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RISK-RATIOS AND THEIR RELEVANCE FOR FINANCING REAL ESTATES

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Introduction

During the last and still ongoing financial crisis also known as Subprime Mortgage Crisis, triggered by a dramatic rise in mortgage delinquencies in the USA, more than 4 million US families lost their homes in cause of foreclosures. Another 4.5 million households are still (end of 2010) in a foreclosure process [1, p. xv]. The USA had nearly 2.8 million foreclosures in 2009 and estimated more than 3 million in 2010 [2]. Millions of people lost a lot of money at funds mostly with high speculative products but even with their pension funds. Huge former triple-A-rated banks as Lehmann Brothers had to declare their bankruptcy. Other banks got billions of taxpayers Dollars/Euros to survive as Citigroup or the two biggest U.S. mortgage banks Fannie Mae and Freddie Mac or they were nationalized as the German Hypo Real Estate Bank. Island and Greece got massive financial problems, which are leading them nearly to a governmental bankruptcy. Spain, Portugal and even big G8 countries as USA and Germany got into big troubles with their financial systems. All these things happened because U.S. credit grantors and credit users did not realized their real risks in financing real estates with subprime loans. In addition the securitization of the credit risks and the worldwide allocation of the products made this crunch, which was created in the USA, to an international crisis. In general, financial systems are characterized by ups and downs. The financial market is a permanent cyclical process. It is very important to take an early perception of signs of an economic slump, to avoid such giant and worldwide impacts on the economy of so many countries.

The aim of the paper is to reveal that poor risk management in the policies of lending money and of securitization of mortgages led doubtless to this disastrous situation. A verification for that assumption is e.g. that the Financial Crisis Inquiry Commission of the US Congress used inside "The Financial Crisis Inquiry Report" from January 2011 the word "RISK" for 1093 times [1]. Inside the paper there is an explanation of the risk term and the process of risk management. Especially the part measurement of risks is considered, because this is one leverage instrument for observing the risks of financing. The paper gives explanations to the following questions:

- How will the risks measured in financing today?
- How do perform the existing risk measurement tools?
- Which modifications are necessary and possible?
- Which changes will lead to which outcomes?

The aim of the paper is to reveal and to compare different approaches for risk-measurement because different situations need different models of risk measurement and "any model is only as good as its assumptions" [3, p. 31]. There will be displayed that one of the most important risk ratios the Value at Risk defaulted in its existing frame. Furthermore is shown, which outcomes can be reached by different changes of the Value at Risk variables as Loss Given Default (LGD), Probability of Default (PD) or the correlation factor ρ in loan portfolios. The VaR-approach will be compared with other risk management methods as Extreme Value Theory (EVT) or the Expected Shortfall (ES) approach.

Risk-Definition

The definition of the word "risk" can be very extensive because there are so many different kinds of risks. In the view of the topic "financing residential real estates" it is helpful to use the New Oxford American Dictionary, which defines "risk" as "*a situation involving exposure to danger*" or in economic terms "*the possibility of financial loss*". The notion of "risk" is coming from Italian noun "risco" (danger) or Italian verb "rischiare" (run into danger) [4]. Thus, the mean association to this word is negative. Risk-aversion is a normal behavior of anxiety in the human nature. Risk-management can handle these anxieties and can avoid risks. (See chapter: Risk-Management). Mostly there will be seen only the danger of losses without the chance and the opportunity of making profits, compare Maier [5, p. 3]. Jorion defines risk as "*the volatility of unexpected outcomes*" [6, p. 3]. Volatility is the negative and positive deviation from the statistical average. People and institutions can choose, how much risk they want to accept. There is common sense of the ratio between risk and return, as higher the expectations of returns as higher the risks that have to be accepted. Hui, Wang and Zheng use the term of "*risk appetite*" to describe the "*investors' tolerance for financial risks and willingness to bear uncertainty*" [7, p. 421]. Risk is described by the uncertainty of future events.

Types of Risks

As much possibilities of definitions of the word "risk" are existent as much types of risks are existent. To explain the kinds of risks is also dependent on the stakeholder of the risks. In the field of financing real estates the two main stakeholders are the lenders and the borrowers of the money.

