securitization seems to be a lucrative way for banks to not only enhance liquidity and diversify risk but also improves their performance considerable incentive problems occurred during the turmoil and among the different parties (Keys et al., 2010). Those incentive problems led to information asymmetries and moral hazard among the involved stakeholders (Stein, 2002). As the

gap between mortgage originators and investors increases, it reduces the incentives for lenders‘ to screen mortgage applicants thoroughly (Keys et al., 2010).

Keys et al., (2010) outlines how through the securitization process moral hazards as well as information asymmetries arise. Information asymmetry refers to a situation when one stakeholder has more information then another stakeholder over a certain issue (Bebczuk, 2003). During the turmoil banks had more and better information about the Mortgage Backed Securities and their performance value in contrast to third parties as they knew more about the mortgage applicant and the underlying mortgage loan (Ashcraft and Schuermann, 2008). Moral Hazard indicates a situation in which one party takes excessive risk as this party does not bear the cost of the risk (Bebczuk, 2003). As bank incentives are to issue more mortgage loans and then sell them to bankruptcy remote trusts to securitize them, they did not bear the risk of the mortgage default and this leads to, as Bond, Musto and Yilmaz (2009) would phrase it, predatory mortgage lending. Banks issued loans to applicants which were not in the applicant’s full interest and which they should have denied as it does not solely harm them in an ex post but also ex ante sense by accepting such loans (Bond et al., 2009). These issues play a significant role in this paper as they affect bank performance and are significant aspects which caused this crisis.

During the application process for a loan applicant to obtain a mortgage loan banks need to conduct due diligence by screening the applicants soft and hard information (Keys, et al., 2010). Hard information refers to rather concrete information about the applicant with regard to his employment status, credit history, income etc. (Keys et al., 2010). Soft information refers to more personal information about the applicant which cannot be obtained by the bank by solely examining an applicant’s financial history but via a personal interview (Ashcraft and Schuermann, 2008). This then leads, according to Keys et al., (2010) to information asymmetries and moral hazard as soft information is difficult to inspect and to be verified by the third parties, such as investors, which bear the default risk (Stein, 2002). As banks beforehand know how they will precede with the mortgage loan their incentives to conduct in-depth due diligence about an applicant’s loan request is not as important as they do not bear the risk of default if they sell the mortgage loan (Ashcraft and Schuermann, 2008).

Ashcraft and Schuermann (2008) outline in their paper so called „Frictions“ between the involved parties as each party has more or less information than the other. The very first „Friction“ appears already when a mortgage applicant applies for a loan and the originator offers a loan in their but not in the applicants favor, as Bond et al. (2009) outlines (Ashcraft and Schuermann, 2008). The next „Friction“ which occurs is the information advantage originators have over bankruptcy remote trusts, as they do not know which mortgages are „lemons“ and which ones

are not (Ashcraft and Schuermann, 2008). This then leads to a Moral Error between the trust and the investor, as the trust intends to sell well reimbursing Mortgage Backed Securities but unconsciously also sells „lemons“ due to the actions of originators (Ashcraft and Schuermann, 2008). As every party was somehow certain about their safety regarding the default risk of loans and relies on the other party and their reputation, it did not pay too much attention on screening the prior parties on their activities but also faced the problems of missing information and predatory activities (Keys et al., 2010). Banks mislead borrowers by conducting an injustice practice of predatory lending to borrowers and offer them loans under conditions which are lucrative for banks but not for borrowers (Ashcraft and Schuermann, 2008). This then leads to the „lemons“ problem were banks know the „good“ and „bad“ loans but the following parties are unaware of it (Ashcraft and Schuermann, 2008). In addition a great deal of inaccuracies in the risk assessment and mispricing materializes according to Coval et al., (2009a) and Coval et al., (2009b) while rating and securitizing mortgage loans.

Now that a large amount of mortgage loans and Mortgage Backed Securities are present in the market it can result in a domino effect when the delinquency rate of mortgage loans starts to increase (Acharya and Richardson, 2009). Applicants default on their loans, Mortgage Backed Securities become worthless and investors, banks, as well as bankruptcy remote trusts lose a lot of money.

### *c. Empirical evidence on the role of Mortgage Backed Securities during the crisis*

Various studies emphasize how securitization causes bad lending practice within the banking sector and more lenient lenders when it comes to screening mortgage applicants (Dell‘Ariccia et al., 2008; Keys et al., 2010; Mian & Sufi, 2009).

Between 2001 and 2007 80-95% of Mortgage Backed Securities received the highest possible rating of triple-A (Ashcraft, Goldsmith-Pinkham, Vickery, 2010). This results in a high attractiveness for Mortgage Backed Securities by investors as a triple-A rating indicates a safe investment option and the ability to obtain the promised returns (Ashcraft et al., 2010). It is also important to mention that not all mortgage pools were sold to governmental institutions but also to private banks which issue Mortgage Backed Securities and this number increased to 60% during 1996-2005 (Mian & Sufi, 2009). Keys et al., (2010) demonstrate in their research paper that banks issued lower quality loans which resulted in a higher mortgage delinquency rate and therefore affected the Mortgage Backed Securities (Del‘Ariccia et al., 2008). Furthermore, Acharya and Richardson (2009) emphasize that as the delinquency rate increased investors realized the low

quality of Mortgage Backed Securities and the demand drastically declined and as banks were unable to sell the Backed Mortgage Securities they were stuck with them and were hit heavily by the large number of mortgage defaults. Dell'Ariccia et al., (2008) also relate the expansion of credit in the subprime mortgage market to the denial rates and loan-to-income ratios. As Keys et al., (2010), Dell'Ariccia et al., (2008) demonstrate how lax screening as well as lower lending standards are significant factors which affect bank performance during the crisis. They show that demand-factors play the important role and trigger through increasing demand for credit the lower lending standards arise and competition among banks increases (Dell'Ariccia, 2008). Crotty (2009) argues in his paper that banks' incentives to increase performance and profitability pushes them to keep a certain amount of high risk Mortgage Backed Securities which, however, turn out to be negatively affecting their performance and profitability when the mortgage market collapses. He even counter argues Ashcraft et al. (2008) and states that banks purposely maintained risky Mortgage Backed Securities within their portfolio to reduce Moral Hazard and to convince investors of the safety of these Mortgage Backed Securities.

