# CEO Incentives and Bank Risk over the Business Cycle

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## Abstract

Due to government guarantees provided to financial firms, bank shareholders have a natural preference for taking excessive risks at the expense of debt holders and taxpayers (risk-shifting). We propose and test a joint hypothesis that risk-shifting incentives become more prominent as economic conditions deteriorate and that shareholders' increased risk appetite leads to a stronger relationship between managerial risk taking incentives and bank risk in a contracting economy. Consistent with this hypothesis, we find that the same level of risk taking incentives given to a manager through stock-based compensation leads to higher bank risk during macroeconomic downturns. Our results suggest that holding sufficiently high amount of bank capital limits this effect, making the compensation-bank risk relationship less sensitive to the underlying macroeconomic environment.

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## 1. Introduction

Following the onset of the 2007-2008 financial crisis, compensation practices in the financial industry have come under scrutiny with the popular belief that they lead to excessive risk taking. Following the crisis, governments in the US, UK, and Europe have taken steps to regulate bank managers' pay packages (e.g. Dodd-Frank Act) with the aim of limiting the excessive risk taking implications of executive compensation.

Related to these developments, there is a growing academic and policy interest in investigating the relationship between bank risk and managerial compensation. In particular, recent theoretical studies have argued that aligning managerial incentives with shareholders' incentives through stock-based pay, a practice that is normally considered as good governance behavior in non-financial firms, may in fact exacerbate risk-taking in the banking sector (Bolton et al., 2015; Eufinger and Gill, 2016; Thanassoulis and Tanaka, 2017; Kolm et al., 2017). Due to the government guarantees provided to financial firms, bank shareholders do not fully bear the losses in case of failure. Hence, they have a natural preference for risky lending (Allen and Gale, 2000), taking excessive risks at the expense of debt holders and taxpayers (risk-shifting). To the extent that shareholders can pass their risk-shifting incentives onto the manager via stock-based compensation, banks that compansate their Chief Executive Officers (CEOs) mostly with stock tend to shift more risk to debt holders and tax payers (Eufinger and Gill, 2016; Kolm et al., 2017).

In this paper we emphasize that banks' likelihood of financial distress increases when macroeconomic conditions deteriorate due to the widespread weakening of balance sheets (Mishkin, 1999). This increase in financial distress probability is likely to exacerbate bank shareholders' risk-shifting incentives (Gale and Allen, 2000). Motivated with this background, we propose and test a joint hypothesis that the risk-shifting incentives become more prominent during macroeconomic contractions and that this increase in shareholders' risk appetite leads to a stronger relationship between managerial risk-taking incentives and bank risk. This is because shareholders' increased risk tolerance is passed on to the manager (through CEO's stock ownership), leading the sensitivity of bank risk to CEO risk-taking incentives to increase during contractions. That is, shareholders' state-dependent risk-shifting preferences imply a state-

dependent compensation-bank risk relationship. Therefore, our joint hypothesis implies a counter-cyclical link between managerial risk-taking incentives and bank risk. The alternative hypothesis is that during macroeconomic downturns managers may become more risk averse due to a larger possible loss in their expected wealth if the bank becomes insolvent during a bad state of the economy (Raviv and Şişli-Ciamarra, 2013).

To test these hypotheses, we use a quarterly panel dataset, covering the US public bank holding companies (BHC) between 1996 and 2013, a period that includes two business cycles. Our measure of managerial risk-taking incentives is the ratio of vega to cash compensation (vega/cash). We calculate vega as the change in the dollar value of a CEOs accumulated stock and stock options for a 0.01 change in the annualized standard deviation of stock returns (Core and Guay, 1999). This measure captures the magnitude of CEO's stock-based risk incentives relative to her risk-dampening cash earnings and aligns our empirical specification with the theoretical literature (e.g., Eufinger and Gill, 2016). In accordance with the extant literature, we use realized stock return volatility as a measure of bank risk (Acharya et al., 2014). We also decompose total risk into its systematic and idiosyncratic components and consider them as additional measures of bank risk. To capture banks' downside risk, we calculate tail risk, which is equal to the BHC's average equity loss on days of extremely negative events experienced by the banks (Ellul and Yerramilli, 2013; Van Bekkum, 2016; Bushman et al., 2017). Our main measure for the underlying macroeconomic state is the seasonally-adjusted real GDP growth rates.

Using GDP growth rates, we show that there is in fact a state-dependent relationship between managerial risk taking incentives and bank risk. In particular, in quarters when GDP contracts (grows) by one percentage point, a one percent increase in vega/cash ratio leads to a 0.024 percent increase (decrease) in bank risk. To state the impact in economic terms, consider that the GDP growth rate is at its minimum (-6.1 percent, 2009 Q2). In such a state, increasing bank manager's risk-taking incentives from its median value (vega/cash ratio = 3.7 percent) to its 75th percentile (vega/cash ratio = 9.6 percent) would be associated with a 24 percent increase in bank risk. This result is robust to using alternative measures of macroeconomic state as well as alternative proxies for bank risk.