Lenders as financial firms are concerned to two main types of risks: business and financial risks [6, p. 3]. **Business risks** are connected to activities of the corporation that means which products it makes or sells, which technologies it uses in which markets it operates and which risks it wants to carry for the main aim to create maximum added value for the share- and stakeholders. Strategic risks as part of business risks are connected to fundamental changes in the economical or political environment of the corporation e.g. the decision of Germany to stop the nuclear power production for concerned energy corporations or the break of economical connections to politically unstable regions for concerned firms. **Financial risks** can be classified into: Market risks, Credit risks, Liquidity risks and Operational risks. **Market risks** are those, which are linked to changes of the prizes of a category of products at the markets, in the case of real estate financing – the prizes of the real estates. The volatility of prizes is depending from the supply and demand of a product. If there are too much products/houses at

the market the prizes will decrease and vice versa, as happened during the subprime mortgage crisis of 2007/2008. Financial institutions use several variables of the markets e.g. prizes of shares, interest rates, exchange rates and so on to control the development at their business.

Credit risks are highly connected to the default risk of the borrowers in case of being unwilling or unable to repay a loan. Credit risk leads directly to losses for the financial institution because of replacing the expected cash flows from repayment. This kind of risks was the most important of all risks as trigger of the financial crisis. **Operational risks** pertain to firms by internal or external causes of interrupting the "normal" business operations. Internal causes can be failures of management or of technology systems, fraud (e.g. unapproved trading) or other human errors in trading, inadequately control mechanisms and many other organizational risks. External causes can be fraud as well by externals, natural catastrophes and others. The Basel Committee on Bank Supervision (BCBS) defined operational risk at the Basel II Accord as "*the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events … includes legal risk, but excludes strategic and reputational risk*" [8, p. 144]. Regulatory and Legal risks are belonging to the external part of the operational risks and they are those, which are set e.g. by political decisions, changes of regulations or laws e.g. of accounting standards, tax codes. Legal risks are also exposures to fines and penalties, resulting from judicial or governmental regulation authorities in case of breach of financial restrictions e.g. manipulation or insider trading. **Liquidity risks** are connected to the possibility of having enough liquid money for all liabilities and the daily business both in private or commercial sector. If a bank doesn't have enough liquidity the core business is in big trouble so as seen in the case of the British Northern Rock bank in the September 2007.

Borrowers of the money for real estates are concerned nearly to the same kinds of financial risks as liquidity risk, default risk and credit risks, with little modifications.

Their liquidity and default risk is reliant on their personnel situation of earnings and expenses. The credit risk of the debtors is also dependent on the kind of mortgage contract that they have. Fixed Rate Mortgages (FRM's) or Adjusted Rate Mortgages (ARM's) are possible. The FRM have the safety of a fix interest rate for the duration of the contract mostly long term 15 to 30 years. The interest rate of ARM's can and will change during the time of the contract. Often there is only a short time fix and a long time variable interest rate e.g. 2/28 means 2 years fix and 28 years of variable rates. The changing of interest rates can be an advantage or a disadvantage depending on the direction of change. The number of ARM's had a steep increase at the US market between 2001 and 2004 from 12% to 34% see [9, p. 33]. The 2008 default rate of subprime ARM's was 33.4% vs. 3.0% of prime FRM's see [9, p. 91]. Connected to the theme of the dissertation project the main risks that are concerned to financing real estates are at least always the financial risks both for credit lenders as for credit borrowers.

Risk-Management

The aim of risk-management should be to organize a situation for borrowers and lenders in which they are comfortable with their risks of financing. The main tasks of risk-management are the diagnosis of the recent and future risks and the decision of which risks are acceptable or which risks have to be managed by the organization [10, p. 2]. Risk-management is no longer a voluntary practice for enterprises since the Accords of the Basel

Committee on Banking Supervision (BCBS) are fixed in governmental laws or regulations such as the International Financial Reporting Standards (IFRS) and not at least at the codes of Corporate Governance or the 2002 Sarbanes-Oxley-Act at the USA. The Basel II Accord requires at the side of the internationally active banks a minimum capital for managing worst-case situations. This required capital is the sum of the credit risk, operational risk and market risk related amount [8, p. 5].