However, very little real empirical evidence exists which clearly demonstrates how Mortgage Backed Securities affected bank performance and played a role during the crisis. ). Studies, as shown above, attempt to outline how the rating by the Rating Agencies are the cause of the weak performance of banks and criticize their role during the crisis (Ashcraft et al., 2010). Others exists which demonstrate how the delinquency rate of mortgage loans can be associated to the crisis and bank performance (see Dell'Ariccia et al., 2008; Keys et al,. 2010; Mian & Sufi, 2009). Theoretical analyzes are also present which combine different points of view and draw logical conclusions (see Acharya and Richardson, 2009; Barth, Li, Phumiwasana, Yago, 2008). Nevertheless, empirical evidence is missing which clearly outlines the role of Mortgage Backed Securities and their affect on bank performance, which will be the goal of this paper.

## III. Data

In this section the emphasis lays on our variable analyses, however, some limitations need to be mentioned beforehand in particular associated with Mortgage backed Securities and the default on mortgage loans.

### *a. Sample*

The sample contains the Top 375 Banks in the United States of America. The data from the 375 banks is obtained from Bankscope, a database which contains thousands of Financial Statements from banks all over the world[2]. They are ranked according to the Total amount of Assets each bank states on their balance sheet. As this sample encloses those banks which were highly involved in the financial turmoil and also had the resources and capabilities to influence the market, they should be an adequate sample for this research.

The period which is of interest is 2005 until 2009. The reason why this research begins as of 2005, even though many studies illustrate an increase in mortgage loans and Mortgage Backed Securities already since 1995 (see Barth, 2008; Bajari, 2008), is that not enough sufficient data is available for this research before 2005. Furthermore, 2009 is a year where many banks went bankrupt, merged or were acquired by others as the list from the Federal Deposit Insurance Corporation demonstrates.[3]

### *b. Mortgage Backed Security variable constellation*

MBSs are a highly complex financial instrument and draw some attention on themselves since the recent banking turmoil. The limitations and critics against MBSs is their low transparency for investors in association with banking leverage, which gives little information on how banks control and expand their activities and investments. This is possible because MBSs are mostly categorized as "off-balance sheet items" which makes it difficult for investors and institutions to screen banking data and information regarding their activities and risk assessments (Simkovic, 2011). As MBSs are not individually listed on a bank's financial statement a different way to assess their impact on the turmoil is established. In order to be able to carry out the analysis other variables are taken into consideration such as: Securities Available for Sale, Held till Maturity Securities, Off-balance sheet items and Total Securities.

[2] Bankscope.com
[3] http://www.fdic.gov/bank/individual/failed/banklist.html

Even though Mortgage Backed Securities are not directly identifiable on a bank's balance sheet it is still possible to a certain degree to filter them out. As mentioned in the Literature Section banks do not solely sell their mortgage loans but also retain them after they are securitized to sell them by themselves. The heading Securities Available for Sale contains those Mortgage Backed Securities on a bank's financial statement which a bank offers for Sale before they reach maturity. However, the quantity of the Mortgage Backed Securities available for sale is not individually given; therefore, this can affect the results as also other securities are present under this heading of the bank statement and are incorporated into the regression analysis. Securities Held Till Maturity are those securities the bank invests in to earn a certain yield at the expiration date of the given security. This heading contains those Mortgage Backed Securities which the banks invest in themselves and maintain until they reach Maturity. Moreover, here the same constraint is being observed as with the previous heading Securities Available for Sale. As the individual quantity of Mortgage Backed Securities which are held till maturity is not given, other securities which are under this heading are also included in the regression analysis. Off-Balance Sheet items are items which are not found on the bank's financial statement and therefore unavailable for investors and others to examine. As already mentioned by Simkovic (2011), Mortgage Backed Securities are often placed as Off-Balance Sheet items for several reasons, one is if a customer of the bank invests in Mortgage Backed Securities via the bank the bank does not hold those Mortgage Backed Securities directly on their financial statement as it is not part of their portfolio but only manages them for the client. Here though the same constraint is faced as with the two prior variables, it is not possible to obtain the exact share of MBSs on the Off-Balance Sheet item Statement.

Next the given variables are illustrated via graphs to demonstrate their trends during the turmoil. The Figures illustrate the average number of the given variable over the five year time period. Even though a variation among the different variables is present we can identify a certain link between the different trends of the variables; Fig. 1 and Fig. 2 respectively illustrate how Off-balance sheet items as well as Total Securities tend to increase until 2007 before they drop and increase again at the end of 2008. Fig. 3 plots Securities Available for Sale and demonstrates how they increase until the end of 2006 before a strong drop occurs which lasted until the end of 2009. On the other hand Securities held till Maturity, Fig. 4, illustrate another trend were a strong increase during 2006 and 2008 occurred before a 40 percent drop took place. The strong increase in securities held till maturity can be explained by the analyzed literature in the previous section, which identified a strong demand for securities, especially MBSs. Therefore, we can assume that the increase in the supply of those highly attractive MBSs is the cause of the illustrated trend. In addition, the drop in Securities Available for Sale is caused by the increasing number of mortgage defaults, which makes

MBSs, containing a high share of mortgages, extremely unattractive after investors realized the risk of those backed securities. Even though variations exist among the different variables and their trends, it can be identified that between the beginning of 2006 and the end of 2008 where the actual turmoil began the greatest changes in trends of these four variables occurred.

### *c. Impaired loans and Return on Average Assets*

Great emphasis also lies on the default of mortgage loans and the relation between them and other variables used during the research. Here another constraint arises as data on mortgage defaults are difficult to attain and are not present in the bank's financial statements. Hence, we use simply the total number of impaired loans from each bank within the sample. This of course will not give us fully accurate information but according and referring back to the literature section, studies were conducted which state that more than 40 percent of the defaulted loans were mortgage loans (Dell'Ariccia et al., 2008). As already assumed and provided by recent literature the number of impaired loans increased dramatically starting from 2006 until 2009 and further. To illustrate it in another dimension fig. 5 shows the share of impaired loans over gross loans and an increase of enormous 85 percent starting from 2006 all the way till 2009. Furthermore, a relation exists between the loan variables and the bank performance measure Return on Average Assets. The variable Return on Average Assets is incorporated into the research to attain a measure which can be utilized to analyze the performance of the banks within the given time. To illustrate the performance of banks during the time fig. 6 shows a trend which provides further assurance on how bank performance drastically declined during the turmoil. In the year 2006 the rate of Return of Average Assets dropped by incredible 113 percent before it began to recover itself as of 2008. It also stands out that in particular real estate/mortgage banks as well as bank holding/holding companies, dummy4 and dummy5 respectively, are negatively correlated to the Return on Asset variable, indicating that their performance level decreased during the given time as shown by Table 1.