Better risk management practices within a BHC can influence the level of bank riskiness. Therefore, we also consider the strength and quality of the bank's risk management function using an index constructed by Ellul and Yerramilli (2013). We find that our results remain unchanged when we include this measure in our analysis.

An important concern in empirical compensation studies is the endogenous nature of the relationship between bank risk and compensation contracts (Murphy, 2012). We have two further endogeneity concerns specific to this study. First, the relationship between bank risk and managerial risk taking incentives might be correlated with an omitted factor that is related to economic growth. Consequently the interaction of vega/cash and the macroeconomic state may be endogenous with respect to risk taking. Second, the economic state may have a direct impact on the value of managerial incentives because stock prices tend to be lower during contraction periods, which may lead to a mechanical decrease in the value of vega/cash for a fixed amount of stock option holdings. Due to these concerns, we reestimate our regressions using the instrumental variables (IV) approach. We find that our results are robust to the consideration of the endogenous nature of compensation contracts.

The rest of the paper aims at uncovering whether cross-sectional differences in bank, governance and managerial characteristics affect the results we have documented so far. First, we find that our result holds only for those banks whose Tier-1 capital ratio is below 10 percent. This finding suggests that holding sufficiently high amount of bank capital limits the risk inducing effects of vega/cash during downturns, making the CEO compensation-bank risk relationship less sensitive to the underlying macroeconomic environment.

Second, we check whether our results are sensitive to bank size. Larger banks that are considered to be too big to fail (TBTF) are more likely to receive government support due to the systemic risk they pose to the financial system. Therefore, shareholders of big banks are particularly susceptible to the moral hazard problem that leads to increased risk-shifting incentives in times of economic contraction. Consistent with this conjecture, we find that the risk-amplifying effects of manager's vega/cash ratio are larger for TBTF banks.

Third, we examine managerial power because an executive's ability to adjust the bank's risk profile over a short period of time depends critically on her managerial power over the bank's resources. If indeed the proposed effect of compensation on bank risk is due to the manager's actions, then we would expect our results to be more pronounced in banks that are run by more powerful CEOs. Using CEO tenure as a measure of managerial power over the bank's resources, we show that the counter-cyclical relationship between the executive's risk-taking incentives and bank risk is valid only for those banks that are managed by seasoned CEOs.

Our research contributes to prior empirical studies, which show that the strong alignment of shareholder and manager interests aggravates the risk-shifting problem. For example, Fahlenbrach and Stulz (2011) suggest that bank executives whose incentives were better aligned with shareholder interests performed worse during the US financial crisis. Similarly, banks that had higher CEO performance pay prior to the crisis were more likely to receive government support (Adams, 2012) and they had a higher probability of failure during the crisis, especially if they were highly levered banks (Boyallian and Ruiz-Verdú 2017). In addition, banks in which executives were more insulated from shareholders were less likely to be bailed out during the crisis (Ferreira et al. 2016). Consistently, Laeven and Levine (2009) and Westman (2010) show that high shareholder power within a bank's governance structure is associated with higher bank risk. Our results also provide empirical support to the recent theoretical literature, which highlights the importance of restricting convex CEO pay schemes to curb the excessive risk taking implications of bank shareholders' moral hazard problem (Thanassoulis and Tanaka, 2017) by documenting the amplified risk-taking impact of CEO's vega/cash ratio during economic contractions.

We also contribute to the empirical literature that examines the effects of managerial compensation on bank risk. Cheng et al (2015) focuses on CEO's total compensation and shows that banks with higher executive compensation had higher return volatility, and were more likely to be in the tails of performance during the crisis. DeYoung, Peng, and Yan (2013) show that higher pay-for-risk incentives are associated with higher idiosyncratic and systematic bank risk. Similarly, Chesney et al. (2016) finds a positive link between banker's asset-based risk-taking

incentives and write-downs during the crisis; yet they show that this relationship disappears when they use equity risk-taking incentives. Acharya et al. (2014) and Ellul and Yerramilli (2013) also find CEO vega to be an insignificant determinant of bank risk. Van Bekkum (2016) focuses on debt-based compensation and finds that, unlike stock-based managerial pay, it limits bank risk by encouraging more conservative decision making. Yet, none of these studies analyze the sensitivity of the link between CEO compensation and bank risk to the macroeconomic environment. To our knowledge, this is the first empirical study that investigates the variability of the CEO compensation – bank risk relationship over the business cycle.

Overall, our results suggest that policy makers designing regulatory reform with the aim of limiting excessive bank risk should take into account the state-dependent link between managerial compensation and bank risk. Our findings also shed light on the likely consequences of the interaction between capital regulations and compensation regulations that simultaneously aim at reducing excessive bank risk.

