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CEO compensation and risk-taking:

Evidence from the US banking industry

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Abstract

This study examines the influence of CEO compensation on risk in the US banking industry for the period 1993-2016. Both the effect of the CEO's cash-based incentive compensation and equity-based compensation on risk-taking and the effect of the financial crisis on the relationship between CEO compensation and risk-taking is researched.

This study focuses on two types of CEO compensation, both measured in relative weight to total compensation and in total dollar value. The first type is the variable CEO cash-based incentive compensation consisting of bonuses, long-term incentive plans and other non-equity incentives, but without fixed salary. The second type of CEO compensation used in this paper is CEO equity-based compensation, consisting of stock-options and restricted stock grants. Bank risk-taking is measured in five different ways. One accounting-based measure: the Z-score. And four market-based measures: Total risk, Systematic risk, Idiosyncratic risk and Systemic risk.

The results show a negative relation between CEO cash-based incentive compensation and bank risk. These findings hold when using different measures of CEO cash-based incentive compensation and are robust using different risk-estimators. These findings are consistent with previous literature, suggesting that increasing CEO cash bonuses lower the default risk of a bank. Relative CEO equity-based compensation also shows a negative relationship with bank risk. Only in the regressions with Total risk and Idiosyncratic risk as the dependent variable, the coefficient is statistically significant. When the total dollar value of equity-based compensation is considered, this effect is also perceivable, but only in the regression with the Z-score as the dependent variable the coefficient is statistically significant. The regressions using a pre and post-crisis period suggest there is no difference in impact of CEO compensation between the two periods.

Contents

1. Introduction

The recent global financial crisis of 2007-2008 resulted in a worldwide debate about executive compensation in the financial sector. Many scholars, regulators and others believe that executive compensation has encouraged excessive risk-taking in the financial industry (among others Bhagat & Bolton, 2014). These beliefs have led firms and regulators to reform managerial compensation schemes in order to prevent future excesses. In 2010 the American government implemented the Dodd-Frank Act, which introduced several restrictions in order to end excessive risk-taking in the financial industry.[1] However, not everyone believes that executive compensation encouraged excessive risk-taking. They argue that the failure to perceive risks and excessive optimism which are not driven by executive compensation, are the reasons behind the excessive risk-taking decisions of managers (Fahlenbrach & Stulz, 2009; and Murphy, 2009).

In the aftermath of the financial crisis many scholars have researched the influence of executive compensation on risk-taking in the financial industry. Most researchers found evidence that equity-based compensation in the form of restricted stock and stock-options indeed increased bank risk (e.g. Mehran and Rosenberg, 2009; and Bebchuk, Cohen & Spamann, 2010). However, most studies focus only on the effect of equity-based compensation on risk-taking, neglecting the role of cash-based compensation. The researchers that did study the effect of cash-based compensation on risk-taking in the financial industry found a negative relationship. Balachandran, Kogut and Harnal (2010) found evidence that equity-based compensation increases the probability of default, however, non-equity compensation (i.e. cash bonuses) decreases it. Vallascas and Hagendorff (2013) found evidence that an increase in the CEO's cash bonus lowers the bank's default risk.

Although much has been written about the relationship between executive compensation and risk-taking in the financial industry, most studies neglect the role of cash-based incentive compensation, while CEO compensation consists for a large amount of this variable cash-based incentive compensation. Therefore, the main focus of this paper is to examine the effect of CEO cash-based incentive compensation on bank risk. First, this paper tries to contribute to the existing literature by using not only a pre-crisis period, but also including a post-crisis period. Second, instead of using the probability to default used by Vallascas and Hagendorff (2013) and Balachandran et al. (2010), five different estimators for risk-taking are used to test the effect of

[1] the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010

CEO cash-based incentive compensation on risk-taking. These five estimators are proxies for Total risk, Systematic risk, Idiosyncratic risk, Systemic risk and a Z-score.

The research question tried to be answered in this thesis is: *What is the effect of CEO cash-based incentive compensation on risk-taking in the banking industry?* In addition to this main research question, two sub-questions are posed. To get a clear understanding of the effect of CEO compensation, also the effect of equity-based compensation is tested and the difference in effect between cash-based incentive compensation and equity-based compensation is examined. Therefore, the first sub-question is: *What is the difference between the effect of the CEO's cash-based incentive compensation and equity-based compensation on bank risk?* The second sub-question considers the effect of the financial crisis. The crisis changed the economic and regulatory environment for financial firms. For example, Congress passed the Dodd-Frank Act of 2010, which includes several executive compensation requirements. The second sub-question is: *What is the effect of the financial crisis on the relationship between CEO compensation and bank risk?* Because CEO compensation is not the only (possible) driver of bank risk several control variables are included.

In order to answer the research questions a new database is constructed, covering the years 1993 through 2016. Five different measures of bank risk are used. The first measure is total risk measured as the annualized volatility of daily stock returns. The advantage of using stock volatility is in the fact that this measure uses market-based data instead of accounting-based data (Laeven & Levine, 2009). The second risk measure is the stock's beta, which is a proxy for systematic risk. The third risk measure is the standard deviation of the residuals from the market model, which captures the idiosyncratic or firm-specific risk. The fourth risk measure is the Marginal Expected Shortfall (MES) and is a proxy for systemic risk. The MES is firstly introduced by Achary, Santos, and Yorulmazer (2009). The MES measures the return for an individual bank when the market as a whole is performing poorly. The last measure used in this paper is the Z-score for each bank first introduced by Roy (1952). The Z-score is a widely used bank risk measure (e.g. Leaven & Levine, 2009 and Brown, Jha & Pacharn, 2015). The Z-score is inversely related to the probability of insolvency, therefore a higher Z-score means more bank stability (Laeven & Levine, 2009).

Further, four independent variables of CEO compensation will be constructed. The first one is the total amount of the CEO's cash-based incentive compensation in dollar value, consisting of bonuses, long-term incentive plans and non equity-based incentives, but without fixed salary.

The second one captures the relative importance of cash-based incentive compensation, calculated as the ratio of the CEO cash-based incentive compensation to total compensation. To measure the effect of equity-based compensation on bank risk, the total CEO equity-based compensation in dollar value, consisting of stock-awards and stock-options, is used in this paper. Last, the ratio of equity-based compensation to total compensation is used. To prevent an omitted variable bias, controls for bank level and CEO characteristics will be used in this paper. The following bank characteristics are used as control variables: bank size and leverage. The CEO characteristics that will be controlled for are: CEO age, CEO tenure, and CEO gender. In addition, there will be controlled for unobserved CEO heterogeneity using fixed effects. To control for time-series trend, year dummies are included in all regressions.

The CEO compensation data and CEO characteristics are obtained from the Execucomp database. Accounting data of the bank is obtained from the Compustat Bank database. Stock data is extracted from The Center for Research in Security Prices (CRSP) database. All these databases are accessed via Wharton Research Data Services (WRDS).

The results show statistically significant negative relations between Relative cash-based incentive compensation and Total risk, Systematic risk and Idiosyncratic risk. When Total cash-based incentive compensation is used as the independent variable of interest, also negative relations with the bank risk measures are found. These results are consistent with the view CEO cash-based incentive compensation lowers the risk-taking behavior of CEOs, because bonus payments depend on the bank's solvency. Relative equity-based compensation also has a negative relationship with bank risk. This negative relationship is also perceivable when Total equity-based compensation is considered, but only in the regression with the Z-score as the dependent variable the coefficient is statistically significant. These findings are not in line with the view that incentives induced by equity-based compensation increase risk-taking by banks. The effect of the financial crisis is estimated by using a pre-crisis and a post-crisis period. The results do not suggest that the financial crisis affects the relationship between CEO compensation and bank risk.

Finally, the endogeneity problem that instead of CEO compensation affecting bank risk, bank risk affects profit and therefore the amount that the CEO gets compensated in bonuses, is addressed. A two-stage least square model with two instrumental variables is used to handle this reverse causality problem. Past performance in the form of return on assets is the first instrument used in the two-stage least square model. Based on past performance banks award their CEOs with

cash bonuses and equity-based compensation. However, there is no clear reason for the presence of a relationship between past performance and bank risk, other than the effect through CEO compensation or the control variables (Armstrong & Vashishtha, 2012). The second instrument is a dummy variable that proxies for the bank's marginal tax rate. If expected future tax rates are higher it becomes more favorable to use deferred compensation to offset future tax deductions (Core & Guay, 1999). Therefore the use of stock-based compensation is less costly for firms with low marginal tax rates (Core & Guay, 1999). Other than through CEO compensation the bank's marginal tax rate is unlikely to affect the bank's risk-taking. The results of the instrumental variable regressions with Relative cash-based incentive compensation and Relative equity-based compensation support the hypothesis that the instruments are valid instruments. The instrumental variable regressions show a negative relationship between Relative cash-based incentive compensation and bank risk. Also a negative relationship between Relative equity-based compensation and bank risk is perceivable. The findings suggest that causality is present between CEO compensation and bank risk. However, the results of the instrumental variable regression with Total cash-based incentive compensation do not support the hypothesis that the instruments are valid. Although the results support the hypothesis that the instruments are valid when Total equity-based compensation is considered, the coefficients are not statistically significant.

The rest of the thesis is organized as follows. In chapter 2 the current literature and hypothesis are discussed. In chapter 3, the methodology and variables are explained. In chapter 4, the data sample and the descriptive statisitics are discussed. In chapter 5, the results of the regressions are presented. In chapter 6, a conclusion based on the findings is given.

2. Literature review

In the years prior to the financial crisis equity-based compensation for executives in the form of stock and stock-options has seen rapid growth (Murphy, 1998; Perry & Zenner, 2000). The justification for this increase finds its base in the widely discussed paper of Jensen and Meckling (1976). They argued that the relationship between the stockholders and the CEO of a company is a pure agency relationship. The problems associated with the separation of ownership and control in the modern company is associated with the general problem of agency. There is a conflict of interest between the management and the shareholders of a company. The management, acting as the agent, is supposed to make wealth increasing decisions for the principal, in this case the shareholders. However, the actions of a manager are not perfectly observable. It's often hard to judge for shareholders which of these actions are wealth increasing and which not (Jensen & Murphy, 1990). On top of that, managers are – unlike diversified shareholders – risk averse, because of their organization-specific human capital and undiversified wealth portfolios (Amihud & Lev, 1981). It is not always in the best interest of the management of a company to make wealth increasing decisions if they are not rewarded for this. Therefore, in order to align the CEOs wealth more with the value of the company, firms tend to design a compensation policy that give managers incentives to select and implement wealth-increasing actions. There are many different wealth-increasing incentives that can be used in CEOs compensation policies, including performance-based bonuses and salary incentives, stock options, and performance-based dismissal decisions (Jensen & Murphy, 1990). However, Bebchuk and Spamann (2010) argue that executives aligned with the shareholders through equity-based compensation have incentive to take on risky activities which are beyond efficient, because they do not bear losses that this risk-taking behavior has on other stakeholders of the bank (e.g. debt holders). Hence, executive compensation could lead to excessive risk-taking.