Irrespective the legal determinations risk management is a necessary tool for corporations to react quickly on the permanently changing market conditions as e.g. share-values, interest rates or exchange rates. Risk-management is a row of processes (shown at the Figure 1), which contains risk-identification, risk-measurement and analysis, risk-handling and risk-controlling. These processes are running dynamically. At the beginning of the risk-management process the financial corporation has to identify, which types of risks are close to it. The next step is to measure and analyze the outcomes of the risk. At the end of these two stages the enterprise knows its risks and the financial value of the vulnerability. The next process is to decide how to handle the risks. It has to be made a strategy, which instruments should treat the risks. Depending on the risk aversion of the corporation there are different methods to minimize or to avoid the risks, but there will not be a complete risk avoidance without the minimization or elimination of returns too, see [5, p. 3]. Afterwards the kind of risk handling is defined the realization of the strategy has to be organized, done and controlled. Risk management is basically a necessary tool for moneylenders but some of the following processes are useful for borrowers, too.

Risk-Identification **Types of Risks**	**Risk-Measurement** **Risk-Analysis** **Business Ratios**	**Risk-Handling** **Instruments**	**Risk-Controlling** **Organization**
• Credit Risks • Market Risks • Operational Risks • Liquidity Risks • Legal Risks	• Expected Loss • Worst Loss • Volatility • Value at Risk • RaRoC	• Prevention • Limitation • Compensation • Diversification	• Planning • Control • PDCA • Information

Figure 1. Process of Risk-Management

Source: own in adaption to Wolke, [11, p. 4]

Inside this paper there will be explained more in detail only Risk-Identification and the Risk-Measurement-Process for the case of financing private real estates in USA and Germany.

Risk-Identification

The task of the risk identification is to allocate the types of risks and their dangers or chances for the enterprise. In the case of financial institutions that are lending money and giving mortgages for real estates the main types of risks are as mentioned before market, financial especially credit risks and operational risks. The main risk and the **trigger of the financial crisis from 2008 was the credit default risk**. The extreme delinquency rate of US American credit

borrowers with subprime loans (to see at Figure 2) initialized a chain reaction at the system of the second mortgage market, where the mortgages were securitized and bundled into Collateralized Debt Obligations (CDO). The breakdown of this CDO-market was followed by the crash of giant financial institutions as Bear Stearns or Lehman Brothers and a led to a world wide financial crisis. CDO's are a part of the derivative market. Derivatives were originated as an instrument to shift the risk from debts (see chapter risk compensation). They have developed themselves to a much higher risk than the original risk from the mortgages before. CDO's have shifted the default risk from the originator banks to the investment banks, which were holding the CDO's and the risks now without the possibility to be shifted or minimized again. The following Figure 2 shows the market situations and the developing of home-prizes at the USA between 1988 and 2011.