The rest of the paper is organized as follows. We describe our data and variables in Section 2, and report the main results in Section 3. We present the results from our instrumental variables regressions in Section 4, and the results of additional robustness tests in Sections 5 to 8. Section 9 concludes the paper.

## 2. Data and Variables

### 2.1 Sample Construction

To construct our sample of publicly traded banks, we gather data from several sources. We obtain quarterly balance sheet and income statement information from the Bank Regulatory database of the Federal Reserve Bank of Chicago, which collects data from the FR Y-9C reports that banks are required to file with the Federal Reserve for the period 1996-2013. We merge this dataset with financial data from Compustat and with stock price data from Center for Research in Security Prices (CRSP).

For each bank's Chief Executive Officer (CEO), we gather compensation data including

salary, bonus, stock option grants, restricted stock grants and total pay from ExecuComp. However, this dataset is compiled on an annual rather than quarterly basis. Hence, we match quarterly bank information with annual compensation data and assume that managers base their financial decisions on the value of their annual compensation rather than quarterly amounts.

ExecuComp database does not have available information for all BHCs in our sample. Therefore, the inclusion of executive pay data limits our sample size to 207 BHCs. Our final sample size ranges between 6,006 and 6,034 bank-year observations depending on the specification. The list of banks in our final sample is reported in Appendix 1.

### 2.2 Variable Definitions

#### 2.2.1 Compensation Variables

ExecuComp database contains detailed data on managerial pay components including cash compensation (i.e., salary and bonus) and stock compensation (i.e., stock and options).[1] The reporting of compensation variables has changed due to the implementation of the FAS 123R regulatory standard after December 15, 2006. We follow Hayes et al. (2012) to make the necessary adjustments to these variables in the post-2006 period.

As standard in empirical literature, we measure CEO risk taking incentives by vega, the change in the dollar value of a CEO‘s accumulated stock and stock options for a 0.01 change in the annualized standard deviation of stock returns (Core and Guay, 1999; Coles et al., 2006). We then divide vega by CEO’s cash compensation (salary plus bonus). Cash compensation have been shown to curb managerial risk taking. Therefore, vega to cash ratio allows us to capture the magnitude of stock based risk taking incentives relative to the manager’s risk dampening cash earnings. Defining CEO this way aligns our empirical specification with related theoretical models (e.g. Eufinger and Gill, 2016), which suggest that banks that incentivize their managers mostly by stock based pay tend to take more risk.

[1] If option or stock holdings are missing in ExecuComp database, we set their values to zero. In addition, we replace observations with negative bonus values with zero. Also, if for a given year CEO tenure data is missing, we hand-collect and fill in the missing information by searching bank 10-K reports and online resources.

Since our analysis focuses on bank risk, we emphasize the results regarding the effect of risk taking incentives (i.e. vega/cash ratio), but we also control for performance incentives provided to managers. Controlling for performance incentives is important because they, too, can affect the manager's risk taking behavior.[2] We measure performance incentives by delta, the change in the dollar value of a CEO's wealth for a one percent change in the stock price (Core and Guay, 1999; Coles et al., 2006). We divide delta by cash compensation to capture the magnitude of CEO's stock-based performance incentives relative to her cash earnings.

We winsorize delta, vega, bonus and salary variables at the 1st and 99th percentiles (as in Core and Guay, 2002; Coles et al., 2006; Acharya et al., 2014; Chesney et al., 2016). To account for the effect of inflation, we use the GDP deflator to convert the compensation and bank financial variables to 1992 dollars.

### 2.2.2 Bank Risk Variables

To capture the riskiness of BHCs in our sample, we employ various measures of bank risk that are standard in the literature. Our first measure is total risk, which is equal to the annualized variance of daily stock returns in a given quarter. It is a widely used proxy for bank risk (DeYoung et al., 2013; Ellul and Yerramilli, 2013; Acharya et al., 2014). Stock-return volatility is an informative measure of bank riskiness because shocks to a bank's stock returns are reactions to the news about the bank's future expected cash flows resulting from its investment and financing activities. Therefore, realized stock return volatility should reflect business decisions that influence the bank's expected cash flow volatility. To analyse the systematic and unsystematic components of total bank risk, we estimate the market model using CRSP value-weighted returns as our proxy for the returns on the market portfolio (Bhattacharyya and Purnanandam, 2011; DeYoung et al., 2013). To obtain market betas, we regress bank excess returns on market excess returns. We compute unsystematic risk as the annualized variance of the residuals from the market model and the systematic risk as the variance of the product of the bank beta and the

[2] If higher net present value projects (NPV) are also inherently riskier, then higher performance incentives can increase bank risk. Yet, they can also reduce risk taking, because a risk averse manager may reject risky but high NPV projects to maintain the value of her portfolio due to her organization-specific human capital or undiversified wealth portfolio (Amihud and Lev, 1981; Tufano, 1996).

market daily returns.