Since the start of financial crisis in 2007, more attention has been paid to the role of CEO compensation in the financial industry (e.g. Belkhir & Chazi, 2010; Balachandran et. al., 2010; Hagendorff & Vallascas, 2011; Bhagat & Bolton, 2014). Many scholars have blamed incentives induced by CEO compensation for the cause of this financial crisis. However, the findings in the literature are not unambiguous. Bhagat and Bolton (2014) find a positive relation between CEO equity-based compensation and risk, supporting what they call *The Managerial Incentives Hypothesis* that incentives induced by a managerial compensation program would lead to

excessive risk-taking by banks. This excessive risk-taking would benefit bank managers at the expense of long-term shareholders. Projects that led to excessive risk-taking had a negative net present value. They reject their hypothesis which they refer to as the *Unforeseen Risk Hypothesis*: Bank managers did their work honorably, but the poor performance of their banks during the crisis was not foreseeable. Chen, Steiner, and Whyte (2006) examined the effect of stock option-based compensation in a pre-crisis period. Their results also support a management risk-taking hypothesis, rejecting their *Risk Aversion Hypothesis*. That is rejecting the idea that bank risk decreases as equity-based compensation increases, because the CEO's personal portfolio becomes less diversified when equity-based compensation of a CEO increases. Therefore making the CEO more risk averse and more likely to follow a mitigating risk strategy. Bolton, Mehran and Shapiro (2015) argued that executive compensation programs that provide incentives to maximize shareholders wealth have led to excessive risk-taking, especially in levered firms. The value of the stock in a levered firm can be seen as a call option and increases with the volatility of the assets held by the firm. This is in particular troublesome for financial institutions: while the average non-financial firm has about 35% debt, financial institutions have about 90% debt. Raviv and Sisli-Ciamarra (2013) argue that the state of the economy influences the relationship between equity-based compensation and risk-taking in the financial industry. They show that the executive's optimal choice during a systemic crisis is to target lower levels of asset risk. On the other side, they show that when the economy is far from a systemic crisis the same executive with the same level of equity-based compensation would optimally aim for a higher risk level.

However, as stated earlier, not all studies support the Managerial Incentives Hypothesis, which states that the composition of executive pay results in excessive risk-taking behavior. Houston and James (1995) found little evidence that the compensation in the banking industry is structured to encourage excessive risk-taking. They conclude that compensation policies in the banking industry do not necessarily provide incentives to engage in risky activities. Therefore the moral hazard problem may not be that severe in the banking industry. However, instead of examining the impact of equity-based compensation across banks, they focused on comparing the compensation structure of financial firms to the compensation structure of industrial firms. Fahlenbrach and Stulz (2011) analyzed the US banking industry for the year 2006, and found no evidence for the statement that either stock-option based compensation or cash bonuses have led to excessive risk-taking in the financial industry and argue therefore that executive compensation

cannot be blamed for the financial crisis. They come to their conclusion because they find no evidence that banks with higher CEO stock-option or cash-based incentive compensation performed worse during the crisis. CEOs did not reduce their holdings in anticipation of the crisis, therefore suffering large wealth losses.

However, as most of the literature supports the view that CEO equity-based compensation induce risk-taking in the banking industry, the following hypothesis is stated:

> *Hypothesis 1: CEO equity-based compensation is positively related to risk-taking in the US banking industry.*

Most studies focus on excessive risk-taking induced by CEO equity-based compensation, neglecting the fact that a large portion of CEO compensation consists of cash-based incentive compensation. Cash-based incentive compensation is potentially less risky, because it is based on historically derived results instead of forward looking market values (Barclay, Gode & Kothari, 2005). After the cash-based incentive compensation has been awarded, the CEO cannot influence the value of this compensation. In contrast, the CEO can influence the value of equity-based compensation. The CEO can increase the value of the stock-options and restricted stock by taking on more risks. Therefore, CEO cash-based incentive compensation can play a mitigating role to prevent risk-shifting incentives induced by equity-based compensation.

Vallascas and Hagendorff (2013) pose three hypotheses in their paper about the effect of cash-based incentive compensation on bank risk. The first hypothesis suggests that cash bonuses have no effect on risk-taking. In contrast to stock options, there is no convex payoff in the cash bonus scheme. Cash bonuses are earned after meeting an earning based target over a one year period. After exceeding this threshold, the CEO's bonus increases in performance until the maximum amount is met (Murphy, 2000). So this should not promote excessive risk taking. (Vallascas & Hagendorff, 2013). The second hypothesis suggests that rather than having no effect, increasing CEO cash bonuses can in fact lower the default risk of a bank. Because bonus payments depend on the bank's solvency, they lower the risk-taking behavior of CEOs (Vallascas & Hagendorff, 2013). The last hypothesis suggests that cash bonuses encourage excessive risk-taking. The first assumption for this hypothesis is that CEOs are not sufficiently exposed to downside risks and are therefore being rewarded for taking more risk to achieve the performance

goals (Vallascas & Hagendorff, 2013). The second assumption is that, by relating cash bonus payments to annual performance targets, shareholders design these bonuses to affect short-term behavior and CEOs will therefore engage in riskier activities to achieve these short-term targets (Vallascas & Hagendorff, 2013). In their study, Vallascas and Hagendorff (2013), found evidence for the risk-reducing view that CEO cash bonuses lower the default risk of banks. They also found that this effect disappears when the bank moves closer to the default point, suggesting that financially distressed banks try to maximize the value of their financial safety net. Balachandran et al. (2010) used the financial crisis like a type of stress test experiment to determine the relation between executive compensation and the probability of default in the financial industry for the period 1995-2008. Their results indicate that equity-based compensation increases the probability of default, but non-equity compensation decreases it. Based on the described literature, the following hypothesis is posed:

> *Hypothesis 2: CEO cash-based incentive compensation is negatively related to risk-taking in the US banking industry.*

Since the start of the financial crisis executive compensation has been subject to legislative and regulatory scrutiny, especially in the financial industry. In 2008 the US government introduced the Troubled Asset Relief Program (TARP), a program to strengthen the financial sector by funding financial firms. To qualify for this program participating firms were required to meet several compensation criteria. This criteria includes: limits on the level of pay, reducing the risk-taking incentives induced by executive pay, the requirement to claw back any bonus or incentive compensation paid on statements of earnings later to be proven inaccurately, and the prohibition of the use of any golden parachute. In 2010 the US congress passed the Dodd-Frank Act, which is primarily aimed at updating the existing regulation on executive compensation and corporate governance in order to promote financial stability. The Dodd-Frank includes several executive compensation requirements. These requirements include say-on-pay, which means a non-binding vote by shareholders of publicly traded firms to approve or disapprove the executive compensation program of the firm. Also disclosure requirements are updated. Companies are required to disclose the ratio of the compensation of its CEO to the median of its employees. Also disclosure is required

about the role of, and potential conflicts involving, compensation consultants. The aim of these regulations is to reduce the risk-taking effect of compensation schemes.

It also conceivable that since the financial crisis banks are more conscious about the influence of CEO compensation on risk-taking and therefore introduced themselves regulation to reduce this risk-taking. Therefore, the following and last hypothesis is stated.

Hypothesis 3: After the financial crisis the impact of CEO compensation on risk-taking in the US banking industry decreased.

3. Model and variables

In this section, the model used to test the effect of CEO compensation on bank risk in the US banking industry is described. Further, the different dependent, independent and control variables that are used in this thesis are explained. Additionally, the explanation why these variables are being used, as well as a clarification on how these variables are calculated is given.

3.1 Empirical Model

Testing the model using different tests, including an F-test, the Lagrange-Multiplier test (Breusch and Pagan, 1980) and the Hausmann-test (Park, 2011) results in the conclusion that a fixed-effect model is the best fit. The model is also tested for heteroscedasticity with White's General Test for Heteroscedasticity. Heteroscedasticity seems to be present and therefore cluster robust standard errors will be used in the analyses. Further, to control for the influence of time-series trends year fixed effects are also included in the model.

The following model will be used to test the effect of CEO cash-based incentive compensation and equity-based compensation on risk-taking in the banking industry:

$$\begin{aligned} Risk_{i,t} = {} & \alpha_i + \beta_1 * CEO\ cash\ based\ incentive\ compensation_{i,t-1} \\ & + \beta_2 * CEO\ equity\ based\ \ compensation_{i,t-1} + \beta_3 * Bank\ size_{i,t-1} \\ & + \beta_4 * Leverage_{i,t-1} + \beta_5 * CEO\ age\ _{i,t-1} + \beta_6 * CEO\ tenure_{i,t-1} \\ & + \beta_7 * CEO\ gender_{i,t-1} + Year\ dummy + \varepsilon_{i,t} \end{aligned}$$

Where i stands for bank, t for time, α_i is the unknown intercept for each bank and $\varepsilon_{i,t}$ is the error term. The following descriptions are used to define the different variables:

Risk	Dependent variable, one of the five estimated risk-proxies, including: Total risk, Idiosyncratic risk, Systematic risk, Systemic risk and the Z-score;
CEO cash-based incentive compensation	The main independent variable, one of the following two measures of CEO cash-based incentive compensation: The Relative cash-based incentive compensation or Total cash-based incentive compensation;

CEO equity-based compensation	Independent variable, one of the following two measures of CEO equity-based compensation: The Relative equity-based compensation or Total equity-based compenstion;
Control variables	
Bank size	The natural logarithm of total assets;
Leverage	The leverage-ratio, total debt divided by total assets;
CEO age	The CEO's age;
CEO tenure	The number of years the CEO has been in office;
CEO gender	A dummy variable that has the value 1 when the CEO is a male, and 0 otherwise;
Year dummy	A dummy variable included for all years of the sample.

3.2 Definition of variables

For the dependent variable different measures of risk-taking will be used. Consistent with Brown et al. (2015) the first three risk measures are conventional market-based measures for risk-taking, including the standard deviation of stock returns, the standard deviation of the residuals from the market model, and the stock's beta. These measures proxy respectively for total risk, idiosyncratic risk and systematic risk. The advantage of using these proxies for risk-taking is the fact that they are market-based– not accounting-based – proxies (Laeven & Levine, 2009). The first measure of risk-taking in this paper is the stock volatility. Stock volatility has been used as a proxy for bank risk-taking in several previous studies (Coles, Daniel, & Naveen, 2006; Mehran & Rosenberg, 2007). Stock volatility is the annualized standard deviation of daily stock returns. The second risk measure is the standard deviation of the residuals from the market model, which captures the firm-specific or idiosyncratic risk. Following Brown et al. (2015), this risk measure is obtained using the following two-factor market model commonly used in the literature (see for instance Chen et al. 2006; Belkhir and Chazi 2010 and Brown et al. 2015) and is estimated using daily data from CRSP database for each year:

$$R_j = \alpha + \beta_{mj} R_m + \beta_{ij} I + u_j$$

Where R_j is the firm's daily stock return, R_m is the daily market return on the CRSP value weighted index, I is the daily three-month T-bill yield, obtained from the Federal Bank of St. Louis, and u_j

is the error term. Idiosyncratic risk σ_{uj} is the standard deviation of the residuals u_j. The third risk measure is the stock's beta β_{mj}, which is a proxy for systematic risk and is also calculated using the above two-factor market model (Brown et al. 2015). Stock beta is also a widely used proxy for bank risk-taking (e.g. Chen et al. 2006 and Brown et al. 2015). If the beta is greater than 1 it indicates that the stock price is more volatile than the market, and vice versa.

The fourth risk measure is the bank's systemic risk exposure. Systemic risk can be defined as the risk of a complete collapse or failure of the financial industry (Achary et al., 2009). The systemic risk exposure of an individual bank can be measured by the Marginal Expected Shortfall (MES) firstly introduced by Acharya, Pedersen, Philippon, & Richardson (2010). It measures the average return of the individual financial firm for the 5% worst days of the value-weighted market return (Acharya et al. 2010). The following model is used to calculate the MES.

$$\mathrm{MES}_{\mathrm{i,t}} = -E\left(r_{i,t+1} \middle| I_{5\%}\right)$$

Where $r_{i,t+1}$ is the daily stock return of the individual bank and $I_{5\%}$ can be defined as the 5% worst market outcomes at daily frequency. The MES measures the return for an individual bank when the market as a whole is performing poorly.