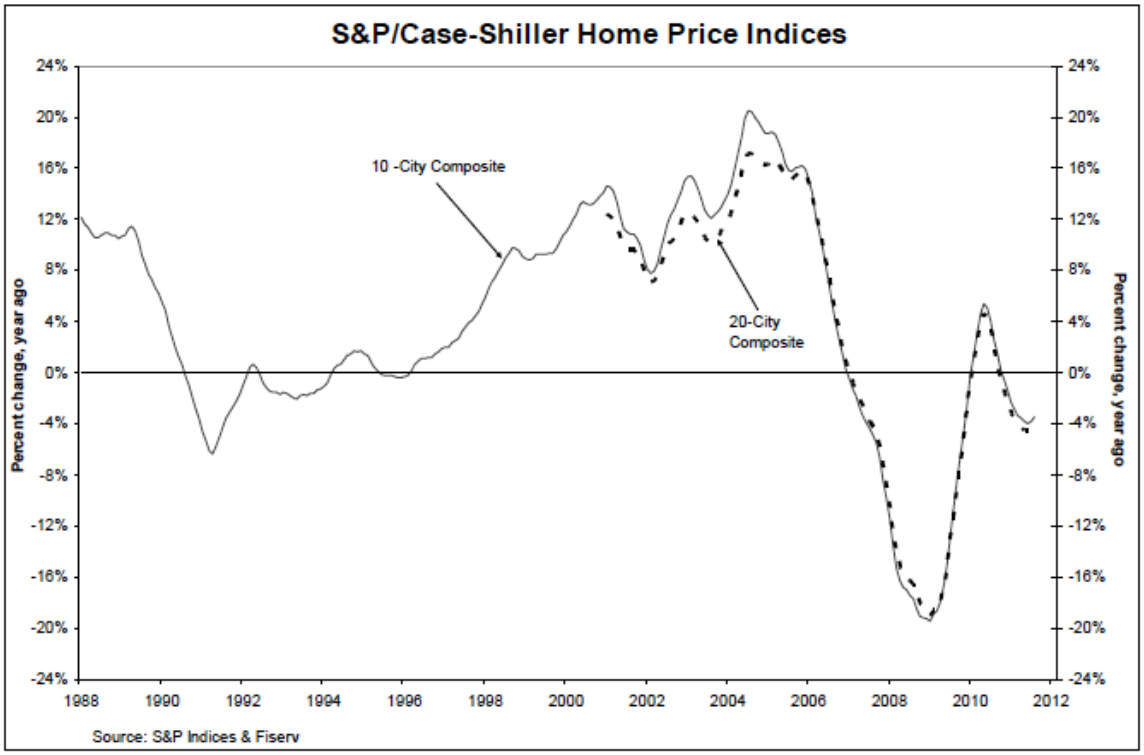

Figure 2. Standard & Poor's / Case-Shiller Home Price Index

Source: S&P Indices & Fiserv 2011

It is visible that the peak of the house prizes in USA was around 2005 and that there was definitely a downsize of the prizes since 2006. But the "machine" of unregulated selling of mortgages and their securitization was running further this way until autumn of 2008 until Lehman crashed! Then in 2009 was reached the bottom.

Figure 3 shows the same house selling market at same time but in Germany. You can see also a very "bullish" market with a steep increase of housing prizes but starting first in 2006, when the American market was already "bearish" and on the way down.

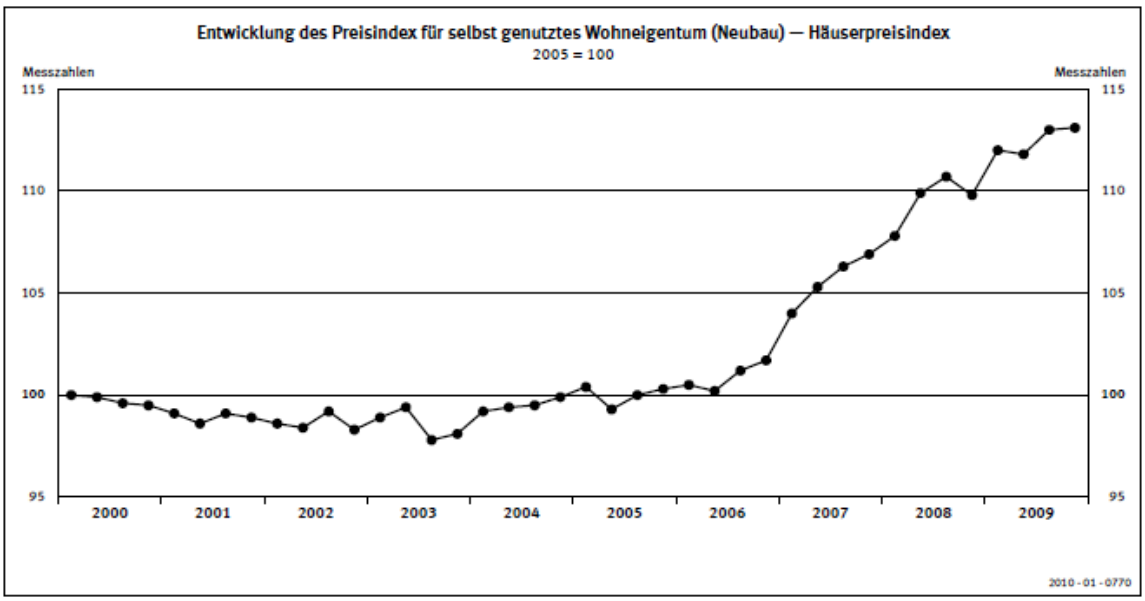

Figure 3. Development of Prizes for self-used Homes in Germany (2000-2009)

Source: Statistisches Bundesamt, Wirtschaft und Statistik, 10/2010, 939 p.

As mentioned before the Figure 4 shows the Delinquency Rates and the Rates of Mortgage Originations. You can see as that the purchase as well as the refinance rate increased until 2005 and had a decrease after that point. Same result as seen at Figure 2.