Table 4 exemplifies the correlations among the security, loan and performance variables. Return on Average Assets has a negative correlation to securities held until maturity which is reasonable as we assume that a great share of MBSs was part of the Security portfolio and because of the high delinquency rate of mortgage loans this affects the MBSs and therefore influences the bank's performance negatively. Same counts for Total Securities within the portfolio as well as Available for Sale Securities. The percentage of NPLs/Gross Loans has of course, too, a negative correlation with the Return on Average Asset variable as a bank's performance tends to go down the higher the

rate of defaulting loans is. The Off-balance sheet item variable also takes an important role during the research as Mortgage Backed Securities are mostly part of those off-balance sheet items. It shows a positive correlation between Return on Average Assets, Securities Available for Sale and Total Securities and is also highly statistically significant in all three cases. The only variable which shows constantly low statistical significance with all of the given variables is Securities held till maturity. The correlation of this variable with the other ones seems correct, however, shows no sign of relatedness to the variables. This appears to be odd as Mortgage Backed Securities should be part of the Securities held till Maturity figure in a bank's financial statement and as bank's themselves invested also in those MBSs the given measure should show high significance in association with the variables. However, this might be because only 57 observations are present to conduct the research and as fewer observations are available less correlation can be found among the variables

### *d. Control Variables*

In order to control for dissimilarities some additional variables are incorporated into the analysis to make the results more robust and accurate. In general dummy variables are included which should give more accurate results in the sense that they focus on specific characteristics. The dummy variables "dummyspec" as well as "dummysta" take into consideration the banks specialization and its current status, respectively. The specialization variable indicates the specific field a bank is active in, for instance investments, savings etc. The status dummy gives information on the current state of the bank, if it is still active, merged, liquidated and so on. Furthermore, the Total Asset measure is also used as a control variable in order to control for size differences. Additionally, other variables such as Net Loans/Total Assets are included to control again for difference in loans compared to Total Assets of the bank. Table 5 states the variables used and information about the descriptives of these variables.

## IV. Analysis and Results

During the analysis several regressions are conducted with two different dependent variables. At first the bank performance measure is used as a dependent variable to observe how the bank performance depends on several factors which are said to have caused the financial turmoil, special focus lays on the Mortgage Backed Securities. Moreover, the research also focuses on the numbers of impaired loans of the given banks as this was also said to be the actual cause why so many banks went bankrupt and to give some further insight on what factors are related to the increase in the number of impaired loans and if a relation can be observed between this number and the Mortgage Backed Securities within the bank portfolios.

### *a. Bank performance analysis and results*

This section emphasizes the effect the different variables have on the bank performance during the financial turmoil. As mentioned before Mortgage Backed Securities are not directly identifiable on the financial statement of a bank, therefore, other measures are incorporated which have been outlined in the Data Section. Table 2 presents the results of the regressions conducted taking Return on Average Assets as the dependent variable. In this regression analysis several variables are transformed into a logarithmic variable in order to enhance linearity. As the top 375 banks are chosen most of them are clustered together within a tight area and by logarithmic transformations of certain variables the data spreads more evenly and improves the results.

Regression 1 tends to explain the effects security variables have on the bank performance measure. Securities which banks have available for Sale show a negative correlation of -0.326 towards the bank performance measure with a relevant significance indicator of 0.05. This indicates that an increase of 1 unit within the Securities Available for Sale the bank performance would drop by 0.326 units. Also Securities which are held until Maturity have a negative correlation towards the bank's performance; however, it can be observed that this measure obtains a relatively low significance value. The table also illustrates how real estate and mortgage banks tend to have a relatively large negative correlation, indicating that during the turmoil those banks did very poor in their performance which is in line with the literature. Moreover, Off-Balance sheet items tend to have a positive and significant correlation with the dependent variable, which seems to be going against the hypothesis. However, this might be explained by the fact that not merely Mortgage Backed Securities are items on the Off-Balance Sheet but also other items which do not appear on

the bank's financial statement. Therefore, the explanation of this positive correlation might be the number of Mortgage Backed Securities on the Off-Balance Sheet in comparison with the other items is too small to have a negative effect on the bank performance measure. The following regressions are fully analogous with regression 1 but obtain other relevant independent variables which should have an effect on the dependent variable and control for differences.

The remaining regressions illustrate similar results as regression 1; furthermore, the additional variables such as Total Securities, Non-Performing Loans, Dummysta1 and Reserv./NPL show the expected results as mentioned in the Data Section. Total Securities are negatively correlated to the dependent variable indicating that an increasing number of Securities in a bank's portfolio tends to have negative consequences on the bank's performance. This could be the result of a large quantity of Mortgage Backed Securities within the bank's Security portfolio and as mentioned in the previous sections, due to a high rate of mortgage delinquencies which in turn influences the performance of MBSs. The following variables tend to have the expected correlations; nevertheless, do not tend to show a high significance for the conducted regressions.

Next we observe the economic significance of the independent variables on the dependent variable. In regression 4 Securities Available for Sale obtain the economic significance value of -2.86, this value indicates that a one standard deviation increase in the independent variable results in a decrease of the dependent variable of -2.86. This is quite large compared to the standard deviation of the dependent variable which is 1.5 and indicates that this variable is highly economically significant and has an important role when it comes to assessing bank performance. Off-Balance sheet items obtain an economic significance value of 0.319, which indicates that the dependent variable increases by 0.319 if the standard deviation of the Off-Balance sheet items increases by one unit. This change does not seem to be as economically significant as the Securities Available for Sale which obtains a much larger value. As mentioned before it is important to notice that the coefficient of the Off-Balance items is positive which contradicts the hypothesis which assumes the opposite; however, as explained before this can be caused by the number of Mortgage Backed Securities on the Off-Balance sheet is not large enough to have a negative correlation with the dependent variable. This seems to be in line with Crotty's (2009) argumentation that many banks hold Mortgage Backed Securities themselves on their Balance Sheets as they have to comfort investors about the safety of Mortgage Backed Securities and some Mortgage Backed Securities also offer high yields which are attractive for banks to earn a high profit. Furthermore, the real estate and mortgage bank dummy obtains a economic significance -0.300 which is also not as high as the Securities Available for Sale value but still indicates a certain economic significance that real estate and mortgage banks tended to perform poor during the crisis. The remaining variables tend to

have a relatively low economic significance and therefore indicate not to have such a immense economic impact on the banks performance.