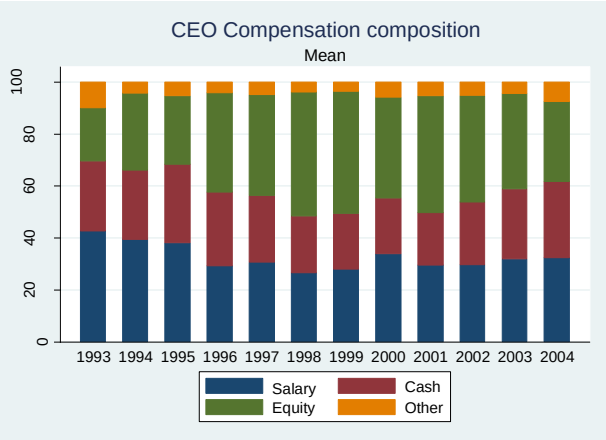
The fifth and last measure of bank risk-taking is the Z-score for each bank. The Z-score is a widely used proxy for bank risk in the recent literature (Brown, Jha, & Pacharn, 2015; Laeven & Levine, 2009) and firstly introduced by Roy (1952). The Z-score is a measurement for the distance to insolvency (Brown et al. 2015). A firm is insolvent when the firm's losses exceed its equity. Therefore, the probability of insolvency can be defined as the probability that the negative of the bank's return on assets (ROA) is smaller than the capital asset ratio (CAR). The Z-score is inversely related to the probability of insolvency (Brown et al. 2015); i.e. a higher Z-score means a more bank stability (Laeven & Levine, Bank governance, regulation and risk-taking, 2009). Under the assumption that profits are normally distributed, consistent with Laeven & Levine (2009) the Z-score is calculated as follows:

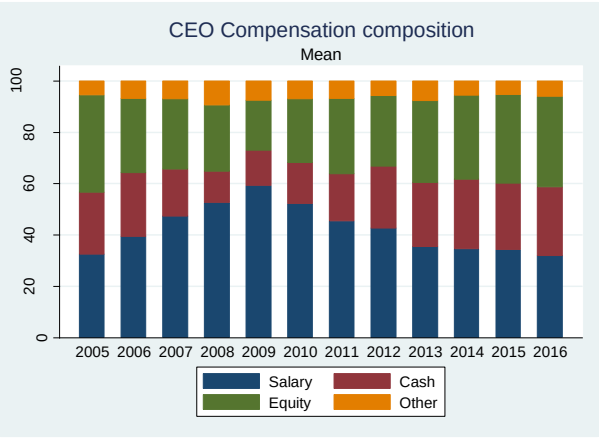
$$Z - score = ln\left(\frac{ROA + CAR}{\sigma(ROA)}\right)$$

Where $\sigma(ROA)$ is the standard deviation of ROA. The natural logarithm of the Z-score is used, because the Z-score is highly skewed (Laeven & Levine, 2009). In the rest of the paper, if referred to the Z-score, the logged Z-score is meant.

The annual compensation of executives is composed out of several components. This includes a base salary, non-equity based incentive compensation (including annual cash bonuses tied to accounting performance and compensation from the company's long-term incentive plan (LITP)), equity-based compensation (including stock options and restricted stock plans) and other compensation (including pension contributions and healthcare benefits) (Balachandran et al. 2010). The base salary is a fixed pay and the preference pay for risk-averse executives (Murphy, 1999). Non-equity incentives are typically rewarded annually based on one year objectives. Non-equity incentives can also be rewarded based on longer-term incentive plans, like LTIPs, that span multiple years and have multiple targets (Balachandran et al. 2010). Non-equity compensation using accounting based information, focuses on measures that are more related to the actions of managers. In contrast, equity-based compensation also reacts to other factors, such as interest rates and macro-economic trends (Barclay et al., 2005). Equity-based compensation consists of stock-options and restricted stock. Both usually carry a vesting period during which the stock options cannot be executed and the restricted stock cannot be sold. Normally, the vesting period is three to five years (Balachandran et al. 2010). Figure 1 and 2 illustrate the relative importance of the different components of CEO compensation.

Figures 1 and 2





The main focus in this paper is to test the effect of cash-based incentive compensation on risk-taking. Secondly, the difference in effects between cash-based incentive compensation and equity-based compensation on risk-taking is being researched. Consistent with Balachandran et al. (2010), to measure the effect of cash-based incentive compensation on risk-taking two variables are constructed. The first variable used in this paper is Total cash compenstion, which is the total dollar value of the CEO's cash-based incentive compensation. The following formula is used to calculate Total cash-based incentive compensation.

$$\text{Total cash-based incentive compensation} = \text{Bonus} + \text{LTIP} + \text{Non-equity Incentives}$$

Where Bonus is the dollar value of annual cash bonus earned by the CEO during the fiscal year, LTIP is the dollar amount paid out in longterm incentive plans, and non equity-based incentives is the amounts earned during the year in non-equity incentive plans. The second variable captures the relative importance of cash bonuses, which is the ratio of CEO cash-based incentive compensation to total compensation. Relative cash-based incentive compensation is the Total cash-based incentive compensation divided by the Total compensation.

To measure the effect of equity-based compensation on bank risk, again consistent with Balachandran et al. (2010), two variables are constructed. The first variable is Total equity-based compensation, which is the total dollar value of the CEO's equity-based compensatation and is calculated using the following formula.

$$\text{Total equity-based compensation} = \text{stock-awards} + \text{stock-options}$$

Where, stock-awards is the value of stock-related awards (including restricted stock and phantom stock), and stock-options is the value of option-related awards. The second variable used, is Relative equity-based compensation, a ratio of equity-based compensation to total compensation and captures the relative importance of equity-based compensation.

This research will control for numerous bank level and executive characteristics to prevent an omitted variable bias. Larger firms are likely to be less risky relative to smaller banks, because larger banks have more opportunities to diversify in products and operations, resulting in a more constant cash flow, and therefore reducing the risk of the bank. (Chen et al., 2006). However, a

different view is that bank size contributes to risk. Large banks tend to engage in riskier activites and have more short-term debt, making them more vulnarable to liquidity shocks and market failures (Laeven, Ratnovski, & Tong 2016). Another view is that large banks engaging in multiple activities suffer from increased agency problems and poor corporate governance resulting in more systematic risk (Laeven et al. 2016). A last argument why larger banks are more likely to engage in risky activities is because of the implicit government guarantee to 'bail out' financial institutions in near default (Balachandran et al. 2010). Therefore, the benefits of increasing risk goes to the shareholders and top managers, while the downside costs are borne by the government as insurer of deposits if the bank is in default (Bebchuk & Spamann, 2010). In light of this, there will be controlled for bank size. The following formula is used to calculate bank size.

$$\text{Bank size} = \ln(\text{total assets})$$

Where total assets refers to the total assets owned by the bank.

The second bank characteristic which is being controllled for is leverage. An increase in leverage is expected to increase the bank's risk-taking (Bolton et al., 2015). The gains of risky investments generally go to the shareholders and holders of stock options. Losses however, are also borne by preferred stockholders, bondholders, depositors and tax-payers (Bebchuk & Spamann (2010). When the executive's pay is aligned with the interest of shareholders through stocks and stock-options, he has an incentive to engage in (even inefficient) risky investments, because he does not internalize the adverse effects that risk-taking has on other stakeholders. The following formula is used to calculate leverage.

$$\text{Leverage} = \frac{\text{long term debt} + \text{short term debt}}{\text{total assets}}$$

Where Leverage refers to the leverage ratio, which defines the total amount of debt relative to the total amount of assets.

Different CEO characteristics could have an effect on bank risk. One important characteristic that could influence bank risk is the CEO's age. Previous studies have found that older CEOs are more likely to be risk-averse than their younger counterparts (Serfling, 2014;

Sigler, 2015). Prendergast and Stole (1996) argued that younger CEOs take on more risk in order to signal the market of their superior abilities. Older CEOs are more likely to be entrenched and have shorter horizons and therefore will be more risk-averse (Dechow & Sloan, 1991). However, some studies find opposite results and find evidence that younger CEOs are more risk-averse than older CEOs (Scharfstein & Stein, 1990 and Holmstrom, 1999). Younger CEOs would be more risk-averse, because they risk to be more critically judged for bad decisions. This could potentially reduce their future career opportunities (Scharfstein & Stein, 1990 and Holmstrom, 1999).

The second executive characteristic which will be controlled for is CEO tenure. CEO tenure measures the number of years the CEO has been in office. It is likely that an executive's internal governance mechanism grows as he remains in office for a longer period of time (Belkhir & Chazi, 2010). Various prior studies have used the length of CEO tenure as a measure of CEO entrenchment (e.g. Belkhir & Chazi, 2010). Coles, Daniel, & Naveen (2006) found that CEO tenure is significantly negatively related to firm risk. Berger, Ofek, & Yermack (1997) argue that CEOs with longer tenures and higher cash-based incentive compensation are more likely to be entrenched and therefore will be more risk-averse. Belkhir and Chazi (2010) argue that an entrenched CEO would prefer a compensation scheme with low incentive to take on risk. Because this would increase the likelihood of a default and therefore threatens the executive's job. However, Belkhir and Chazi (2010) argue, that on the other hand, a longer tenure could indicate more managerial skill or quality rather than entrenchment. These CEOs are possibly more willing to undertake more risks, because they have the skills to generate a positive outcome. Their compensation plan could be designed in a way it is highly sensitive to risk. Chen and Zheng (2012) found a positive relation between CEO tenure and risk-taking. They argue that declining career concerns associated with longer tenure increase the incentive for a CEO to take on higher risks. To calculate CEO tenure, the year the CEO joined the company is subtracted from the year of the financial report (Guo, Jalal, & Khaksari, 2015).

The last CEO characteristic which is being controlled for is the gender of the CEO. Faccio, Marchica and Mura (2016) found that female CEOs run firms that have lower leverage, less volatile earnings and a higher chance of survival than similar firms run by male CEOs.

4. Data

In this chapter the data sample and the descriptive statisitics will be discussed. First the database construction is explained. Next, a summary of the variables of interest is given. Last, a correlation matrix is formed to give a first insight of the signs.

4.1 Database

A new database is constructed using data for fiscal years 1993 to 2016 for the banking industry of the US. Only banks with at least 5 years of data are included in the database. Consistent with Vallascas and Hagendorff (2013) executive compensation data is collected from the Execucomp database for firms with SIC codes between 6000 and 6300. Firms with SIC code 6111 (Federal Credit Agency), SIC code 6199 (Finance Services), SIC code 6211 (Security Brokers and Dealers), and SIC code 6282 (investment Advice) are excluded. The Execucomp data is annual data. The compensation variables are consistent with Balanchandran et al. (2010). For the missing fields of total compensation, the data is calculated manually.

For the first risk measure, Total risk, daily data from the CRSP is obtained. Total risk (stock volatility) is the annualized standard deviation of daily stock returns. For the second and third risk measure a two-factor market model is used to calculate Systematic risk (stock's Beta) and Idiosyncratic risk (the standard deviation of residuals). The return on the Standard & Poor's Composite Index is used as the market return and is also obtained from the CRSP database. The daily three-month T-bill yield is obtained from the Federal Bank of St. Louis. For the fourth risk measure, Systemic risk (MES), also the daily stock returns from the CRSP database are used. For the fifth and last risk-measure, the Z-score, annual accounting data is obtained from the Compustat Bank database.