Item	1990	2000	2004	2005	2006	2007	2008	2009	2010
MORTGAGE ORIGINATIONS									
Total (bil. dol.)	**459**	**1,139**	**2,773**	**2,908**	**2,726**	**2,306**	**1,509**	**1,995**	**1,572**
Purchase (bil. dol.)	389	905	1,309	1,512	1,399	1,140	731	664	473
Refinance (bil. dol.)	70	234	1,463	1,397	1,326	1,166	777	1,331	1,099
DELINQUENCY RATES [1]									
Total	**4.7**	**4.4**	**4.5**	**4.5**	**4.6**	**5.4**	**6.9**	**9.4**	**9.3**
Prime conventional loans	(NA)	2.3	2.3	2.3	2.4	2.9	4.3	6.5	6.5
Subprime conventional loans	(NA)	11.9	10.8	10.8	12.3	15.6	19.9	25.5	25.9
Federal Housing Administration loans	6.7	9.1	12.2	12.5	12.7	12.7	13.0	14.0	12.8
Veterans Administration loans	6.3	6.8	7.3	7.0	6.7	6.4	7.2	7.9	7.5

Figure 4. USA Mortgage Originations and Delinquency Rates 1990 to 2010

Source: US Census Bureau, Statistical Abstract of the United States 2012, 743 p.

Further on you can see, that after 2005 the delinquency rate had a steep increase in total from 4.5% in 2005 up to 9.4% in 2009 and especially the delinquency rate of subprime mortgages increased from "normal" around 11% in 2005 up to 26% in 2010. At same time the German total mortgage Delinquencies Rates are very stable on a value around 2.5% much deeper than at the American market at "normal" times (see Table 1).

Table 1

German Delinquency Rates 2006 to 2010

	2006	2007	2008	2009	2010
Total (%)	2.4	2.5	2.5	2.4	2.5

Source: own with data from SCHUFA, Kreditkompass 2011, 60 p.

After identification of risks there follows the measurement and analysis of the risks. This process is a core process of risk-management and it is essential to further decisions in what ways the risks should be treated.

Risk-Measurement

After identification of risks there follows the measurement and analysis of the risks. This process is a core process of risk-management and it is essential to further decisions in what ways the risks should be handled. Only things that are measured can be analyzed and if need be changed analog to "What gets measured gets managed (or gets done)" by Peter Drucker. Risk-measurement can be divided into quantitative and qualitative approaches. Qualitative methods are the determination of scorings or ratings.

Quantitative methods are based on the determination of risk ratios. These are discovered by measurement of countable data of financing and using these data at stochastic equations to describe the risks. There are simple Quantitative Risk-Ratios as the Expected Loss and there is a second part of more complex risk ratios as Worst Case Loss, Unexpected Loss, Variance, Volatility or Value at Risk (VaR). Duffie and Singleton discussed the primary focus for financial institutions and warn for extreme losses as e.g. the Unexpected Losses (UL) as a significant ratio for insolvency [12, p. 13]. The main ratio for risk measurement of financial institutions is the Value at Risk and the Value at Risk approach. The Basel Accords also require that ratio for the determination of needed economical capital for the three main risks (financial, market and operational risks).

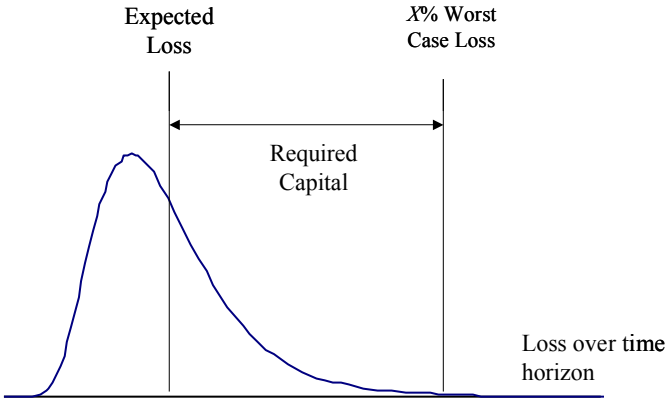

Figure 5. Distribution of Credit Losses

Source: [10, p. 280]