Since it is the banks' downside risk that is of critical importance to shareholders, we also consider an additional measure of bank riskiness called the tail risk. This variable captures the average equity loss on days of extremely negative events specific to the individual bank. Similar to prior studies, we define tail risk as the average return on the bank's equity over the 10% worst return days for the bank's stock in a given quarter (Ellul and Yerramilli, 2013; Van Bekkum, 2016; Bushman et al., 2017). We employ the negative of this measure, so higher values indicate higher downside risk.

### 2.2.3 Control Variables

In our analysis of the relationship between executive compensation and bank risk, we use the standard set of control variables, which may influence BHC risk independently from executive incentives (Ellul and Yerramilli, 2013; Acharya et al., 2014).

We control for bank size (Total Assets) since, larger banks, if more diversified, would be less risky. We also include bank profitability (ROA) in our list of control variables. This is because banks that miss their target returns may be more inclined to undertake riskier investments. We include the Deposits/Assets in our specification since banks with more deposits may have a higher likelihood of receiving government support upon financial distress. In addition, we control for Tier-1 Capital/Assets because banks that lack sufficient amount of capital may be more exposed to insolvency in times of distress, and hence can exhibit more conservative preferences in their investment policy. Or alternatively, lower capital ratios can be due to a riskier business model, hence may be associated with higher bank risk. To capture additional factors that are related to the balance sheet composition of banks, we also control for Loans/Assets ratio. As a measure of loan portfolio quality, we employ Bad Loans/Assets ratio, where Bad Loans include non-accrual loans and loans past due 90 days or more. To gauge bank's reliance on off-balance-sheet activity, we use Non-interest Income/Income. This latter variable also captures the diversification of banking activities. Banks engaged in multiple lines of business may be more willing to take on risk. Since bank risk can depend on the type of activities it pursues, we further

control for the impact of diversification by including Insurance Assets/Assets and Underwriting Assets/Assets in our specification. Additionally, we control for derivative usage of banks with Derivative Hedging/Assets and Derivative Trading/Assets.

Prior research documents that CEOs with longer tenure and higher cash compensation are more likely to be entrenched and seek to avoid risk (Coles et al., 2006; Hayes et al., 2012). Therefore, we include Cash Compensation (salary plus bonus) and CEO Tenure to proxy for the CEO's level of risk aversion. Variable descriptions are available in Appendix 2.

Table 1 presents summary statistics on the compensation variables and bank financial characteristics. Mean (median) total assets is $93.8 bn. ($11.7 bn) in 1992 dollars. Median vega is $30,740, median delta is $153,470, and median cash compensation is $832,780. This translates into a median vega/cash ratio of 3.71 and a median delta/cash ratio of 16.2. As Figure 1 shows there is considerable variation in the vega/cash ratio over our sample period.

### 2.2.4 Macroeconomic Indicators

We use four different variables to measure the state of the macroeconomy. To capture the degree of macroeconomic contractions and expansions, we first conduct our analysis using a continuous indicator of economic activity, i.e. the seasonally-adjusted real GDP growth rates. We consider the unrevised announcement values of the variables to capture the macroeconomic climate as perceived by the banks during a fiscal year.[3]

Our second measure of macroeconomic activity is a macroeconomic contraction indicator variable based on the Chicago Fed National Activity Index (CFNAI). CFNAI represents the first principal component of 85 monthly indicators of national economic activity. It is computed following the methodology in Stock and Watson (1999). The index has an average value of zero and a standard deviation of one. A positive value represents growth above trend and a negative

[3] Revised values are released with a substantial lag, hence are unlikely to be within the information set of the bank executive in a given quarter. Using unrevised data has a number of advantages over fully revised data for the purposes of real-time forecasting. For a detailed discussion, see Swanson (1996). We obtain the unrevised values from Action Economics.

value corresponds to growth below trend.[4] An important advantage of the CFNAI is that it relies only on the data that are publicly known at the time of its release. Hence, compared to an ex-post measure of the economic state (such as business cycle dates determined by the NBER), it is better suited to capture the manager's real time assessment of the aggregate economy. According to the Chicago Fed, a decline in the 3-month moving average of the index below -0.7 represents an increasing probability that a recession has begun. An increase above 0.2 represents a significant probability that a recession has ended (Basistha and Kurov, 2008).

Third, since both the GDP measure and the CFNAI are backward-looking determinants of economic activity due to lags associated with lengthy data collection and analysis processes, we also consider a forward-looking indicator of economic outlook based on the Yale/Shiller crash confidence index for institutional investors[5]. The Yale/Shiller index is equal to the percent of survey respondents who attach little probability (less than 10 percent) to a stock market crash in the next six months. So, higher values represent an improvement in stock market confidence in percentage terms. For each bank i, we take the average of the index value that corresponds to the bank's fiscal quarter ending in calendar quarter t. To facilitate coefficient interpretation, we standardize this variable by subtracting its sample mean from the value of the index and dividing it by the sample standard deviation so that the resulting variable (Confidence Index) has a mean of zero and a standard deviation of one.