To construct the executive characteristics CEO gender, CEO age, and CEO tenure also data from the Execucomp database is used. To construct the control variables Bank Size and Leverage the Compustat Bank database is used.

The datasample is an unbalanced panel database. This means that not every year has the same number of observations. This is due to two factors: the exit and entry of banks, and also the fact that the accesed databases are not complete. To adress the difficulties associated with outliers in the database, the risk-estimators are winsorized at the 1^{st} and 99^{th} percentile values.

The final database, which includes all the necessary data to conduct the emperical analyses, consists of 90 banks with 112 different CEOs for the period 1993-2016. The sample contains 1,017 CEO-year observations.

4.2 Descriptive Statistics

Table 1 presents the descriptive statistics for the variables used in this paper. The mean value of CEO's cash-based incentive compensation (Total cash-based incentive compensation) is $771,020 with a standard deviation of $1,301,168 a minimum of $0.00 and a maximum of $14,500,000. The relative low median of $407,320 suggests that there is a lot of varation in cash-based incentive compensations and that they are highly skewed to the right. Meaning that a relative small group of CEOs received a rather large amount of cash-based incentive compensation.The mean value of CEO's equity-based compensation (Total equity-based compensation) is $1,657,749 with a standard deviation of $3,564,688 a minimum of $0.00 and a maximum of $50,894,940. The relative low median of $606,075 in comparison to the mean suggests similar to cash-based incentive compensation that equity-based compensation is highly skewed to the right. Meaning that a relative small group of CEOs received a rather large amount of equity-based compensation. The percentage of annual compensation the CEOs receive from cash-based incentive compensation (Relative cash-based incentive compensation) has a mean value of 22.3%. The minimum value of 0% means that in certain years at least one CEO didn't receive cash-based incentive compensation. The percentage of compensation CEOs receive from equity-based compensation (Relative equity-based compensation) has a mean value of 32.5%, a mimimum of 0% and a maximum of 96.2%. In table 1 of the appendix the mean and standard deviation of Relative cash-based incentive compensation and Relative equity-based compensation by year can be found. In 1993 the mean value of Relative equity-based compensation was 26.8% with a mean value of $441,352.49 while in 2001, on its peak, it was 44.8% with a mean value of $2,270,522.20. After the financial crisis this percentage declined and in 2009 it was at it lowest: 19.6% with a value of $542,131.78. In figure 1 of the appendix, the historical composition of CEO compensation, consisting of equity-based compensation, cash-based incentive compensation, salary and other compensation can be found. This numbers support the statement made earlier in the thesis that equity-based compensation have seen a rapid growth in the early 2000s.

Table 1: Descriptive statistics
This table presents the descriptive statistics for the sample of US banks for the period 1993-2016.

Variable	N	Mean	St. dev.	Median	Min	Max
CEO Compensation						
Total cash-based incentive compensation ($)	1,017	771,020	1,301,168	407,320	0	14,500,000
Total equity compensation ($)	1,017	1,657,749	3,564,688	606,075	0	50,894,940
Cash-based incentive compensation %	1,017	0.223	0.160	0.222	0	0.756
Equity-based compensation %	1,017	0.325	0.238	0.330	0	0.962
Risk measure						
Total risk	1,017	0.352	0.207	0.284	0.146	1.300
Systematic risk	1,017	1.103	0.404	1.089	0.166	2.385
Idiosyncratic risk	1,017	0.018	0.011	0.014	0.007	0.075
Systemic risk	1,017	0.028	0.022	0.021	-0.050	0.151
Z-score	1,017	3.344	0.950	3.342	0.860	5.388
Control variable						
Bank size	1,017	9.389	1.309	9.088	6.826	14.761
Leverage	1,017	0.170	0.107	0.152	0.000	0.709
CEO age	1,017	56.565	7.402	57	34	81
CEO tenure	1,017	10.014	7.917	8	0	39
CEO gender	1,017	0.986	0.117	1	0	1

Total risk has a mean of 0.352 with a standard deviation of 0.207. Systematic risk has a mean of 1.103 with a standard deviation of 0.404. The average US bank is hence more volatile than the market over the sample-period 1993-2016. Idiosyncratic risk has a mean of 0.018 with a standard deviation of 0.011. Systemic risk has a mean of 0.028 and a standard deviation of 0.022. The last risk-measure, the Z-score, has an average of 3.344 with a standard deviation of 0.950. The median of 3.342 is close to the mean due to the fact that it is the natural logarithm of the Z-score.

In respect to the bank characteristics, the mean value of the natural logarithm of total assets (Bank size) is 9.389 with a standard deviation of 1.309, while the leverage-ratio (Leverage) has a mean of 17% with a standard deviation of 10.8%. In respect to CEO characteristics, the average CEO in the sample is 56 years old, while the youngest is 34 years and the oldest 81 years. The average CEO is 10 years in office. 98.21% of the sample of CEOs was male.

4.3 Correlation

In addition to the descriptive statistics, a correlation matrix is conducted to obtain some first insight about the relation between the variables of interest. The relation between the variables are checked on multicollinearity. Table 2 reports the correlation matrix for the variables of interest. Total equity-based compensation and Total cash-based incentive compensation are positively correlated, suggesting that CEOs who receive more cash-based incentive compensation also receive more equity-based compensation. Relative cash-based incentive compensation is negatively associated with Total risk, Systematic risk and Idiosyncratic risk and positively associated with the Z-score. The positive association with the Z-score is expected, because the Z-score is inversely related to the probability of insolvency. Total risk and Idiosyncratic risk are highly correlated. So the expectation is that the regressions with Total risk and Idiosyncratic risk as the dependent variable show similar results. Contrary to expectation, relative equity-based compensation is negatively associated with the first three risk estimators. However, it is also negatively associated with the Z-score. The risk estimators are consistent with each other; Total risk, Systematic risk and Idiosyncratic risk are all positively correlated with each other and negatively correlated with the Z-score.

Table 2: Correlation Matrix

Correlation matrix for the sample of US banks for the period 1993-2016. P-values are presented in the parentheses, ***,** and * indicate respectively a 1%, 5% and 10% significance level.

Variable	Total cash	Total equity	Relative cash	Relative equity	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk	Z-score	Bank Size	Leverage	CEO age	CEO tenure	CEO gender
Total cash	1													
Total equity	0.554***	1												
	(0.000)													
Relative cash	0.434***	-0.084***	1											
	(0.000)	(0.008)												
Relative equity	0.232***	0.585***	-0.271***	1										
	(0.000)	(0.000)	(0.000)											
Total risk	-0.184***	-0.073	-0.292***	-0.116***	1									
	(0.000)	(0.020)	(0.000)	(0.000)										
Systematic risk	0.007	0.025	-0.144***	-0.079**	0.437***	1								
	(0.823)	(0.435)	(0.000)	(0.012)	(0.000)									
Idiosyncratic	-0.209***	-0.097***	-0.271***	-0.119***	0.965***	0.282***	1							
risk	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)								
Systemic risk	0.085	0.012	0.242***	0.060*	-0.804***	-0.648***	-0.658***	1						
	(0.007)***	(0.694)	(0.000)	(0.055)	(0.000)	(0.000)	(0.000)							
Z-score	0.044	0.013	0.093***	-0.056*	-0.247***	-0.002	-0.326***	0.073**	1					
	(0.158)	(0.676)	(0.003)	(0.073)	(0.000)	(0.948)	(0.000)	(0.020)						
Bank Size	0.641***	0.639***	0.095**	0.444***	-0.120***	0.111***	-0.182***	-0.054*	0.070**	1				
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.084)	(0.026)					
Leverage	0.098***	0.148***	0.002	0.156***	0.033	-0.183***	0.069**	0.032	-0.210	0.247	1			
	(0.002)	(0.0000)	(0.951)	(0.0001)	(0.299)	(0.000)	(0.027)	(0.308)	(0.000)	(0.000)				
CEO age	0.078***	0.036	-0.024	-0.041***	-0.043	0.019	-0.048	0.011	-0.031	0.101***	0.037	1		
	(0.0014)	(0.250)	(0.443)	(0.197)	(0.175)	(0.555)	(0.127)	(0.718)	(0.323)	(0.001)	(0.242)			
CEO tenure	-0.083***	-0.111***	-0.0234	-0.115***	-0.011	-0.017	-0.008	0.016	0.062**	-0.026	-0.011	0.528***	1	
	(0.008)	(0.000)	(0.455)	(0.000)	(0.727)	(0.582)	(0.801)	(0.620)	(0.049)	(0.406)	(0.731)	(0.000)		
CEO gender	0.047	0.046*	-0.008	0.034	-0.031	-0.006	-0.048	-0.002	0.251***	0.102***	-0.127***	0.020	0.042	1
	(0.137)	(0.146)	(0.807)	(0.285)	(0.324)	(0.839)	(0.130)	(0.954)	(0.000)	(0.001)	(0.000)	(0.515)	(0.183)	

5. Results

In this chapter the results of the regressions will be discussed. First, the relations between Relative cash-based incentive compensation, Relative equity-based compensation and the five estimated risk-proxies are investigated. Second, the regressions are ran with Total cash-based incentive compensation and Total equity-based compensation as the independent variables. Next, the impact of the financial crisis is examined. Last, the reverse causality problem is addressed.

5.1 Relative compensation and bank risk

Table 3 presents the results of the first regressions showing the relation between Relative cash-based incentive compensation, Relative equity-based compensation and the five estimated risk-proxies. Fixed effects are included in the regressions to control for market wide fluctuations. To control for time-series trend, year dummies are included in all regressions. Also, in all regressions cluster robust standard errors are used. For all the specifications of bank risk, Relative cash-based incentive compensation is negatively related to bank risk. (Note: the Z-score is inversely related to the probability of insolvency: a higher Z-score means more bank stability). As can be observed from the table, the coefficients of Relative cash-based incentive compensation are negative and statistically significant in the regressions with Total risk, Systematic risk and Idiosyncratic risk as the measures of bank risk. When Systemic risk and the Z-score are used as the dependent variable the results show a statistically insignificant coefficient of Relative cash-based incentive compensation. The negative coefficients of Relative cash-based incentive compensation in the regressions indicate that higher cash-based incentive compensation relative to total CEO compensation is associated with lower risk. The first three coefficients are also economically significant. The coefficient of Relative cash-based incentive compensation in the regression with Total risk gives a coefficient of -0.187 and is statistically significant at the 0.01 level. An increase of one standard deviation in Relative cash-based incentive compensation (0.160) is associated with a change in Total risk of 0.030 (=0.160*0.187). Compared to a mean of Total risk of 0.352 and a standard deviation of Total risk of 0.207, the coefficient of Relative cash-based incentive compensation is not only statistically but also economically significant. Relative cash-based incentive compensation has a coefficient of -0.250 that is statistically significant at the 0.05 level in the model where Systematic risk is the dependent variable, changing Relative cash-based incentive compensation with one standard deviation results in a change in Systematic risk of 0.040

(=0.160*0.250). In comparison with the mean (1.103) and the standard deviation (0.404) of Systematic risk, this coefficient is economically significant. When Idiosyncratic risk is the dependent variable, the regression gives a coefficient of -0.010 that is statistically significant at the 0.01 level. Increasing Relative cash-based incentive compensation with one standard deviation is associated with a change in Idiosyncratic risk of 0.002 (0.160*0.010). Given the mean (0.018) and the standard deviation (0.011) of Idiosyncratic risk, this coefficient is also economically significant. As can be seen in the table Relative cash-based incentive compensation is also negatively related with Systemic risk and has a coefficient of -0.009. However, this coefficient is not statistically significant. The regression with the Z-score as the dependent variable gives also a statistically insignificant coefficient. The results of the regressions are consistent with the hypothesis that CEO cash-based incentive compensation is negatively related to risk-taking in the US banking industry. Supporting the view of Vallascas and Hagendorff (2013) that CEO cash bonuses lower the default risk of banks, because bonus payments depend on the bank's solvency, and therefore lower the risk-taking behavior of CEOs

The coefficients of Relative equity-based compensation show similar to Relative cash-based incentive compensation a negative sign, indicating that higher equity-based compensation is also associated with lower risk. Only the coefficients of Relative equity-based compensation in the regressions with Total risk and Idiosyncratic risk are statistically significant. In the first column the coefficient of Relative equity-based compensation of -0.092 can be found when Total risk is the dependent variable. This coefficient is statistically significant at the 0.01 level. A change in Relative equity-based compensation with one standard deviation (0.238) results in a change in Total risk of 0.022 (=0.238*0.092). This change is economically significant, relative to the mean (0.352) and standard deviation (0.207) of Total risk. Relative equity-based compensation also has a negative relationship with Systematic risk with a coefficient of -0.087. However, this coefficient is not statistically significant. Relative equity-based compensation is also negatively associated with Idiosyncratic risk. The regression gives a coefficient of -0.006, which is statistically significant at the 0.01 level. Changing Relative equity-based compensation with one standard deviation results in a change in Idiosyncratic risk of 0.001 (0.238*0.006). Given the mean (0.018) and standard deviation (0.011) of Idiosyncratic risk, this result is economically significant. When Systemic risk is used as the risk measure of interest Relative equity-based compensation also has negative coefficient, however this coefficient of -0.001 is not statistically significant. These finding

are inconsistent with (most) previous literature and do not support the hypothesis that CEO equity-based compensation is positively related to risk-taking in the US banking industry.