What also can be observed is the affect the combined individual variables have on the regression model as a whole. R-squared attempts to explain how well the individual variables explicate the variations in the data in relation to the dependent variable. Regression 1 inclines to show a relatively good explanation of the variation among the different variables of 39 percent. For the following regressions 2-6 various control variables are incorporated to control for differences and robustness. As expected R-squared tends to increase up to 50% in Regression 6, indicating that this regression model explains up to 50% of the variation of the data and how well the individual variables explain the dependent variable.

For this analysis we can conclude that indeed MBSs have a negative effect on the performance of banks. However, as outlined in the Data section several constraints were identified which cause limitations. Variables such as Securities Available for Sale, Securities Held till Maturity or Off-Balance Sheet items do not reflect only MBSs within the portfolio of a bank but also other items which do not play a significant role within our analysis but cannot be eliminated and therefore limit our analysis to obtain more accurate results. Moreover, the issue of multicollinearity has been observed during the regression analysis. In regression 5 and 6 Off-Balance Sheet items do not tend to be highly statistically significant anymore, which is caused by other individual and control variables. Multicollinearity refers to a regression analysis where multiple independent variables are added to the model and where some of these variables might cause the Beta of other variables to change and therefore affect the result (Nieuwenhuis, G., 2009). It has been endeavored to remove certain variables and include other ones to solve the problem of multicollinearity, however, in many cases it is difficult to completely eliminate this issue. The aim is to mitigate the problem of multicollinearity as good as possible and to obtain the most accurate results. In order to make the analysis more robust and accurate the following section will present another regression analysis to strengthen the hypothesis.

### *b. Impaired Loans(NPL) analysis and results*

As Loans play a significant role during the turmoil as already outlined in the previous sections a regression analysis is conducted to illustrate and analyze the effect of MBSs on Impaired Loans. As Impaired Loans are the origin of MBSs but MBSs were the financial instrument which triggered the increasing demand for issuing larger amount of mortgage loans the analysis will demonstrate if the hypothesis that an increase in MBSs also causes an increase in the number of Impaired Loans.

Table 3 illustrates 6 regression analyses making Impaired Loans the dependent variable and regressing it against the MBS variables outlined in the Data section and alternating individual as well as control variables. Regression 1 only includes the three main MBS variables and the Mortgage and real estate bank dummy variable. It can be observed that Securities Available for Sale and Off-Balance Sheet items have a positive and significant correlation with the dependent variable, indicating that an increasing number of securities offered by a bank as well as a larger number of off-balance sheet items lead to a larger number of impaired loans. The Beta for Securities Available for Sale of 0.004 indicates that an increase of 1 unit in Securities Available for Sale will increase the amount of impaired loans by 0.004 units, which does not demonstrate a very strong affect and the same holds for Off-Balance sheet items which have a Beta of 0.001. Securities Held till Maturity even tend to have a negative correlation towards the dependent variable indicating that an increase of 1 unit in Securities Held till Maturity will lead to a decrease of 0.025 in the number of Impaired Loans. However, this variable does not show a high statistical significance within the model as well as the Real Estate and Mortgage Bank dummy but tend to help to explain the model with an R-Squared of 43 percent. This strengthens our hypothesis and the results from the section IV.a., which illustrate similar findings on the effect of MBSs on the performance of banks.

The Following regressions illustrate a rather surprising result, as the Total Security and Total Asset variable are added Securities Available for Sale unexpectedly show a negative correlation towards the dependent variable but no high statistical significance anymore and neither does the Off-Balance Sheet item variable. The Total Security variable even contradicts the hypothesis that an increasing number of MBSs will increase the number of impaired loans as it shows a negative correlation towards the dependent variable and a high statistical significance. Total Assets on the other hand show a high statistical significance and a positive correlation towards impaired loans indicating that an increase in assets will increase the number of impaired loans. This suggests that larger banks with more assets were more prone to have an increasing number of Non-performing Loans. The models which include the Total Asset and Total Security variable tend to explain the model with a high certainty up to 90 percent as illustrated in regression 6. What also can be observed from the table is that when adding Total Assets and Total Securities to the regression Off-Balance sheet items and Securities Available for Sale become less statistically significant, furthermore, the correlation towards to the dependent variable shifts from positive to negative.

The analysis demonstrates that indeed the MBS variables have an effect on the number of loans which defaulted. However, as detected in the regression table certain variables such as Total Assets as well as Total Securities tend to have an impact on the hypothesis and results. At first regression 1 illustrates what proves the hypothesis to be correct. An increasing number of Securities for Sale as

well as Off-Balance Sheet items fueled the number of impaired loans to rise. However, the variables Total Assets and Total Securities decrease the significance of the Securities Available for Sale variable and cause it to be negatively correlated to the dependent variable. The same holds for Off-Balance Sheet items, which on the other hand continue to have a positive correlation towards the dependent variable but show a lower statistical significance. Here the problem of multicollinearity arises again and best explains the changes in the independent variables as in the previous regression analysis. To illustrate ones more, multicollinearity states that in a regression analysis where multiple independent variables are added to the model and where some of these variables might cause the Beta of other variables to change and therefore affect the result (Nieuwenhuis, G., 2009). It has been tested if the outcomes of the three main MBS variables have an effect on each other; however, this is not the case as all three variables are highly individually statistically significant towards the dependent variable. In this case the assumption is that Total Assets and Total Securities have changing effects on the variables Securities Available for Sale, Securities Held till Maturity and Off-Balance Sheet items.

Form an economic perspective this can be explained by the fact that a bank holds a large amount of other Securities within their portfolio than MBSs and the share of MBSs within the Total Securities of a bank might be too small to positively affect the number of impaired loans. It can be assumed nonetheless, that the share of MBSs within the portfolio of a bank was relatively large as the Beta of Total Securities is quite low with -0.009. However, the economic significance of most variables in this analysis seems to be relatively low. The Securities Available for Sale variable obtains values around 0.05, which gives the impression that in this regression with the defaulted loans as a dependent variable the economic relevance is not as present as in the bank performance analysis. The same counts for variables such as Off-Balance sheet items, Total Assets or Total Securities. This means that the economic significance these variables have on the number of defaulted loan variable is not very strong and does not seem to show that an increase in Mortgage Backed Securities in a bank's portfolio would lead to a strong increase in defaulted loans.