Finally, in addition to the state of the economy itself, aggregate policy environment surrounding the economy may also affect bank manager's decisions. This is because the manager's moral hazard problem and the resulting risk-shifting incentives are also sensitive to changes in economic policies. Here, it is worth noting that the economic policies that may influence the bank shareholders' risk-shifting motives are not just confined to the regulatory changes in capital requirements, deposit insurance schemes or government guarantees, which directly affect the banking sector. They may also include the accommodative fiscal and monetary policies that support financial institutions indirectly, even though the primary aim of the policies

[4] We obtain CFNAI data from https://www.chicagofed.org/research/data/cfnai/historical-data.
[5] The data and a detailed explanation of the survey that the index is based on are available at http://icf.som.yale.edu/stock-market-confidence-indices-explanation

may be to help prop up the real sector. Therefore, it is important to consider the aggregate economic policy environment and not just the banking sector related policy actions when we analyze the relationship between CEO risk taking incentives and bank riskiness.

To consider this possibility, we employ the Baker, Bloom and Davis (2016) index, which measures the aggregate economic policy uncertainty in the US as a weighted average of three distinct components. The first component is based on a count of newspaper articles containing keywords related to economic policy uncertainty. The second component measures uncertainty about future changes in tax code and the third one uses dispersion in economic forecasts of inflation and government spending to proxy for uncertainty about fiscal and monetary policy. Using this index, for each bank, we calculate the economic policy uncertainty variable (henceforth, EPU index) as the arithmetic average of the original BBD index during the three months of the bank's fiscal quarter. Similar to Confidence Index, we use the standardized version of this variable, so that EPU index has a mean of zero and a standard deviation of one.

Figure 2 plots the GDP growth rate together with the contraction periods as identified by our recession indicator variable. During our sample period, the minimum value for the GDP growth measure is -6 percent (2009 Q2) and the maximum value is 7 percent (2003 Q4). With regards to the unstandardized value of Confidence Index, the minimum value over our sample period is 18 (2009 Q1) and the maximum value is 58 (2006 Q2)[6]. The corresponding quarterly (unstandardized) values for the minimum EPU index is 43 (2006 Q4) and the maximum EPU index is 192 (2011 Q3) over our sample period[7].

As can be seen from these figures, the EPU index is negatively correlated with both the GDP growth rate (–0.52 correlation coefficient) and the Confidence Index (–0.42 correlation coefficient). The correlation between the GDP growth rate and the Confidence Index, on the other hand, is positive (0.23 correlation coefficient). Hence, although the three indicators are clearly related to each other, they are far from being perfectly correlated, which enables us to capture different facets of the macroeconomic dynamics that drive the risk-compensation

[6] The standardized Confidence Index range is [-1.79, 2.65].
[7] The standardized EPU Index range is [-1.28, 2.62].

relationship in the banking industry.

## 3. Results

### 3.1 Baseline Specification

We use the following empirical specification to test the relationship between stock-based managerial incentives and bank risk.

Equation 1:

$$Bank\ Risk_{i,t} = \alpha + \beta\left(\frac{Vega}{Cash\ Compensation}\right)_{i.t-1} + \gamma\ X_{i,t} + \varepsilon_{i,t}$$

Our primary measure of bank risk is stock return volatility, which is equal to the annualized volatility of daily stock returns in quarter t. We also decompose total risk into systematic and unsystematic components and consider them as additional measures of bank risk. All risk variables enter the regressions in their natural log forms. Our main variable of interest is vega/cash.

We also control for other components of CEO pay that have been shown to affect risk-taking behaviour, namely delta/cash and cash compensation (salary plus bonus). To mitigate endogeneity concerns, as in Coles et al. (2006), we use the lagged values of vega/cash, delta/cash and cash compensation in our specifications. The compensation variables enter the regressions in their natural logarithm forms. The vector $X_{i,t}$ includes a standard list of control variables used in the literature (as discussed previously in the data section). All regressions are estimated with bank and year fixed effects. Bank fixed effects are used to mitigate the concern that unobservable bank characteristics might be affecting both the structure of executive compensation and bank risk outcomes; year fixed effects help capture systemic variations in bank risk over time. We cluster the robust standard errors at the bank level.

We present the baseline results in Table 2. Our results indicate that vega/cash ratio does not have a statistically significant effect on bank risk. This finding is in line with the estimates reported in the literature - Ellul and Yerramilli (2013), Acharya et al. (2014) and Chesney et al.

(2016) report vega to be an insignificant determinant of bank risk.[8] Our results also support the previously documented depressive effects of managerial performance incentives on bank risk.[9] After controlling for the other determinants of stock return volatility, a one percent increase in delta/cash ratio translates into a 0.095 percent decrease in bank risk. Expressing the effect in economic terms, increasing delta/cash from its median (16.2) to its 75th percentile (35.5) is associated with an 11 percent decrease in bank risk (Table 2, column 1). We find similar depressive effects for the BHC's downside risk and its unsystematic risk.