Consistent with the view that larger banks engage in more and riskier activities Bank size is positively related to bank risk. The coefficient estimates are statistically significant when Systematic risk, Systemic risk or the Z-score is used as the independent variable. Leverage is negatively related to bank risk. The regressions with the market-based risk measure show all statistically significant coefficients for Leverage. These results are not consistent with the view that the CEO has an incentive to engage in more and riskier activities, because they do not bear the losses that risk-taking has on other stakeholders. CEO age has a positive association with bank risk. This indicates that older CEO's are less risk-averse. However, none of the coefficients are statistically significant. CEO tenure show negative coefficients, suggesting that the longer a CEO is in office, the less risk he takes. Also none of the coefficients of CEO tenure are statistically significant. The dummy variable CEO gender is omitted from these and further regressions due to multicollinearity.

Table 3: Relative cash-based incentive compensation, Relative equity-based compensation and bank risk

This table shows the results of the regressions run between the Relative cash-based incentive compensation, Relative equity-based compensation and the five different risk-estimators for the period 1993-2016 for US banks. In all regressions CEO fixed effects are included. In all regressions cluster robust standard errors are used. In all the regressions year fixed effects are included, where 1993 is the base year. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4	5
	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk	Z-score
Relative cash-based incentive compensation	-0.187***	-0.250**	-0.010***	-0.009	0.035
	(0.000)	(0.024)	(0.000)	(0.127)	(0.628)
Relative equity-based compensation	-0.092***	-0.087	-0.006***	-0.001	0.075
	(0.001)	(0.189)	(0.001)	(0.651)	(0.106)
Bank size	0.001	0.167***	-0.001	0.008***	-0.084**
	(0.950)	(0.006)	(0.514)	(0.001)	(0.030)
Leverage	-0.287**	-0.668**	-0.015**	-0.026**	-0.007
	(0.013)	(0.013)	(0.026)	(0.024)	(0.977)
CEO age	0.009	0.052	0.000	-0.000	-0.008
	(0.757)	(0.443)	(0.820)	(0.996)	(0.801)
CEO tenure	-0.008	-0.042	0.000	-0.000	0.017
	(0.786)	(0.532)	(0.808)	(0.918)	(0.604)
Year dummies	Included	Included	Included	Included	Included
Constant	-0.026	-2.706	0.014	0.050	4.417***
	(0.985)	(0.416)	(0.862)	(0.679)	(0.006)
Observations	1,017	1,017	1,017	1,017	1,017
Within R-squared	0.780	0.526	0.683	0.764	0.158

5.2 Total compensation and bank risk

Next, the regressions are run using Total cash-based incentive compensation and Total equity-based compensation as the independent variables. The coefficients of Total cash-based incentive compensation, Total equity-based compensation have been scaled (*1000). Table 4 shows the results for the regressions between Total cash-based incentive compensation, Total equity-based compensation and the five risk-estimators.

As can be seen in the table, the regressions give similar results when Total cash-based incentive compensation is used as the independent variable of interest. The regressions on the four market-based measures of bank risk all give statistically significant coefficients. The regression run with the Z-score as the dependent variable gives no statistically significant result. When Total risk is considered, the coefficient of Total cash-based incentive compensation of -0.013 is statistically significant at the 0.01 level. This coefficient is also economically significant. One standard deviation change in Total cash-based incentive compensation ($1,301,168) results in a change in Total risk of 0.017 (=1.301168*0.013). Relative to the mean (0.352) and the standard deviation (0.207) of Total risk this coefficient is thus economically significant. The regression on Systematic risk gives a coefficient of Total cash-based incentive compensation of -0.038, which is statistically significant at the 0.01 level. Changing Total cash-based incentive compensation with one standard deviation results in a change in Systematic risk with 0.049 (=1.301168*0.038)., in comparison to the mean (1.103) and the standard deviation (0.404) of Systematic risk, this coefficient is also economically significant. In the third column the results of the regression between Idiosyncratic risk and Total cash-based incentive compensation can be found. The estimated coefficient is -0.001 and is statistically significant at the 0.05 level. A change of one standard deviation of Total cash-based incentive compensation results in a change in Idiosyncratic risk of 0.001 (=1.301168*0.001). Relative to the mean (0.018) and the standard deviation (0.011) this coefficient is economically significant. The regression between Total cash-based incentive compensation and Systemic risk gives a coefficient of -0.001. Increasing Total cash-based incentive compensation with one standard deviation results in an increase in Systemic risk with 0.001 (=1.301168*0.001). Given the mean (0.028) and the standard deviation (0.022) of Systemic risk, this coefficient is also economically significant. These results suggest that there is a link between CEO cash-based incentive compensation and bank risk. They also support the hypothesis that CEO cash-based incentive compensation is negatively related to risk-taking in the US banking

industry. This supports the view of Vallascas and Hagendorff (2013) that, because bonus payments depend on the solvency of banks, they lower the risk-taking behavior of CEOs.

Total equity-based compensation has in most regressions a negative relationship with bank risk. However, Total equity-based compensation only has a statistically significant estimated coefficient in the regression with the Z-score as the dependent variable. The coefficient of 0.004 is statistically significant at the 0.05 level. One standard deviation change in Total equity-based compensation ($3,564,688) results in a change in the Z-score with 0.014 (3.564688*0.004). Relative to the mean (3.344) and the standard deviation (0.950) of the Z-score, this coefficient is economically insignificant. These findings reject the hypothesis that CEO equity-based compensation is positively related to risk-taking in the US banking industry.

The estimated coefficients of Bank size support the view that larger banks engage in riskier activities. The negative coefficients of Leverage do not support the view that more leveraged banks are more risk-taking. The coefficient of CEO age and CEO tenure are in none of the regressions statistically significant.

Table 4: Total cash-based incentive compensation and bank risk

This table shows the results of the regressions run between the Total cash-based incentive compensation, Total equity-based compensation and the five different risk-estimators for the period 1993-2016 for US banks. In all regressions CEO fixed effects are included. In all regressions cluster robust standard errors are used. In all the regressions year fixed effects are included, where 1993 is the base year. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1 Total risk	2 Systematic risk	3 Idiosyncratic risk	4 Systemic risk	5 Z-score
Total cash-based incentive compensation	-0.013***	-0.038***	-0.001**	-0.001***	-0.008
	(0.007)	(0.000)	(0.027)	(0.006)	(0.205)
Total equity-based compensation	-0.001	-0.003	0.000	-0.000	0.004**
	(0.552)	(0.357)	(0.921)	(0.161)	(0.032)
Bank size	0.000	0.175	-0.001	0.008***	-0.080**
	(0.998)	(0.005)	(0.471)	(0.001)	(0.040)
Leverage	-0.310***	-0.726	-0.016**	-0.028**	-0.011
	(0.006)	(0.009)	(0.013)	(0.018)	(0.962)
CEO age	0.009	0.045	0.000	-0.000	-0.013
	(0.763)	(0.519)	(0.801)	(0.920)	(0.691)
CEO tenure	-0.008	-0.035	-0.000	0.001	0.022
	(0.797)	(0.620)	(0.793)	(0.830)	(0.512)
Year dummies	Included	Included	Included	Included	Included
Constant	-0.091	-2.548	0.009	-0.044	4.629***
	(0.951)	(0.467)	(0.914)	(0.730)	(0.004)
Observations	1,017	1,017	1,017	1,017	1,017
Within R-squared	0.770	0.527	0.670	0.764	0.157

5.3 Financial crisis

Next, the impact of the financial crisis will be investigated. The regressions will be run using two different sample periods. The first period will be the pre-crisis period (1993-2007) and the second period the post-crisis period (2008-2016). The results for the pre-crisis and post-crisis period regressions between Relative cash-based incentive compensation, Relative equity-based compensation and the five risk-estimators can be found in table 5. Only when Total risk is considered, the coefficients of Relative cash-based incentive compensation are in both the pre as the post crisis period statistically significant. In the post-crisis period the magnitude of this coefficient is greater in comparison to the pre-crisis period. When Total cash-based incentive compensation is used as the independent variable of interest this increase in sign is also perceivable for Total risk, these results can be found in table 6. Although, only the post-crisis coefficient is statistically significant. When Systematic risk is the dependent variable, the coefficient is bigger post-crisis than pre-crisis. The estimated coefficients of Relative equity-based compensation are not conclusive; none of the coefficients is statistically significant in both the pre as the post-crisis period. When Total equity-based compensation is the independent variable of interest, the coefficients show that in the post-crisis period the magnitude of these coefficients are bigger. However, the coefficients are never statistically significant in both the pre-crisis as in the post-crisis period. Therefore, the findings do not support the hypothesis that after the financial crisis the impact of CEO compensation on risk-taking in the banking industry decreased.

Although the effect of CEO compensation does not differ significantly between the pre-crisis and post-crisis period, the coefficient of Leverage is in all post-crisis analyses bigger than in the post crisis period. So, after the crisis banks with more leverage became more risk-averse.