The EAD (Exposure at Default) is the monetary amount of outstanding debts. LGD (Loss Given Default) is the percentage of money that is lost in case of default of the credit counterparty. It is the difference 1 minus Recovery Rate (RR) what is that part of the loan, which is repaid already, see E-1. The Expected Loss (EL) of a portfolio of loans can be estimated as the weighted sum of all possible losses (EADi*LGDi), each weighted by its probability of default (PDi). It represents the average or the mean of losses (μ) see E-2. The amount of the expected loss is predictable and will be prized into the interest rate of a loan. The Worst Case Loss (WCL) is the highest default during a time period, which will not be exceeded at a specified level of confidence, see E-3. The WCL varies with the Worst Case Default Rate (WCDR), which depends from the correlation ρ between the assets of the portfolio and their probability of default PD, see E-4. The Unexpected Loss (UL) is that amount of money that defaults outside of the confidence level of the PD. The Basel II Accord requires capital reserves for the amount of that Unexpected Loss, which is determined as the difference amount between Worst Case Loss and Expected Loss, see E-5. One cause for this is, that the value of UL is mostly much higher than the value of EL, compare with Figure 5. The next ratio that can be computed is the variance, which is defined as the weighted sum of squared deviations around the mean, see E-6. The volatility is the ratio of the standard deviation around the mean and will be calculated from the variance. The volatility as a worldwide-accepted ratio for risk measurement is a necessary instrument to evaluate shares and portfolios of credits, see E-7. The Value at Risk (VAR) is that expected maximum amount of money, which could be lost during a target time horizon (T) and with a given confidence (c), see E-8. Basel Committee requires for credit risks: Time is one year and Confidence is 99.9%. The confidence is the base for determination of factor α. As higher the confidence level as higher the VAR. The J.P. Morgan Bank New York created the VAR-Model in 1994. Value at risk is today the standard tool in risk management for banks and other financial institutions as well as for regulation authorities. A disadvantage of the VAR is that the VAR is not useful for extreme situations as i.e. the massive default of subprime loans, which do not reflect the VAR assumption of a normal distribution [6, p. 543]. Advantages of VAR are: easy to use, easy to understand and it can be back or stress tested. The VAR-model has to be adapted immediately for such extreme situations with the assumption of higher default rates. The VAR-approach is used for standard deviations with normal tails. For extreme situations it is better to use the Extrem Value Theory (EVT) or so called fat tail method or Expected Shortfall. The EVT can show the amount of losses behind the confidence level of the VAR, that means which lost is possible when confidence level will be exceeded. EVT is not so easy to calculate and to understand as the VAR-method and there is no possibility for backtesting. Another method is the Mark-to-Market-Approach. It uses the standard deviation and probability of default for calculating of the possible default rates. In the appendix is an excel calculation which shows a comparison of VAR-calculation with different variables and the Mark-to-Market-Model. Possible changing variables can be the Probability of Default (PD), the correlation factor (R) of the loan portfolio and the Loss Given Default (LGD). The PD is taken by the values of census bureaus in US and Germany. The correlation factor is normally 0.15 for loans with real estates and the LGD is given and fixed by the CreditMetrics calculation with 48.87%. The situation at USA showed that even if the portfolio is diversified by mixing loans from East and West the correlation factor was to low if there is a worstcase situation crosses the whole USA. An increasing of the PD-variable increases the VAR too. This

changing has a higher outcome than change of LGD by same factor. Possible is also a mix of both increasings to get a higher security. If you take the Mark-to-Market-Model you have no possibility of changing other variable than PD but these is given by historical data. So you can't adopt this model with the new situation.

Qualitative methods as **Scorings of Borrowers** are a worldwide used aid to evaluate the quality of the credit buyer and the quality of the property that should be financed. The financial and social capability of borrowers and their credit worthiness will be investigated as well as the value of the property by an appraisal. The determined score is necessary for decisions i.e. of the amount of a loan or the interest rate and further to categorize the quality of the credit. It is a very subjective method but a good and necessary addition to the more objective quantitative methods of evaluating risks of the credit counterpart. The qualitative measurement with scoring-models is not only an addition but also a requirement for quantitative evaluations [11, p. 66]. To get a score the financial institution has to define attributes, which count the spread of valuation by numbers and their weight for the whole system. Standard attributes are personnel credit worthiness, which depends on financial status, willingness to pay, liquid capital, job situation, kind and amount of securities, credit card and former credit stories, consumer behavior, payment patterns and many more. In the field of financing real estates further attributes are those from the real estates as macro and micro location and market factors, value of the real estate and the loan to value ratio (LTV). The sense of scoring is to reduce the credit default risks for lenders.