To conclude this analysis, the assumption that MBSs have an increasing effect on the number of impaired loan holds in regression one and the model explains the variation in the data to 43 percent. The following regressions show slightly different results even though the multicollinearity affect is taken into consideration which has an effect on the outcome but remains to explain the model and the data variation to 90 percent.

## V. Conclusion

Mortgage Backed Securities have proven ones more how financial instruments can have a large impact on the entire financial market and their affects when being used inappropriately. During the turmoil hundreds of banks have made use of this financial tool to increase their leverage and diversify the risk in order to enhance their growth. However, in the end this plan failed as banks began to misuse this tool and third parties were unable to screen and observe relevant information with regard to MBSs. This paper strived to demonstrate how Mortgage Backed Securities had a negative effect on bank performance during the banking turmoil as well as on the number of impaired loans. Banks continued to issue mortgage loans in order to transform them into MBSs and increase their leverage and liquidity. As the default rate of mortgage loans began to increase it made MBSs worthless and banks issued and invested in them began to perform poorly. As the results in this paper demonstrated MBSs had indeed an impact on the performance of banks and also on the number of impaired loans. However, some constraints were identified during this investigation and should give further research within this field a better idea on what has to be taken into consideration in order to obtain stronger results which illustrate the effect of MBSs on the bank performance during the financial turmoil.

## VI. Appendix

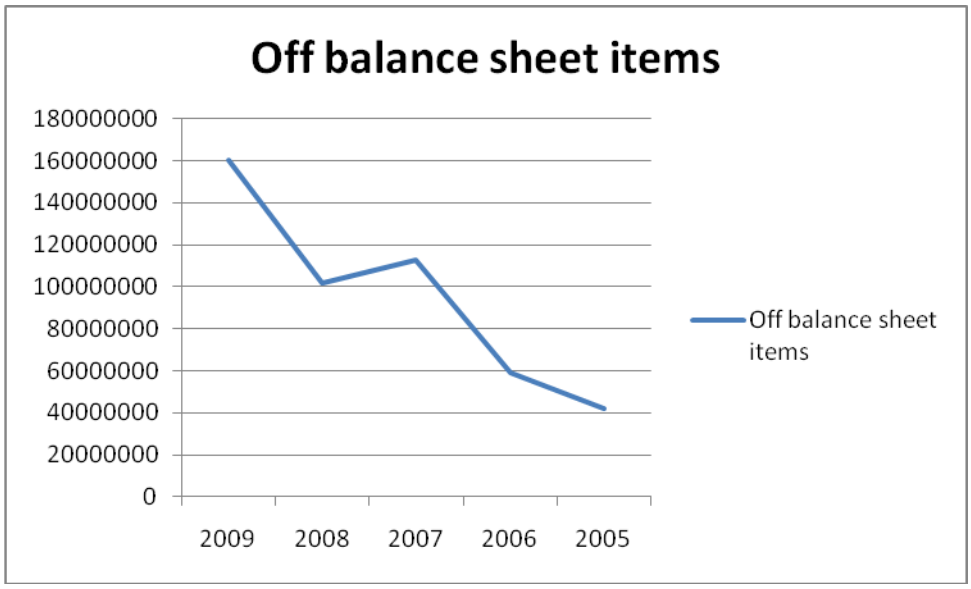


**Fig. 1** Trend of Off-Balance Sheet items. Off-Balance Sheet items are items which are not stated on the financial statements of a bank. The horizontal axis represents years and the vertical axis the number of off-balance sheet items. The Data has been obtained from Bankscope.

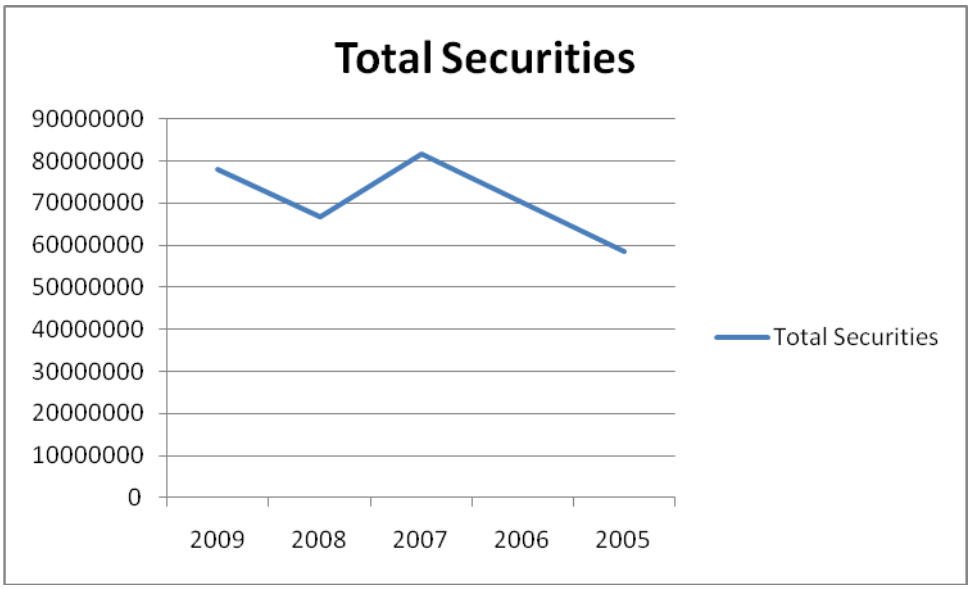


**Fig. 2** Trend of Total Securities. Total Securities are all the Securities in a banks portfolio. The horizontal axis represents the number of years and the vertical axis the number of Securities in th. US dollars. The Data has been obtained from Bankscope.


**Fig. 3** Trend of Securities Available for Sale. Securities Available for Sale are Securities a bank aims to sale before they reach maturity. The horizontal axis represents years and the vertical axis Securities Available for Sale in th. US dollars. Data has been obtained from Bankscope.