Table 5: Relative compensation and bank risk: pre-crisis vs. post-crisis

This table shows the results of the regressions run between the Relative cash-based incentive compensation, Relative equity-based compensation and the five different risk-estimators for two different time-periods for US banks. In all regressions cluster robust standard errors are used. The first period is the pre-crisis period (1993-2006) the second period is the post-crisis period (2007-2016). In all regressions year and CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4	5	6	7	8	9	10
	Total risk		Systematic risk		Idiosyncratic risk		Systemic risk		Z-score	
	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016
Relative cash-based incentive compensation	-0.055*	-0.197***	-0.222	-0.163	-0.003	-0.011***	-0.005	-0.004	0.098	-0.035
	(0.074)	(0.000)	(0.127)	(0.250)	(0.105)	(0.000)	(0.227)	(0.645)	(0.394)	(0.546)
Relative equity-based compensation	-0.010	-0.157***	-0.059	-0.086	-0.000	-0.010***	-0.003	0.001	0.046	0.087
	(0.536)	(0.000)	(0.498)	(0.420)	(0.789)	(0.001)	(0.229)	(0.898)	(0.513)	(0.131)
Bank size	0.016	0.025	0.118*	0.176	0.001	0.000	0.005***	0.011**	-0.089*	-0.172**
	(0.272)	(0.537)	(0.089)	(0.117)	(0.411)	(0.962)	(0.006)	(0.018)	(0.074)	(0.017)
Leverage	-0.003	-0.458**	0.184	-1.260***	-0.002	-0.021*	-0.002	-0.046**	-0.273	0.402
	(0.965)	(0.043)	(0.452)	(0.009)	(0.592)	(0.088)	(0.707)	(0.041)	(0.261)	(0.225)
CEO age	-0.028*	-0.005	-0.017	-0.022*	-0.002**	-0.000	-0.002	-0.002***	0.007	0.032***
	(0.099)	(0.329)	(0.841)	(0.082)	(0.019)	(0.970)	(0.508)	(0.006)	(0.859)	(0.000)
CEO tenure	0.016	(omitted)	0.024	(omitted)	0.001	(omitted)	-0.002	(omitted)	0.002	(omitted)
	(0.342)		(0.785)		(0.212)		(0.538)		(0.964)	
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	1.497*	0.500**	0.701	1.235*	0.009	0.023*	0.074	0.029	3.59*	3.150***
	(0.060)	(0.036)	(0.865)	(0.072)	(0.900)	(0.081)	(0.655)	(0.249)	(0.085)	(0.000)
Observations	441	576	441	576	441	576	441	576	441	576
Within R-squared	0.716	0.790	0.476	0.481	0.713	0.693	0.549	0.732	0.790	0.249

Table 6: Total cash-based incentive compensation, Total equity-based compensation and bank: risk pre-crisis vs. post-crisis

This table shows the results of the regressions run between the Total cash-based incentive compensation, Total equity-based compensation and the five different risk-estimators for two different time-periods for US banks. In all regressions cluster robust standard errors are used. The first period is the pre-crisis period (1993-2006) the second period is the post-crisis period (2007-2016). In all regressions time and CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4	5	6	7	8	9	10
	Total risk		Systematic risk		Idiosyncratic risk		Systemic risk		Z-score	
	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016	1993-2006	2007-2016
Total cash-based incentive compensation	-0.004	-0.018**	-0.041**	-0.034***	-0.000	-0.001*	-0.000	-0.002**	0.001	-0.010*
	(0.312)	(0.024)	(0.011)	(0.001)	(0.294)	(0.052)	(0.426)	(0.030)	(0.959)	(0.067)
Total equity-based compensation	-0.000	-0.003	-0.003	-0.004	-0.000	-0.000***	-0.000*	-0.000	0.005**	0.007
	(0.839)	(0.351)	(0.511)	(0.381)	(0.813)	(0.471)	(0.052)	(0.708)	(0.039)	(0.092)
Bank size	0.019	0.017	0.127*	0.178	0.001	-0.001	0.005***	0.011**	-0.094*	-0.172**
	(0.207)	(0.701)	(0.069)	(0.119)	(0.337)	(0.838)	(0.004)	(0.019)	(0.066)	(0.015)
Leverage	-0.015	-0.497**	0.148	-1.327***	-0.003	-0.023*	-0.003	-0.048**	-0.252	0.407
	(0.832)	(0.026)	(0.548)	(0.007)	(0.500)	(0.056)	(0.623)	(0.038)	(0.315)	(0.226)
CEO age	-0.026	-0.006	-0.013	-0.023*	-0.002**	-0.000	-0.002	-0.002***	0.003	0.032***
	(0.127)	(0.214)	(0.884)	(0.073)	(0.027)	(0.729)	(0.549)	(0.004)	(0.941)	(0.000)
CEO tenure	0.014	(omitted)	0.023	(omitted)	0.001	(omitted)	0.002	(omitted)	0.002	(omitted)
	(0.403)		(0.802)		(0.260)		(0.572)		(0.971)	
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	1.366*	0.605**	0.368	1.247*	0.099**	0.029*	0.017	0.027	3.86*	3.157***
	(0.082)	(0.013)	(0.931)	(0.075)	(0.012)	(0.029)	(0.711)	(0.315)	(0.076)	(0.000)
Observations	441	576	441	576	441	576	441	576	441	576
Within R-squared	0.714	0.779	0.480	0.485	0.711	0.675	0.550	0.734	0.083	0.247

5.4 Reverse causality

The main focus of this paper is to examine the relationship between CEO compensation and risk-taking in the US banking industry. Previous literature and the findings suggest that CEO compensation affects bank risk. However, it is also possible that bank risk affects the bank's profit and therefore the amount that the CEO gets compensated in bonuses. It is also possible that the bank's risk exposure affects the design of the CEO's compensation package (Uhde, 2016). Hence, reverse causality may be a problem. To address this endogeneity problem an instrumental variable is used in a two-stage least square (2SLS) model. Based on past performance banks award their CEOs with cash bonuses and equity-based compensation. Therefore, the assumption is that past performance is correlated with variable CEO compensation (Armstrong & Vashishtha, 2012). However, there is no clear reason for the presence of a relationship between past performance and bank risk, other than the effect through CEO compensation or the control variables (Armstrong & Vashishtha, 2012). Therefore, past performance in the form of ROA can be used as instrumental variables. Because ROA is also a determinant of the Z-score, the Z-score is excluded in this test. Further, a second instrument is added to the 2SLS regressions: the bank's marginal tax rate. When corporate tax rates are expected to be higher in the future, it becomes more favorable for a firm to use deferred compensation to get future tax deduction than pay out in cash-based incentive compensation and receive immediate tax deduction (Core and Guay, 1999). Therefore, Core and Guay (1999) argue, the use of stock-based compensation is less costly for firms with low marginal tax rates. Other than through CEO compensation the bank's marginal tax rate is unlikely to affect the bank's risk-taking. Following Core and Guay (1999) the degree of shortfall is measured as the three-year average of common and preferred dividends plus cash flow used in investing activities minus cash flow from operations divided by total assets. Following Armstrong and Vashishtha (2012) the instrumental variable is a dummy variable that proxies for the bank's marginal tax rate with value one if the bank has a tax-loss carry-forward in any of the past three year and zero otherwise.

After each 2SLS regression different tests are conducted. Firstly, an endogeneity test is ran to test whether the independent variable of interest (i.e. the different variables of CEO compensation) has to be in fact treated as endogenous. For all 2SLS regressions, the null hypothesis, that is that the endogenous regressor can actually be treated as exogenous, is rejected.

Table 7: Relative cash-based incentive compensation and bank risk: instrumental variable
This table shows the results of the second stage of the 2SLS regressions run between the Relative cash-based incentive compensation and four risk-estimators for US banks. In all regressions CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4
	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk
Relative cash-based incentive compensation	-3.641***	-2.090***	-0.198***	-0.321***
	(0.000)	(0.000)	(0.000)	(0.000)
Bank size	0.014	0.230***	-0.001	0.012
	(0.890)	(0.005)	(0.863)	(0.174)
Leverage	-0.130	-1.388***	-0.005	-0.001
	(0.757)	(0.000)	(0.826)	(0.975)
CEO age	0.028	-0.002	0.004	-0.004
	(0.731)	(0.976)	(0.348)	(0.554)
CEO tenure	-0.015	-0.031	-0.003	0.004
	(0.843)	(0.619)	(0.464)	(0.527)
Sargan statistic	0.000	2.956*	0.011	0.123
	(0.991)	(0.086)	(0.918)	(0.726)
Observations	710	710	710	710

Endogeneity seems to be present. To validate ROA and the marginal tax rate as instrumental variables the Sargan's J overidentification test is run for all 2SLS regressions. The results for the 2SLS regression with Relative cash-based incentive compensation as the independent variable can be found in table 7 (see table 3 of the appendix for the results of the first stage). Only the 2SLS regression on systematic risk has a Sargan statistic with a p-value that's too low to reject the null hypothesis. For the other three 2SLS regressions the instruments are valid instruments. The results for the 2SLS regressions with Relative equity-based compensation as the independent variable can be found in table 8 (the results of the first stage can also be found in table 3 of the appendix). All 2SLS regressions with Relative equity-based compensation as the independent variable give Sargan statistics that are too low to reject the null hypothesis. Hence, the instruments pass the test and are valid instruments.

The main findings, that Relative cash-based incentive compensation affects bank risk negatively, sustain using an instrumental variable regression approach. The estimated coefficients of Relative cash-based incentive compensation on the different risk-estimators improve significantly and are all statistically significant at the 0.01 level.

Table 8: Relative equity-based compensation and bank risk: instrumental variable
This table shows the results of the second stage of the 2SLS regressions run between the Relative equity-based compensation and four risk-estimators for US banks. In all regressions CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4
	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk
Relative equity-based compensation	-7.269**	-4.675**	-0.393**	-0.653**
	(0.016)	(0.022)	(0.016)	(0.018)
Bank size	0.745*	0.704**	0.039*	0.078**
	(0.071)	(0.011)	(0.084)	(0.038)
Leverage	-0.738	-1.783**	-0.038	-0.056
	(0.495)	(0.014)	(0.516)	(0.571)
CEO age	-0.100	-0.060	0.003	-0.015
	(0.572)	(0.617)	(0.770)	-0.339
CEO tenure	0.068	0.001	0.002	0.011
	(0.692)	(0.995)	(0.869)	(0.469)
Sargan statistic	0.562	0.025	0.624	0.343
	(0.453)	(0.876)	(0.430)	(0.558)
Observations	710	710	710	710

Thus, the results of the instrumental variable regression with Relative cash-based incentive compensation as the independent variable support the hypothesis that CEO cash-based incentive compensation is negatively related to risk-taking in the US banking industry. Also the findings of equity-based compensation remains the same. Relative equity-based compensation has a negative effect on bank risk in the overall period 1993-2016. The findings of the instrumental variable regressions suggest that causality exists between the two types of Relative CEO compensation and bank risk.

However, when Total cash-based compensation is considered (see table 9), all 2SLS regressions give Sargan statistics that are too high (p-value too low), to accept the null hypothesis. That is, the instruments are not valid instruments. When Total equity-based compensation is the independent variable of interest (see table 10), the 2SLS regressions give Sargan statistics that are all too low to reject the null hypothesis. Therefore, in this 2SLS regressions the instruments are valid instruments. However, the second stage of the instrumental variable regression give in all the regressions statistically insignificant coefficients for Total equity-based compensation.

Table 9: Total cash-based incentive compensation and bank risk: instrumental variable
This table shows the results of the second stage of the 2SLS regressions run between the Total cash-based incentive compensation and four risk-estimators for US banks. In all regressions CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4
	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk
Total cash-based incentive compensation	-0.854***	-0.388***	-0.047***	-0.073***
	(0.000)	(0.004)	(0.000)	(0.000)
Bank size	0.142	0.280***	0.006	0.023*
	(0.374)	(0.002)	(0.487)	(0.093)
Leverage	-1.299*	-1.913***	-0.069*	-0.101
	(0.071)	(0.000)	(0.081)	(0.105)
CEO age	-0.075	-0.092	-0.001	-0.014
	(0.511)	(0.164)	(0.839)	(0.147)
CEO tenure	0.078	0.050	0.002	-0.013
	(0.462)	(0.417)	(0.743)	(0.148)
Sargan statistic	3.773*	11.103***	3.484*	4.872**
	(0.052)	(0.001)	(0.062)	(0.027)
Observations	710	710	710	710

Therefore the results of the instrumental variable regressions using Total cash-based incentive compensation and Total equity-based compensation as the independent variables of interest do not support the hypothesis that causality exists between CEO cash-based incentive compensation or CEO equity-based compensation and bank risk.