By scoring they get information of their clients and this increases the trust to the clients or not, depending on the information. The United States and Canada use the Credit Bureau Scores also known as FICO scores, which were developed by the Fair Isaac Corporation (FICO) in 1956. The range of points is from 300 to 850. Scores below 650 are so called sub primes. Their number increases from 2001 to 2005 from 7.8 to 21.3% see [9, p. 49]. The scoring will be made at the USA by credit agencies as i.e. Equifax or TransUnion. In Germany banks get credit worthiness information of the credit borrowers by SCHUFA the German credit agency, which was founded in 1927. To do that, SCHUFA and the banks change information permanently. SCHUFA has 479 million data sets from 66.2 million people [13]. SCHUFA gives a scoring of a person, which consists of points (max. 1000), a rating class: A, B, C… (A is best) and a percentage of the probability of credit default PD (low is best).

Scorings of Lenders: Financial institutions are subject to a scoring as well as their credit clients. These scorings are not as relevant for the borrowers of private credits as for other banks, financial institutions and insurances because if a bank wants to lend money by another bank or if a bank wants to sell loans, derivatives or other products to other financial or insurance institutions the counterparties want to have this scoring information of the bank and of the product. The score depends on the obligor's capacity to meet its financial commitment, on its business, financial and economic conditions. Scorings for financial institutions reach from AAA, AA, and A… to D (AAA is best). The evaluation and determination will be made in the USA by credit agencies: S&P (Standard and Poor's), Fitch Ratings or Moody's Investor Service.

Risk – Analysis

The risk analysis is the next step following after risk measurement. The analysis and the further decision process depend at first of the risk awareness of the financial institution. This

can reach from total risk avers to adventurous or risk seeking, compared to Wolke [11, p. 67]. The corporation should differentiate their risks into maybe three categories (critical, fundamental and unimportant) reliant on the danger of the measured risks and the risk awareness. This phase is necessary to prepare the decision of how to handle the identified and measured risks and expected revenues.

Risk – Handling

To handle the risks there are many different possibilities. This paper explains four main instruments of them: risk limitation, risk diversification, risk prevention and risk compensation.

Risk limitation is a process to avoid market risks by setting limits to shrink the VAR value of the corporation. Limits at financial positions can be: stop-loss-limits, sensitivity limits, nominal limits or scenario limits. **Risk diversification** is a process to use the effect of shrinking the risk by putting low- or uncorrelated assets into a portfolio. By this way the portfolio VAR is smaller than the sum of each VAR. This is the system of the so-called portfolio theory from Markovitz, created in 1952. The originator banks made diversifications of risk by putting mortgages with different ratings and from different locations into a portfolio to diversify the default risk and sold this portfolio as CDO to investment banks. This kind of diversification worked good for long time with commercial loans, because there were historical data for stochastic computations available. The problem with real estate mortgages was that really a lot subprime mortgages from nearly all locations defaulted. This problem could not be calculated before because there were not enough historical data of subprime mortgage defaults available. **Risk prevention** is an activity, which it used to increase the equity capital resources or the economic capital. A few banks hold a higher amount of economic capital than the Basel Committee requires being better prepared to outcomes of risky occasions. Risk prevention is at first the control of the credit worthiness of the clients. **Risk compensation** can be made by using derivative products or insurance products to decrease the primary risk position. Derivatives are instruments as forwards, futures, options or swaps whose values are dependent on future market conditions of underlying assets.

Risk compensation with derivatives is a market instrument since the eighties of the twenties century. Insurance products are available for lenders and borrowers of credits as well. Products for lenders should reduce operational or credit risks and can be also derivatives. Products for credit borrowers are mostly life insurances.

Risk Controlling

As every business − the risk management has to be under control. Risk controlling is a process of planning and control of risks. Measurement and analysis is the base on which the planning of risk handling can be done. The control of the actual with the target risk values and the analysis of differences is a further step. Another function of controlling is to give the collected data to the management / board of the corporation for further decisions and as a base to realize their liability of information as this is required by regulations for corporate governance as well. The other risk management processes defaulted as well as did the risk controlling process. But this is more dramatic because controlling should avoid such risky developments and make interventions if needed.