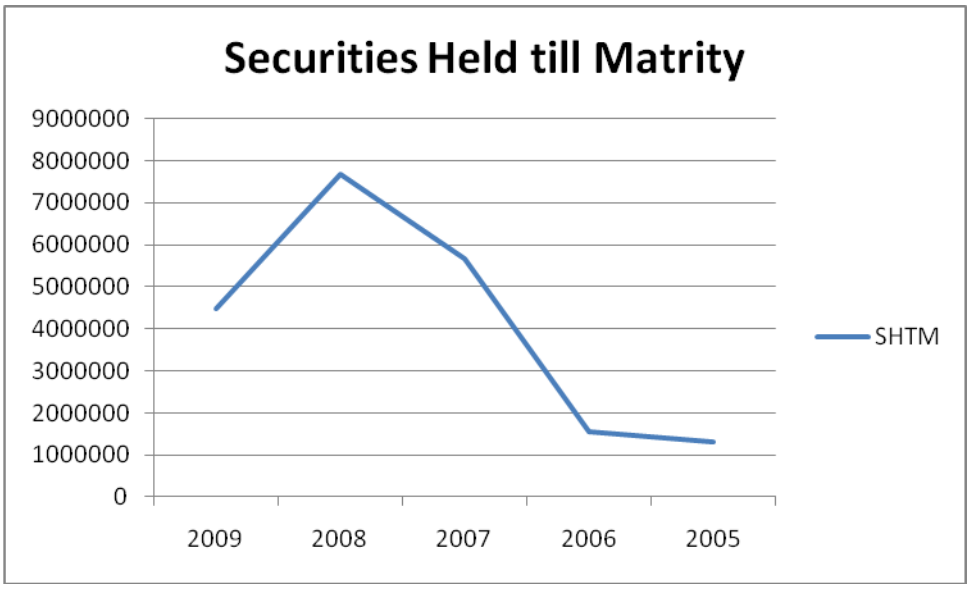


**Fig. 4** Trend of Securities Held till Maturity. Securities Held till Maturity are the securities a bank hold and they reach Maturity and expire. The horizontal axis represents years and the vertical axis the number of Securities held till maturity in th. US dollars. Data has been obtained from Bankscope.

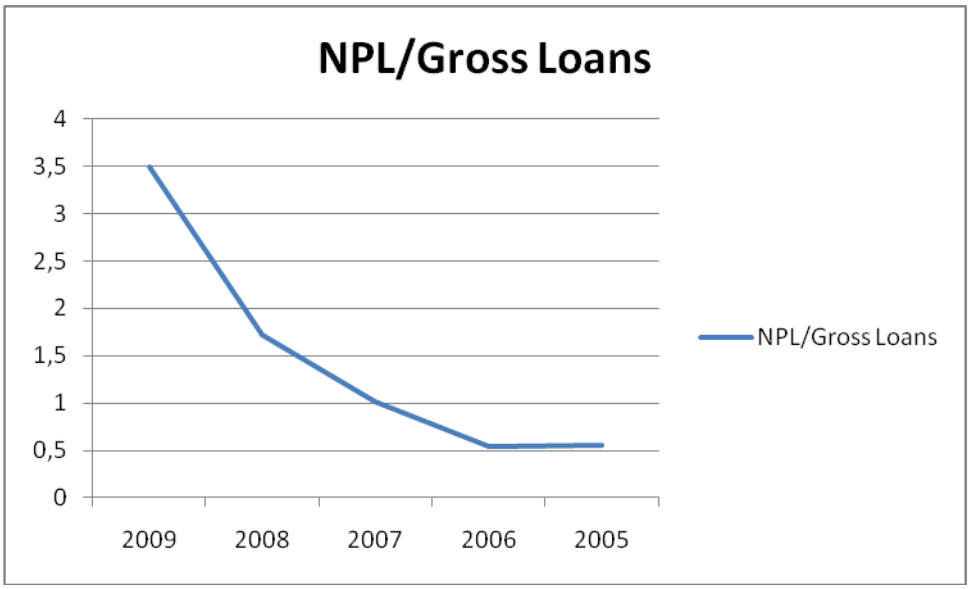


**Fig. 5** Trend of Non-Performing Loans over Gross Loans. The share of Non-Performing Loans or Impaired Loans over the Total number of Loans issued in percent. The horizontal axis represents years and the vertical axis the share of NPL over Gross Loans. Data was obtained from Bankscope.

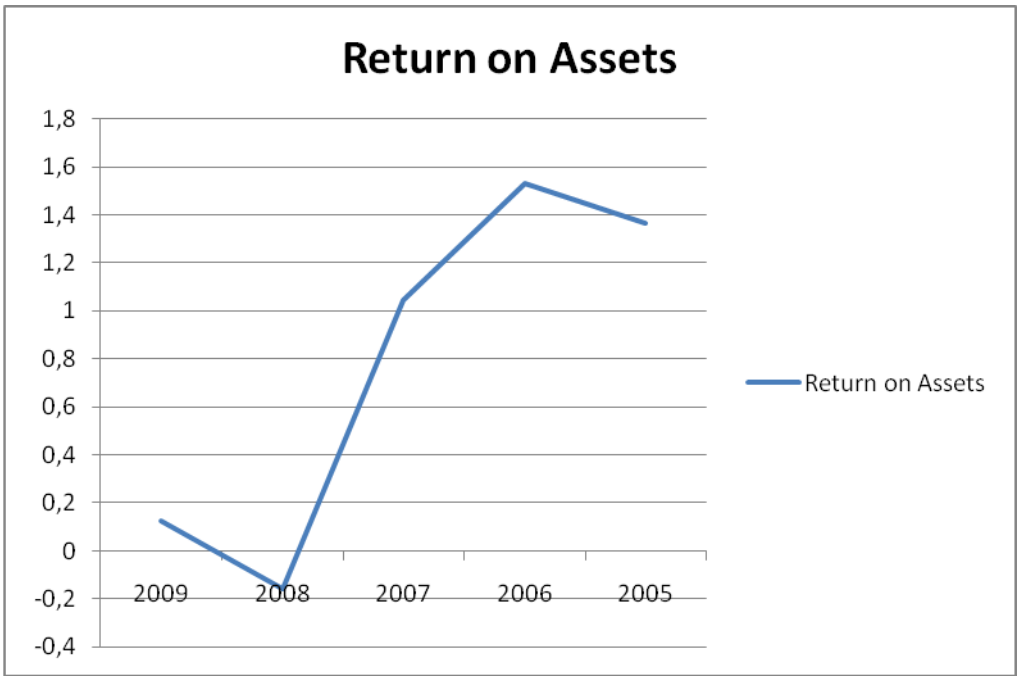


**Fig. 6** Trend of Return on Assets. The Return on Assets is a ratio in percentage dividing Net Income by Total Assets. The horizontal axis represents years and the vertical axis the Return on Assets on percent. The Data has been obtained by Bankscope.