Table 10: Total equity-based compensation and bank risk: instrumental variable

This table shows the results of the second stage of the 2SLS regressions run between the Total equity-based compensation and four risk-estimators for US banks. In all regressions CEO fixed effects are included. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01.

	1	2	3	4
	Total risk	Systematic risk	Idiosyncratic risk	Systemic risk
Total equity-based compensation	-2.671	-1.416	-0.145	-0.233
	(0.490)	(0.490)	(0.490)	(0.491)
Bank size	3.492	2.071	0.189	0.315
	(0.503)	(0.453)	(0.507)	(0.487)
Leverage	-7.696	-5.396	-0.417	-0.660
	(0.509)	(0.383)	(0.512)	(0.516)
CEO age	0.465	0.213	0.028	0.033
	(0.715)	(0.751)	(0.685)	(0.765)
CEO tenure	-0.621	-0.338	-0.036	-0.048
	(0.665)	(0.657)	(0.644)	(0.701)
Sargan statistic	0.018*	0.190	0.015	0.032
	(0.893)	(0.663)	(0.901)	(0.859)
Observations	710	710	710	710

6. Conclusion and limitations

Since the start of the financial crisis the effect of executive compensation on risk-taking in the banking industry has been an ongoing and hot topic. The effect of equity-based compensation on bank risk has been examined in great detail. However, the effect of CEO cash-based incentive compensation on risk-taking does not get the attention it deserves. Only a few studies have examined the effect of CEO cash-based incentive compensation, while a considerable part of the CEO compensation consists of cash-based incentive compensation. Therefore the research question posed in this paper is the following: What is the effect of CEO cash-based incentive compensation on risk-taking in the banking industry? Further, two sub-questions are posed: What is the difference between the effect of the CEO's cash-based incentive compensation and equity-based compensation? And: what is the effect of the financial crisis on the relationship between CEO compensation and bank risk is researched? To answer these questions four different measures of CEO compensation are used in this paper, including Relative cash-based incentive compensation, Total cash-based incentive compensation, Relative equity-based compensation and Total equity-based compensation. Further, four different risk measures are used, three market-based risk measures: Total risk, Systematic risk and Idiosyncratic risk and one accounting-based risk measure: a Z-score. Bank size, Leverage, CEO Tenure, CEO age and CEO gender are used as control variables. The pooled sample consists of 90 banks with 112 different CEOs for the period 1993-2016. The sample contains 1,017 CEO-year observations.

The first conclusion that arises from the empirical findings is that CEO cash-based incentive compensation has a negative relation with bank risk. These findings hold when using different CEO cash-based incentive compensation proxies and are robust across the different risk measures. Therefore, to answer the main research question of this thesis: CEO cash-based incentive compensation has a negative effect on risk-taking in the banking industry. These findings are consistent with previous literature, suggesting that increasing CEO cash bonuses lower the default risk of a bank. Which can be explained by the fact that cash-based incentive compensation depends on the bank's solvency, and therefore could lower the CEO's risk-taking behavior afraid of losing their income. The findings can help to construct a CEO compensation structure in which CEO cash-based incentive compensation plays a mitigating role to prevent excessive risk-taking.

Relative equity-based compensation also has a negative relationship with bank risk. Only the regressions with Total risk and Idiosyncratic risk show statistically significant coefficients.

When Total equity-based compensation is used as the independent variable only the estimated coefficients in the regression with the Z-score shows a positive and statistically significant coefficient (The Z-score is inversely related to the probability of insolvency).

When the regressions are run with a pre-crisis and a post-crisis period, the data does not show interesting results when CEO compensation is considered. The results do not support the hypothesis that the financial crisis affects the impact of CEO compensation on risk-taking in the US banking industry. However, the coefficients of Leverage is post-crisis bigger in all regressions. After the crisis banks with more leverage became more risk-averse.

Bank size is positively associated with bank risk, suggesting that larger banks engage in riskier activities. This supports the view that large banks potentially suffer more from agency problems and poor corporate governance. Also, larger banks could be riskier, because of the implicit government guarantee to bail them out when there in distress, making them "too big to fail". Leverage has a negative relation with bank risk. Banks with more leverage are more risk-averse. CEO age has a negative relation with bank risk, suggesting that older CEOs take less risks. Older CEOs are more likely to be risk-averse, likely because they are more entrenched and have shorter horizons. CEO gender is omitted of the regressions because of multicollinearity, therefore no conclusions about CEO gender can be made.

This paper has addressed the endogeneity problem, in particular the reverse causality problem, but also the possibility that an omitted variable both drives CEO compensation and bank risk. The two instrumental variables used in this paper, include: ROA and a marginal tax rate proxy. The results of the instrumental variable regressions support the hypothesis that Relative cash-based incentive compensation is negatively related to risk-taking in the US banking industry. Also the results of equity-based compensation remains the same. Relative equity-based compensation has a negative effect on bank risk. When Relative cash-based incentive compensation and Relative equity-based compensation is considered, the findings of the instrumental variable regressions suggest that causality exists between CEO compensation and bank risk. However, these findings do not hold when Total cash-based incentive compensation and Total equity-based compensation are considered.

This study comes with some unavoidable limitations. The endogeneity problem is tried to be addressed with a 2SLS model. As stated above, in the 2SLS regression with Total cash-based incentive compensation, the results do not support the hypothesis that the instruments are valid

instruments. Therefore, it is arguable that there are better and more fitting instruments. Further research should take the endogeneity problem into account and should try to find the most valid instrumental variables. Second, the data sample only consists of US banks, because the lack of available executive data outside the US. Therefore, the findings cannot be globally generalized. Including data of banks outside the US to future research will give more robust and valid results. Third, this paper only covers CEOs, neglecting the role of other executives in the decision-making process. Therefore, including not only CEOs, but for instance the top five executives of the bank in future research could give additional and useful information. Furthermore, although five different risk measures are used, both market-based as accounting-based measures, it is possible that these risk measures do not properly reflect bank risk. Using other, different measures of bank risk, for instance: the distance-to-default, non-interest income or a CD spread, could give more accurate results. Finally, using another calculation of cash-based incentive compensation and equity-based compensation could give other results. For instance, in this paper equity-based compensation consists of both stock-options as restricted stock. Examining the differences between the various types of equity-based compensation could give some useful insights.

To conclude: this paper shows that not all bonuses that CEOs receive increase risk-taking in the banking industry. Cash-based incentive compensation actually decreases risk-taking and could therefore play a mitigating role in preventing excessive risk-taking. This should be taken into account when the CEO's compensation plan is structured.

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8. Appendix

8.1 Tables

Table 1: Relative compensation: summary by year
This table presents the mean and standard deviation by year for the variables Relative cash-based incentive compensation and Relative equity-based compensation.

	Relative cash-based incentive compensation		Relative equity-based compensation	
	Mean	Std. Dev	Mean	Std. Dev
1993	0.268	0.143	0.206	0.191
1994	0.266	0.153	0.297	0.249
1995	0.302	0.164	0.263	0.182
1996	0.282	0.187	0.383	0.261
1997	0.256	0.164	0.388	0.239
1998	0.217	0.143	0.478	0.230
1999	0.214	0.113	0.471	0.231
2000	0.215	0.159	0.388	0.252
2001	0.202	0.141	0.448	0.254
2002	0.241	0.153	0.410	0.241
2003	0.269	0.161	0.368	0.233
2004	0.293	0.176	0.307	0.214
2005	0.242	0.153	0.377	0.258
2006	0.248	0.161	0.289	0.252
2007	0.182	0.190	0.275	0.253
2008	0.124	0.158	0.256	0.243
2009	0.137	0.174	0.196	0.204
2010	0.161	0.137	0.248	0.217
2011	0.185	0.155	0.293	0.224
2012	0.239	0.167	0.275	0.197
2013	0.249	0.150	0.319	0.221
2014	0.272	0.111	0.327	0.220
2015	0.258	0.123	0.346	0.213
2016	0.267	0.131	0.353	0.208

Table 2: Total compensation: summary by year
This table presents the mean and standard deviation by year for the variables Total cash-based incentive compensation and Total equity-based compensation.

	Total cash-based incentive compensation		Total equity-based compensation	
	Mean	Std. Dev	Mean	Std. Dev
1993	$ 430,710.12	$ 377,607.01	$ 441,352.49	$ 501,129.03
1994	$ 510,320.66	$ 492,259.69	$ 1,004,404.70	$ 1,595,729.50
1995	$ 685,183.65	$ 906,929.21	$ 703,949.82	$ 844,787.25
1996	$ 932,204.52	$ 1,424,502.70	$ 1,892,418.80	$ 2,825,926.20
1997	$ 990,859.71	$ 1,762,852.50	$ 2,073,730.90	$ 3,913,897.90
1998	$ 909,694.11	$ 1,372,236.10	$ 2,422,977.10	$ 3,011,847.70
1999	$ 788,029.94	$ 976,251.88	$ 3,099,259.70	$ 5,972,066.70
2000	$ 647,657.75	$ 940,168.09	$ 2,744,023.50	$ 8,407,961.90
2001	$ 957,210.66	$ 1,878,983.30	$ 2,270,522.20	$ 3,129,296.80
2002	$ 935,967.59	$ 1,448,212.00	$ 1,862,034.10	$ 2,383,021.80
2003	$ 1,038,999.90	$ 1,489,655.10	$ 1,794,199.40	$ 2,627,686.80
2004	$ 1,337,362.30	$ 1,971,074.90	$ 1,680,300.00	$ 3,043,478.20
2005	$ 1,027,980.30	$ 1,636,494.30	$ 2,208,950.30	$ 3,280,179.50
2006	$ 1,017,536.60	$ 1,967,822.70	$ 2,360,790.70	$ 5,442,422.50
2007	$ 622,204.05	$ 1,897,551.50	$ 1,405,532.40	$ 3,742,126.80
2008	$ 204,521.80	$ 358,889.06	$ 1,123,748.30	$ 4,455,806.00
2009	$ 256,019.16	$ 416,116.96	$ 542,131.78	$ 1,285,175.20
2010	$ 466,504.10	$ 833,797.61	$ 1,126,116.40	$ 2,623,091.50
2011	$ 591,477.55	$ 853,303.36	$ 1,341,175.70	$ 2,659,093.00
2012	$ 694,504.68	$ 1,018,814.50	$ 1,160,471.50	$ 2,395,543.40
2013	$ 729,944.56	$ 802,257.39	$ 1,294,274.30	$ 1,839,147.90
2014	$ 942,654.89	$ 1,139,524.60	$ 1,692,915.70	$ 2,928,496.10
2015	$ 994,622.65	$ 1,160,561.40	$ 1,669,549.50	$ 2,181,929.30
2016	$ 1,076,522.20	$ 1,102,799.50	$ 1,981,732.10	$ 3,314,900.50

Table 3: First stage of the 2-stage least square regression, Relative compensation
This table shows the results of the first stage of the 2-stage least square regression run between Relative cash-based incentive compensation and market-based risk-estimators and Relative equity-based compensation and the market-based risk-estimators. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01

	Relative cash-based incentive compensation	Relative equity-based compensation
ROA	4.292***	1.980**
	(0.000)	(0.022)
Marginal tax rate	-0.002	-0.172
	(0.897)	(0.450)
Bank size	0.010	0.108***
	(0.727)	(0.002)
Leverage	-0.296	-0.070
	(0.806)	(0.639)
CEO age	0.070***	0.020
	(0.000)	(0.346)
CEO tenure	-0.060***	-0.021
	(0.000)	(0.313)
Observations	710	710