Conclusions for Risk Management

The Subprime mortgage crisis was a result of that what happens if there is an immense failing of risk management. All four phases, which were described before did not work. At first the risks with subprime loans were not identified effective. With the knowledge of this crisis the financial institutions are able to make better **Risk Identifications**. The loosing of the diligence to check borrowers' credit worthiness is a further massive fault. It is not only a question of fairness to sell such unchecked mortgages but also a question of fraud and should be corrected directly. Doing this, the investment banks have an enhanced chance to analyze their risk. One security to avoid such trade could be a rule, which requires that up to 30% of all mortgage tranches should stay property of the originator banks. Professor Hull made a recommendation of 20% see [10, p. 411]. **Measurement and Analysis** have to be improved as well. One problem with quantitative measurement of the credit value of risk ratio defaulted because of missing historical data of defaults from subprime mortgages. This can be changed now with actual data. The big financial institutions as J.P. Morgan or CitiGroup, which are experts of measuring credit risk [14, p. 238] and the financial science should think about adaption of existing or creation of new models for risk measurement. Another possibility is to change the value of the used variables. The security amount of money at the banks can be increased by an increase of portfolio correlation factor or the Loss Given Default. The treatment of the risks went terrible wrong because even if financial institutions as CitiGroup realized that the situation has the possibility of great losses they let run the business because of massive returns with these CDO products [15, p. xii]. When house-prizes were falling and default rates were rapidly increasing the situation went catastrophic. Thus alike CitiGroup many other big players were hit by massive losses with their CDO's. Recommendations for the field of **Risk Handling** are at first risk prevention by increasing of checking borrowers before giving a loan. This decreases directly the credit risks for all stakeholders. The supervision of the real estate market is also a basic thing for banks to manage the number of credits in view of avoiding further real estate bubbles. Credit originators should significantly decrease the number of the subprime ARM's. More transparency and a better information infrastructure will increase the confidence to and the reputation of the banks as well as increasing of fairness. Prof. Shiller wrote at "The Subprime Solution" that banks have the responsibility to inform their clients about their risks with credits and further on he requires that public education should *"promote comprehensive financial advice for everyone"* [16, p. 123]. The governments should think about change of regulation of the financial especially the second mortgage market. This is really a rigid suggestion because it reduces a part of free financial markets but the banks got lot of taxpayer's money to survive and the state should have the public concern that this situation will not repeat again.

A further advice is to change the short-term revenue orientated payment of bank staff into a long term to increase the long-term results.

Risk Controlling went wrong on sides of all stakeholders beginning at the borrowers following by the internal and external controlling of financial institutions and further on at the governmental side. Regulation authorities made huge faults in controlling the banks business in the field of the second mortgage market with securitization of real estate loans. Instruments to control the risks were given with the Basel Accords even before the crisis of 2007/2009. So,

why did not the existing risk management methods avoid this crisis? Explanations can be found in the science of financial behavior. Aspects like Moral Hazard, attributes as greed or psychological effects of the stock exchange and other financial markets are driver for financial decisions. Regulation authorities have to control financial institutions strictly on the background of the Basel Accords.

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Appendix 1

Risk-Management-Ratios

$$LGD = (1 - RR) \quad \text{(E-1)}$$

$$EL = EAD * LGD * PD \quad \text{(E-2)}$$

$$WCL = EAD * LGD * WCDR \quad \text{(E-3)}$$

$$WCDR = N * \left(\frac{N^{-1} * (PD) + \sqrt{\rho} * N^{-1} * (0.999)}{\sqrt{1-\rho}} \right) \quad \text{(E-4)}$$

$$UL = WCL - EL = EAD * LDG * (WCDR - PD) \quad \text{(E-5)}$$

$$V(X) = \sigma^2 = \sum_{i=1}^{n} (x_i - \mu_i)^2 * PD_i \quad \text{(E-6)}$$

$$SD(X) = \sigma = \sqrt{V(X)} = \sqrt{\sum_{i=1}^{n} (x_i - \mu_i)^2 * PD_i} \quad \text{(E-7)}$$

$$VAR = EAD * (\alpha * \sigma * \sqrt{T} - \mu * T) \quad \text{(E-8)}$$

Appendix 2

Unexpected Losses with VAR and Mark-to-Market-Model