To summarize, in line with the prior literature, our baseline regressions exhibit an insignificant relationship between bank risk and lagged CEO risk-taking incentives; and provide some support with respect to the depressive effects of CEO performance incentives on risk-taking.

### 3.2 Bank Risk and CEO Compensation Relationship over the Business Cycle

In this section, we test our main hypothesis that the relationship between bank risk and managerial risk taking incentives strengthens during macroeconomic downturns. In order to test this hypothesis, we augment our baseline model (Equation 1) by adding measures of macroeconomic state and interactions of these measures with managerial incentives.

Equation 2:

$$
\begin{aligned}
Bank\ Risk_{i,t} = \alpha + \beta_1 \left(\frac{Vega}{Cash\ Compensation}\right)_{i.t-1} + \beta_2 \left(\frac{Delta}{Cash\ Compensation}\right)_{i.t-1} \\
+ \delta_1 Macroeconomic\ State_{i,t} + \delta_2 \left(\frac{Vega}{Cash\ Compensation}\right)_{i.t-1} \\
* Macroeconomic\ State_{i,t} + \delta_3 \left(\frac{Delta}{Cash\ Compensation}\right)_{i.t-1} \\
* Macroeconomic\ State_{i,t} + \gamma\, X_{i,t} + \varepsilon_{i,t}
\end{aligned}
$$

[8] Since prior studies use vega and delta instead of their ratios with respect to cash compensation, we re-estimate the baseline regression using vega and delta as well and find that our results remain unchanged.

[9] Pay–for-performance incentives may reduce risk taking because of a desire to limit portfolio risk. CEOs tend to be more risk averse than diversified shareholders due to their organization-specific human capital and their undiversified wealth portfolios (Amihud and Lev, 1981; Smith and Stulz, 1985; Tufano, 1996). On the empirical side, Acharya et al. (2014), Van Bekkum (2016) and Chesney et al. (2016) also find CEO delta to have a depressive effect on bank risk.

To capture the effect of macroeconomic conditions on bank risk, first, we estimate Equation 2 using real GDP growth rates. Interaction of the macroeconomic state variable with vega/cash ratio is our main coefficient of interest ($\delta_2$). Our hypothesis states that risk shifting incentives become more prominent during contractions and that this increase in risk shifting incentives leads to a stronger relationship between stock-based CEO pay and bank risk in a contracting economy. Since negative GDP growth rates indicate a contracting economy, our hypothesis predicts a negative coefficient on the interaction term of GDP growth rate with vega/cash, producing a positive (i.e. stronger) effect on bank risk.

Since for each calendar quarter not all banks' fiscal quarters end in the same month, there is some cross sectional variation in our macroeconomic variables for each t. Hence, the macroeconomic variables carry a bank subscript as well. This allows us to include year fixed effects in our specifications and control for other possible time-varying factors that may drive the compensation-bank risk relationship.

We present the results in Table 3, Panel A. Columns 1-4 employ total risk, tail risk, unsystematic and systematic risk as a measure of bank riskiness. In line with the prediction of our hypothesis, we obtain a negative and statistically significant coefficient on the interaction term for vega/cash in all specifications.

Focusing on total risk first, we find that the coefficient on the interaction term is -0.024 and statistically significant at the one percent level (column 1). This coefficient suggests that, in quarters when GDP contracts by one percentage point, a one percent increase (decrease) in vega/cash ratio leads to a 0.024 percent increase (decrease) in bank risk. To state the impact in economic terms, consider that the GDP growth rate is at its minimum (-6.1 percent). In such a state, increasing bank manager's risk-taking incentives from its median value (vega/cash ratio = 3.7 percent) to its 75th percentile (vega/cash ratio = 9.6 percent) would be associated with a 23 percent increase in bank risk.

Showing that our results hold for unsystematic risk is important because it helps address

the concern that our first bank risk measure, stock return volatility, is correlated with the macroeconomic state. Re-estimating equation 2 with systematic risk and unsystematic risk, we find similar results: Increasing vega/cash from its median to 75$^{th}$ percentile value leads to a 12 (20) percent increase systematic (unsystematic) risk when GDP growth rate is at its minimum. Reassuringly, the coefficient magnitudes associated with unsystematic risk are consistent with the total risk results. Later, in the endogeneity section, we will directly address this concern in more detail.

To capture BHC's downside risk, we also conduct our analysis using the Tail Risk measure (Table 3, Panel A, column 2). The coefficient estimates suggest that when GDP contracts (grows) by one percentage point, a one percent increase in vega/cash ratio leads, on average, to a -.008 percent increase (decrease) in Tail Risk. This implies that if the GDP growth rate is at its minimum, increasing vega/cash from its median to 75$^{th}$ percentile value would lead to about an 8 percent increase in Tail Risk.