**Correlations**

| Variable | Dummy4 | Dummy5 |
|---|---|---|
| **Return on Average Assets (ROAA) %** | -0.145* | -0.109 |

**Table 1:**

Correlation among bank dummys and Return on Average Assets.

Correlations between the variables Return on Average Assets (ROAA), dummy4 (real estate and Mortgage banks) and dummy 5 (bank holding/holding companies). *Return on Average Assets* is a ratio where Net income is divided by Total Assets to indicate the performance of a bank. The correlation between ROAA and dummy4 is -,145 and is significant at the 0.05 level. This demonstrates that the performance of Real Estate and Mortgage Banks declined over the given period and the significance interval illustrates that this relation is significant as it shows a 95% confidence of the given correlation. Dummy5 shows also a negative correlation of -,109 but no significance at the 0.01 or 0.05 level meaning they also had a negative performance during the time but do not seem to have a significant correlation with ROAA. * and **denote significance at 5% and 1% respectively.

| Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Log(Securities Held Till Maturity)** | -0.030 (0.056) | -0.016 (0.058) | -0.028 (0.057) | -0.025 (0.059) | -0.031 (0.061) | -0.012 (0.076) |
| **Log(Securities Available for Sale)** | -0.326** (0.122) | -0.150 (0.227) | -0.028** (0.057) | -0.325** (0.143) | -0.323** (0.146) | -0.423** (0.185) |
| **Log(Off-Balance Sheet Items)** | 0.104* (0.055) | 0.126** (0.060) | 0.113** (0.059) | 0.110* (0.060) | 0.099 (0.064) | 0.140 (0.089) |
| **DummySpec4** | -1.467** (0.686) | -1.212 (0.743) | -1.430** (0.706) | -1.464** (0.724) | -1.482** (0.741) | -2.881* (1.589) |
| **Log(Total Securities)** | | -0.202 (0.219) | | | | |
| **Total Securities** | | | -0.003 (0.000) | -0.004 (0.000) | -0.004 (0.000) | -0.002 (0.000) |
| **Non-Performing Loans (Impaired Loans)** | | | | -0.008 (0.000) | -0.008 (0.000) | -0.008 (0.000) |
| **Dummysta1** | | | | | 0.298 (0.468) | 0.293 (0.504) |
| **Log(Loan Loss Reserve/NPL)** | | | | | | -0.223 (0.225) |
| **N** | 375 | 375 | 375 | 375 | 375 | 375 |
| **$R^2$** | 0.392 | 0.424 | 0.403 | 0.417 | 0.434 | 0.500 |

**Table 2:**

The Return on Average Assets.

The dependent variable in columns 1-6 is *Return on Average Assets,* which is a measure to indicate bank performance. *Securities Held Till Maturity* is the natural logarithm of all Securities in a bank's portfolio held till maturity in th. US dollar. *Securities available for Sale* is the natural logarithm of all Securities offered by a bank for sale in th. US dollar. *Off-Balance Sheet Items* is the natural logarithm of items which are not stated on a bank's balance sheet. *DummySpec4* is a dummy variable which takes the value of 1 if the bank is a Real Estate or Mortgage Bank and 0 otherwise. *Total Securities* is the natural logarithm of the bank's Total Securities on its balance sheet in th. US dollar. *Total Securities* are all the securities on a bank's balance sheet divided by 1million in th. US dollar. *Non-Performing Loans (Impaired Loans)* are the number of defaulted loans in a bank's portfolio divided by 10000 in th. US dollar. *Dummysta1* is a dummy variable which takes the value of 1 if the bank is currently active and 0 otherwise. *Loan Loss Reserve/Non-Performing Loans* is the natural logarithm of the share of reserves for defaulted loans over defaulted loans in percent. All the stated variables were taken from Bankscope. Standard Errors are given in parentheses. *,** and *** indicate significance at 10%, 5% and 1% respectively.

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Securities Available for Sale** | 0.004* (0.003) | 0.000 (0.003) | 0.005** (0.003) | -0.001 (0.001) | -0.001 (0.001) | -0.001 (0.002) |
| **Securities Held Till Maturity** | -0.025 (0.026) | -0.040* (0.024) | -0.017 (0.027) | -0.020** (0.012) | -0.025** (0.013) | -0.025** (0.013) |
| **Off-Balance Sheet Items** | 0.100*** (0.000) | -0.100 (0.001) | 0.200*** (0.001) | 0.004 (0.000) | 0.003 (0.000) | -0.005 (0.000) |
| **Dummyspec4** | 254598 (755562) | 287263 (675987) | 113476 (763485) | -437504 (346018) | -293507 (493157) | -306704 (387250) |
| **Total Assets** | | 0.002*** (0.001) | | 0.005*** (0.000) | 0.005*** (0.000) | 0.005*** (0.001) |
| **Total Securities** | | | -0.002 (0.001) | -0.009*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) |
| **Dummyspec5** | | | | | 34121 (372262) | |
| **Dummysta3** | | | | | 332171 (280577) | 322512 (293626) |
| **N** | 375 | 375 | 375 | 375 | 375 | 375 |
| **$R^2$** | 0.425 | 0.555 | 0.447 | 0.893 | 0.898 | 0.900 |

**Table: 3**

Impaired Loans.

The dependent variable in columns 1-6 is *Impaired Loans*, which indicates the number of loans that defaulted in th. US dollar. *Securities available for Sale* are all Securities offered by a bank for sale in th. US dollar**.** *Securities Held TIll Maturity* are all Securities in a bank‘s portfolio held till maturity in th. US dollar. *Off-Balance Sheet Items* are items which are not stated on a bank‘s balance sheet divided by 100 in th. US dollar. *DummySpec4* is a dummy variable which takes the value of 1 if the bank is a Real Estate or Mortgage Bank and 0 otherwise. *Total Assets* are all Assets in a bank’s portfolio in th. US dollar**.** *Total Securities* are all the bank‘s Securities on its balance sheet in th. US dollar. *Dummyspec5* is a dummy variable taking the value of 1 if the bank is a holding/holding bank and 0 otherwise. *Dummysta3* is a dummy variable which takes the value of 1 if the bank went bankrupt and 0 otherwise. All the stated variables were taken from Bankscope. Standard Errors are given in parentheses. *,** and *** indicate significance at 10%, 5% and 1% respectively.

| Variable | Return on Average Assets % | Off-Balance Sheet items | Securities Held till Maturity | Impaired Loans/Gross Loans % | Securities Available for Sale | Total Securities |
|---|---|---|---|---|---|---|
| **Return on Average Assets %** | 1 | | | | | |
| **Off-Balance Sheet items** | 0.198* | 1 | | | | |
| **Securities Held till Maturity** | -0.088 | 0.161 | 1 | | | |
| **Impaired Loans/Gross Loans %** | -0.233** | -0.132 | -0.160 | 1 | | |
| **Securities Available for Sale** | -0.113 | 0.607** | -0.028 | 0.683** | 1 | |
| **Total Securities** | -0.056 | 0.794** | 0.142 | 0.302** | 0.695** | 1 |

**Table: 4**

Correlations among variables.