Table 4: First stage of the 2-stage least square regression, Total compensation
This table shows the results of the first stage of the 2-stage least square regression run between Total cash-based incentive compensation and market-based risk-estimators and Total equity-based compensation and the market-based risk-estimators. P-values are presented in the parentheses. *, ** and *** indicate a significance level of 0.1, 0.05 and 0.01

	Total cash-based incentive compensation	Total equity-based compensation
ROA	13.981***	5.599
	(0.002)	(0.504)
Marginal tax rate	0.194	0.026
	(0.104)	(0.906)
Bank size	0.176	1.313***
	(0.330)	(0.000)
Leverage	-1.827**	-2.92
	(0.020)	(0.046)
CEO age	0.191*	0.258
	(0.087)	(0.213)
CEO tenure	-0.160	-0.308
	(0.135)	(0.122)
Observations	710	710

8.2 Figures

Figure 1

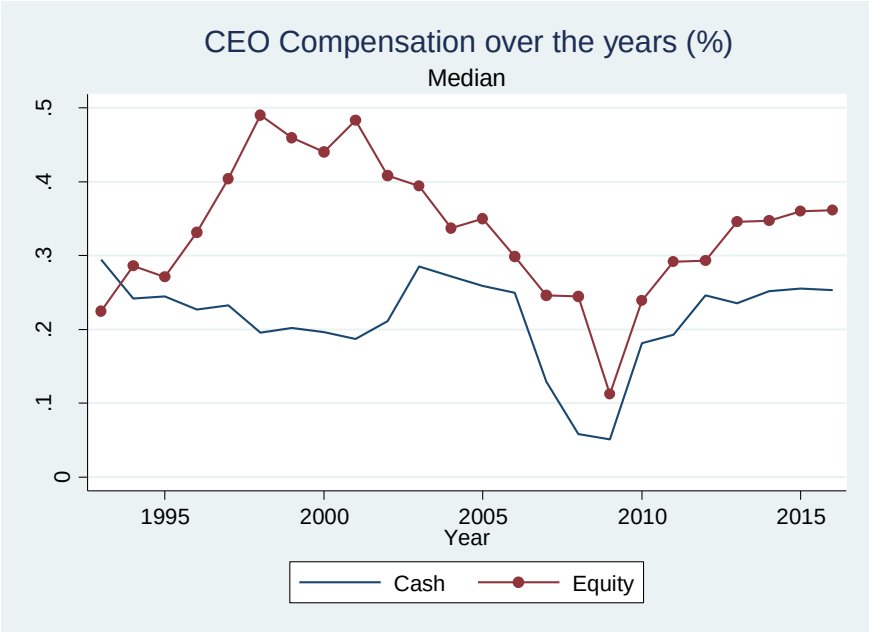
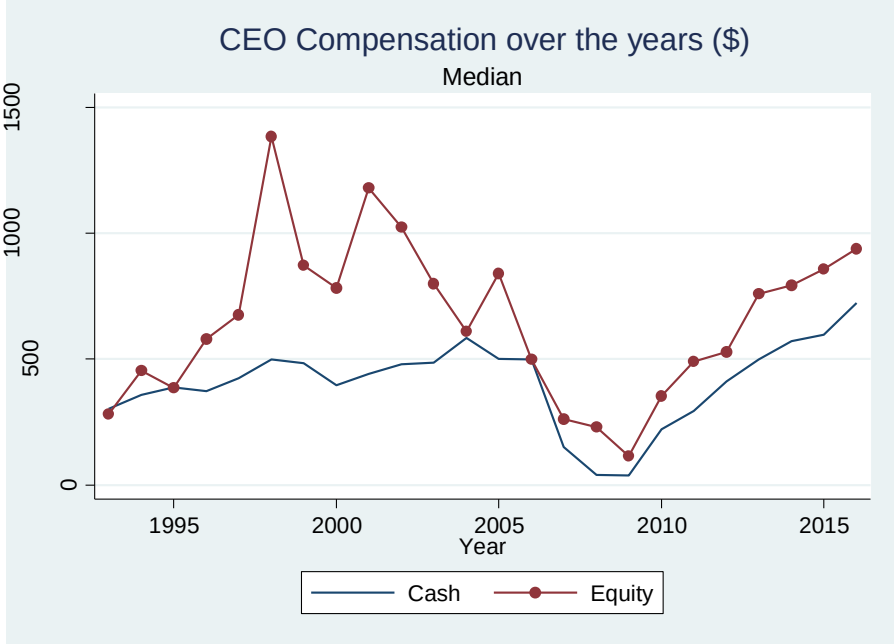


Figure 2



8.3 Variable information and Databases

Variable	Description
Bank size	Calculated as the natural logarithm of total assets; Obtained from Compustat Bank Database;
CEO age	The CEO's age. Obtained from the Execucomp Database;
CEO tenure	Years that the CEO is in office. Calculated as year minus year CEO became CEO. Obtained from the Execucomp Database;
CEO Gender	A dummy variable that has the value 1 when the CEO is a male, and 0 otherwise; Obtained from the Execucomp Database;
Idiosyncratic risk	Calculated as the standard deviation of the residuals using a two-factor market model using daily stock returns obtained from the CRSP database, daily market return on the CRSP value weighted index and the daily three-month T-bill yield obtained from the Federal Bank of St. Louis;
Leverage	The leverage-ratio, total debt divided by total assets; Obtained from Compustat Bank Database;
Marginal tax rate	Dummy variable that has the value 1 when the bank has a tax-loss carry forward in any of the past three years. Obtained from the Compustat Bank Database;
Relative cash-based incentive compensation	Ratio that captures the relative importance of cash-based incentive compensation, calcuated as Total cash-based incentive compensation/ total compensation. Obtained from the Execucomp Database;

Variable	Description
Relative equity-based compensation	Ratio that captures the relative importance of equity-based compensation, calcuated as Total equity-based compensation/ total compensation. Obtained from the Execucomp Database;
ROA	Return on Assets, calculated as Net income/Total assets. Obtained from the Compustat Bank Database;
Systematic risk	Calculated as the Market Beta of a two-factor market model using daily stock returns obtained from the CRSP database, daily market return on the CRSP value weighted index and the daily three-month T-bill yield obtained from the Federal Bank of St. Louis;
Systemic risk	Marginal Expected Shortfall introduced by Acharya, Pedersen, Philippon, & Richardson (2010) Calculated as the average return of the individual financial firm for the 5% worst days of the value-weighted market return using daily stock returns obtained from the CRSP database;
Total cash-based incentive compensation	CEO compensation for the individual year derived from cash-based compensation, including Cash Bonus, Long-term incentive plans and (other) Non-equity incentives. Obtained from the Execucomp database;
Total compensation	Total CEO compensation for the individual year, including Salary, Bonus, Restricted Stock Granted, Total Value of Stock Options Granted, Long-Term Incentive Payouts, and All Other Total. Obtained from the Execucomp database;

Variable	Description
Total equity-based compensation	CEO compensation for the individual year derived from equity-based compensation, including Stock awards and Stock options. Obtained from the Execucomp database;
Total risk	Stock volatility. Calculated as the annualized standard deviation of daily returns obtained from the CRSP database;
Z-score	Z-score firstly introduced by Roy (1952). Measurement for distance to insolvency. Calculated as the natural logarithm of (ROA+CAR)/ σROA. Where ROA is the return on assets, calculated as Net income/ Total assets and CAR is the Capital Asset Ratio. All obtained from the Compustat Bank Database;

8.4 List of banks included in the sample

	Bank Name	Sic code		Bank Name	Sic code
1	Ameris Bancorp	6020	42	Mercantile Bankshares Corp	6020
2	Anchor Bancorp Wisconsin Inc	6035	43	N B T Bancorp Inc	6020
3	Astoria Financial Corp	6035	44	National Penn Bancshares Inc	6020
4	Bank Mutual Corp	6035	45	New York Cmnty Bancorp Inc	6036
5	Bank Of The Ozarks Inc	6020	46	Northern Trust Corp	6020
6	Bankunited Financial Corp	6035	47	Northwest Bancshares Inc	6035
7	Banner Corp	6020	48	Ofg Bancorp	6020
8	BB&T Corp	6020	49	Old National Bancorp	6020
9	Bbx Capital Corp	6035	50	People's United Finl Inc	6036
10	Bofi Holding Inc	6035	51	Privatebancorp Inc	6020
11	Boston Private Finl Holdings	6020	52	Prosperity Bancshares Inc	6020
12	Cascade Bancorp	6020	53	Provident Bankshares Corp	6020
13	Cathay General Bancorp	6020	54	Provident Financial Grp Inc	6020
14	Charter One Financial Inc	6020	55	Provident Financial Svcs Inc	6036
15	Chemical Financial Corp	6020	56	Riggs National Corp	6020
16	City Holding Co	6020	57	S & T Bancorp Inc	6020
17	Commercial Federal Corp	6035	58	Santander Holdings Usa Inc	6020
18	Community Bank System Inc	6020	59	Simmons First Natl Cp -Cl A	6020
19	East West Bancorp Inc	6020	60	South Financial Group Inc	6020
20	F N B Corp/Fl	6020	61	Southside Bancshares Inc	6020
21	Fidelity Southern Corp	6020	62	Staten Island Bancorp Inc	6035
22	First Bancorp P R	6020	63	Sterling Bancorp	6020
23	First Finl Bancorp Inc/Oh	6020	64	Sterling Bancshares Inc/Tx	6020
24	First Finl Bankshares Inc	6020	65	Sterling Financial Corp/Wa	6036
25	First Midwest Bancorp Inc	6020	66	Susquehanna Bancshares Inc	6020
26	First Niagara Financial Grp	6020	67	Svb Financial Group	6020
27	Firstfed Financial Corp/Ca	6035	68	Tcf Financial Corp	6020
28	Flagstar Bancorp Inc	6035	69	Td Banknorth Inc	6020
29	Fulton Financial Corp	6020	70	Tompkins Financial Corp	6020
30	Glacier Bancorp Inc	6020	71	Trustco Bank Corp/Ny	6035
31	Golden West Financial Corp	6035	72	U S Bancorp	6020
32	Greenpoint Financial Corp	6036	73	U S Bancorp/De-Old	6020
33	Hancock Holding Co	6020	74	U S Trust Corp	6020
34	Huntington Bancshares	6020	75	Ucbh Holdings Inc	6020
35	Independent Bank Corp/Ma	6020	76	Umb Financial Corp	6020
36	Independent Bank Corp/Mi	6020	77	Umpqua Holdings Corp	6020
37	Intl Bancshares Corp	6020	78	United Bankshares Inc/Wv	6020
38	Irwin Financial Corp	6020	79	Valley National Bancorp	6020
39	Legacy Tex Financial Grp Inc	6020	80	Wachovia Corp	6020
40	Jpmorgan Chase & Co	6020	81	Wachovia Corp-Old	6020
41	Marshall & Ilsley Corp	6020	82	Washington Federal Inc	6020

	Bank Name	Sic Code		Bank Name	Sic Code
83	Washington Mutual Inc	6035	87	Wilmington Trust Corp	6020
84	Webster Financial Corp	6020	88	Wilshire Bancorp Inc	6020
85	Westamerica Bancorporation	6020	89	Wintrust Financial Corp	6020
86	Whitney Holding Corp	6020	90	Zions Bancorporation	6020

8.5 SIC codes included in the database

SIC codes	explanation
6020	Commercial banks
6035	Federal savings institution
6036	Savings institutions, except federal