We note that in all specifications, the coefficient on GDP is significant and negative, reflecting increased bank risk level during periods of declining GDP. We also find that, during periods of near zero GDP growth rate, the effect of CEO risk incentives on bank risk is negligible as evidenced by the insignificant coefficient on the individual vega/cash variable. In sum, the results from Table 3, Panel A indicate that higher vega/cash ratio is associated with higher risk taking during periods of declining GDP.

Our second measure of macroeconomic activity is the Chicago Fed National Activity Index (FED Index), where a positive value represents growth above trend and a negative value corresponds to growth below trend. Hence, similar to GDP, we predict a significant and negative value for the coefficient of the interaction term between vega/cash ratio and the recession indicator. Columns 1 -4 of Table 3, Panel B present the results using FED Index as a proxy for the macroeconomic state. In line with the predictions of our hypothesis, we obtain a statistically significant negative coefficient on the interaction term in all specifications. According to the Chicago Fed, a decline in the index below -0.7 represents an increasing probability that a recession has begun while an increase above 0.2 represents a significant probability that a

recession has ended (Basistha and Kurov, 2008). Therefore, when the index is equal to -1, representing the high likelihood of a recession period, a one percent increase in vega/cash ratio is associated with a 0.047 percent increase in total risk (column 1). To state the economic effect of such a recession on the relationship between risk incentives and bank risk, we calculate the impact of an increase in a CEOs vega/cash ratio from its median (3.7 percent) to its 75th percentile (9.6 percent). An increase in vega/cash of this magnitude is associated with a 7.5 percent increase in total risk.

Next, we consider a forward looking economic indicator, i.e., the confidence index, as a measure of the economic outlook. Since GDP is released with a substantial lag, bank managers may make decisions based on forward-looking indicators. This measure is based on the Yale/Shiller index, which reports the percent of institutional survey respondents who attach very low probability to a stock market crash in the next six months. Hence, higher values of the index represent a more positive outlook for the economy. The results are presented in Table 3, Panel C. Consistent with the findings reported above, the coefficient on the interaction term is negative and statistically significant for all risk measures. Starting with total risk first, we find that the coefficient on the interaction term is -0.058 (column 1), which suggests that if the confidence index is one standard deviation below its mean (index = -1), increasing risk incentive ratio by one percent is associated with 0.058 percent increase in bank risk. However, the same increase would imply a 0.058 percent decrease in bank risk if the confidence index is one standard deviation above its sample average (index = 1). As before, to assess the effect in economic terms, consider the minimum level of the confidence index over our sample period (index = -1.79). In such an environment, increasing vega/cash ratio from its median to its 75$^{th}$ percentile value would be associated with a 17 percent increase in total risk. Overall, the results from Table 3C suggest that, when investors expect a stock market crash in the near term (over the next six months), higher vega/cash ratio tends to generate higher risk taking in BHCs.

Our final measure of macroeconomic state is the Economic Policy Uncertainty (EPU) index introduced by Baker et al. (2016). This measure helps us assess how bank risk is affected when managers face high levels of economic policy uncertainty. Higher values of the EPU index

represent a more uncertain outlook for economic policy. We expect bank manager's risk-shifting incentives to increase when economic policy uncertainty is high due to increased likelihood of government intervention. Therefore, we predict a significant and positive value for the coefficient of the interaction term between vega/cash ratio and EPU index. Consistent with our hypothesis, the coefficient on the interaction term is positive and statistically significant for all risk measures at the one percent level (Table 3, Panel D). In column 1, we find that if the EPU index is one standard deviation above its mean (index = 1), increasing risk incentive ratio by one percent is associated with 0.042 percent increase in bank risk. However, the same increase would imply a 0.042 percent decrease in bank risk if the index is one standard deviation below its sample average (index = 1). To assess the effect in economic terms, consider the maximum level of the EPU index over our sample period (index = 2.62). In such an environment, increasing vega/cash ratio from its median to its 75$^{th}$ percentile value would be associated with an 18 percent increase in total risk.. Our results from Table 3, Panel D suggest that higher policy uncertainty amplifies the relationship between manager's vega/cash ratio and bank risk taking.

One potentially important control variable that can affect bank risk is the strength of the risk management function within the BHC. To measure the quality of risk management function at the bank level, Ellul and Yerramilli (2013) develop the risk management index (RMI), which captures the importance attached to the risk management function within a bank and the quality of risk oversight provided by the BHC's board of directors. However, since RMI is a hand-collected dataset, it covers a subset of the banks in our sample.[10] Therefore, including the RMI in our analysis introduces the caveat of reducing our sample size by about a third. Nonetheless, we check whether our results are sensitive to the quality of risk management function within a bank by re-estimating the regression equation using RMI. We find that the coefficient estimates on the macroeconomic interaction terms remain unchanged, which suggests that our findings are robust to the consideration of the risk management function within a bank.