*Return on Average Assets* is a ratio where Net income is divided by Total Assets to indicate the performance of a bank by representing how much of the Net income is obtained from the Total amount of Assets a bank possesses. *Off-BalanceSheet Items* are items which are not listed on a bank's balance sheet. *Held to Maturity Securities* are Securities a bank possesses and aims to keep until the Security reaches maturity and expires. *Impaired Loans(NPL)/Gross Loans* is a ratio in percent indicating how many loans of all loans in a bank's portfolio are defaulting or non-performing loans. *Available for Sale Securities* are Securities which a bank aims to sell before they reach maturity. *Total Securities* are all securities in a bank's portfolio. * and **denote significance at 5% and 1% respectively.

| Variables | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| **Total Assets** | 227 | 6084356 | 2187631000 | 187000000 | 317800000 |
| **Net Loans/Total Assets %** | 187 | 0 | 99 | 54.11 | 26.351 |
| **Impaired Loans** | 153 | 0 | 16710000 | 941217 | 2150149 |
| **Securities Available for Sale** | 82 | 0 | 650766000 | 35375873 | 88437062 |
| **Total Securities** | 226 | 0 | 1028058000 | 81546713 | 166500000 |
| **Impaired Loans/Gross Loans %** | 153 | 0 | 21 | 1.01 | 1.958 |
| **Reserves for Impaired Loans/Impaired Loans%** | 138 | 1 | 816 | 192 | 184 |
| **NPL/Net Assets %** | 153 | 0 | 5.341 | 0.568 | 0.767 |
| **Securities Held till Maturity** | 57 | 0 | 151176000 | 5665845 | 20776895 |
| **Off-Balance Sheet items** | 123 | 0 | 1736070000 | 113000000 | 293800000 |
| **Return on Average Assets %** | 196 | -5 | 6 | 1.04 | 1.549 |
| **Loan Loss Reserve** | 161 | 100 | 16117000 | 1117362 | 2295909 |
| **Dummyspec1** | 375 | 0 | 1 | 0.309 | 0.463 |
| **Dummyspec2** | 375 | 0 | 1 | 0.093 | 0.291 |
| **Dummyspec3** | 375 | 0 | 1 | 0.053 | 0.225 |
| **Dummyspec4** | 375 | 0 | 1 | 0.043 | 0.202 |
| **Dummyspec5** | 375 | 0 | 1 | 0.328 | 0.470 |
| **Dummyspec6** | 375 | 0 | 1 | 0.069 | 0.254 |
| **Dummyspec7** | 375 | 0 | 1 | 0.005 | 0.073 |
| **Dummyspec0** | 375 | 0 | 1 | 0.099 | 0.299 |
| **Dummysta1** | 375 | 0 | 1 | 0.693 | 0.462 |
| **Dummysta2** | 375 | 0 | 1 | 0.229 | 0.421 |
| **Dummysta3** | 375 | 0 | 1 | 0.067 | 0.250 |
| **Dummysta4** | 375 | 0 | 1 | 0.005 | 0.073 |
| **Dummysta5** | 375 | 0 | 1 | 0.005 | 0.073 |

**Table: 5**

Summary statistics of bank and control variables.

*Total Assets* are all assets a bank has in its portfolio in th. US dollar. *Net Loans/Total Assets* is the share of all loans a bank issued over all its assets in its portfolio. *Impaired Loans* are defaulted or non-performing loans in th. US dollar. *Available for Sale Securities* are all securities a bank aims to sell before they reach maturity and expire in th. US dollar. *Total Securities* are all securities a bank has within its portfolio in th. US dollar. *Impaired Loans/Gross Loans* is the share in percent of defaulted loans in comparison with all the loans a bank issued. *Reserve for Impaired Loans/Impaired Loans* is the share in percent of how much of the reserve is used to compensate for the defaulted loans. *NPL/Net Assets* is the share in percent of the number of defaulted loans in comparison with the Net Assets of a bank. *Held Till Maturity Securities* are the Securities a banks aims to keep until they reach maturity and expire, in th. US dollar. *Off-balance Sheet Item* are items which are not on a bank's balance sheet in th. US dollar. *Return on Average Assets* is a ratio in percent indicating the Net income over Total Assets to assess the performance of a bank. *Loan Loss reserve* is a reserve a bank has within its portfolio in order to protect itself against defaulted loans and to cover for the losses. *Dummyspec1* is a dummy variable taking the value of 1 if the bank is commercial bank and 0 otherwise. *Dummyspec2* is a dummy variable taking the value of 1 if the bank is an investment bank and 0 otherwise. *Dummyspec3* is a dummy variable and takes the value of 1 if the bank is savings bank and 0 otherwise. *Dummyspec4* is a dummy variable and takes the value of 1 if the bank is a rel estate/mortgage bank and 0 otherwise. *Dummyspec5* is a dummy variable and takes the value of 1 if the bank is bank holding/holding company and 0 otherwise. *Dummyspec6* is a dummy variable and takes the value of 1 if the bank is a security bank and 0 otherwise. *Dummyspec7* is a dummy

variable and takes the value of 1 if the bank is an investment and trust corporation and 0 otherwise. *Dummyspec0* is a dummy variable and takes the value of 1 if the bank is any other bank than the ones already mentioned above and 0 otherwise. *Dummysta1*is a dummy variable and takes the value of 1 If the bank is still active until present and 0 otherwise. *Dummysta2* is a dummy variable and takes the value of 1 if the bank dissolved and 0 otherwise. *Dummyst3* is a dummy variable and takes the value of 1 if the bank bankrupt and 0 otherwise. *Dummysta4* is a dummy variable and take the value of 1 if the bank merged and 0 otherwise. *Dummysta5* is a dummy variable and takes the value of 1 if the bank has been or is currently in liquidation and 0 otherwise.

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