In this section, we have shown that our results are robust to the use of alternative measures of macroeconmic state. For brevity, in the rest of the paper, we continue the analysis

[10] We thank Andrew Ellul for sharing the RMI data with us.

using GDP growth rates as our main economic indicator.

## 4. Instrumental Variables Regressions

In this section, we recognize the possibility for the endogenous relationship between and executive pay components (vega/cash, delta/cash, cash compensation) and bank risk. The main endogeneity concern in compensation studies is the possibility that the executive compensation contracts and firm outcomes such as risk are jointly determined. In addition, we have two further endogeneity concerns that are specific to this study. First, the relationship between bank risk and executive pay might be correlated with a factor related to the macroeconomic state. Consequently, the interaction of the pay components and the macroeconomic state may be endogenous with respect to risk taking. Second, the macroeconomic state may have a direct effect on the value of managerial incentives because during economic contractions, lower stock prices would lead to a mechanical decline in vega and delta for a fixed amount of stock and stock option holdings. Since, on average, bank risk increases during contractions, the increase in the vega-risk relationship may simply be an outcome of the increase in bank risk accompanying the mechanical decline in the value of managerial incentives during economic contractions.

To mitigate these endogeneity concerns, we estimate the relationship between risk taking incentives and bank risk within an instrumental variables (IV) framework. We first regress the compensation contract characteristics on a list of instruments and controls. In the second stage, we regress the bank risk on the predicted values of compensation variables.

The IV estimation requires the use of instruments for vega/cash, delta/cash and cash compensation, the three components of the executives' pay packages that we treat as endogenous. These instruments should explain the variation in compensation contract, but should not have any direct effect on the dependent variables in the regressions (i.e. risk measures). Our first three instruments capture the shifts in compensation contracts due to the changes in institutional and regulatory environment over our sample period. In particular, stock option grants to U.S. executives have increased in 1990s and then have declined steadily starting

in 2002.[11] This decline in option pay has at the same time been accompanied by an increase in restricted stock grants and bonuses. To capture the changes in market sentiment towards different pay components, we calculate the median values for risk incentives (vega), performance incentives (delta) and cash compensation for each year for non-financial firms and use them as instruments for executive incentive variables in the banking sector. The variation in pay components in the non-financial firms should be related to the variation in the pay components in the banking sector since both sectors have been affected similarly by the underlying institutional and regulatory environment. However, median pay components in the non-financial firms should not be a significant determinant of bank riskiness. Therefore, we are confident about our identifying assumption that our instruments do not have any direct impact on bank risk (our dependent variable) and that any impact is through its effect on bank executives' pay.

Our fourth instrument is the accounting cost of implementing FAS 123 (R). Firms responded to the passage of FAS 123 (R) by reducing stock option grants to their executives. It is a well-documented fact that firms with higher accounting costs of options reduced their option grants more because they would have had a larger accounting impact on their profitability measures (Hayes et al., 2012). This non-uniform response to the regulation implies a positive relationship between vega and the accounting cost of FAS 123(R). However, there is no obvious reason to expect FAS cost to affect firm risk. In fact, Hayes et al. (2012) show that the passage of FAS 123(R) has not been accompanied by a similar decline in firm risk. We measure the accounting cost with ratio of the estimated market value of annual CEO option grants to reported net income, .i.e. by how much the reported net income of a bank would decline if stock option grants were expensed at their fair value. This variable has also been employed as an instrument in Savaser and Şişli-Ciamarra (2017).

As noted before, an additional endogeneity concern in the context of our study is that the relationship between bank risk and executive pay components might be correlated with a factor

[11] The decline in option compensation has been attributed to a series of changes in the regulatory and institutional environment including the Sarbanes Oxley Act of 2002 (Cohen, Dey and Lys, 2007), the new NYSE and NASDAQ listing rules requiring shareholder approval for all option plans in 2003 (Murphy, 2012), the changes in the accounting treatment of stock-based compensation under FAS 123R (Hayes et al., 2012) and the negative public opinion about executive pay (Kuhnen and Niessen, 2012).

related to macroeconomic state. The IV estimation is also helpful in alleviating this additional endogeneity concern because in the IV setup the interactions of endogenous variables with an exogenous variable are treated as endogenous. Therefore, aside from vega/cash, delta/cash and cash compensation, we also treat the interactions of these variables with the macroeconomic state measure as endogenous in our first stage regressions. The interactions of instruments for the endogenous variables with the exogenous variable serve as valid instruments (Bun and Harrison, 2014; Wooldridge, p121-122, 2002). Therefore, as prescribed, we include the interactions of our four instruments with the macroeconomic state measure in our list of instruments.

We present our results in Table 5. Columns 2-7 summarize the first stage regressions. To check the validity of exclusion restrictions, we perform the Hansen's test of overidentifying restrictions. We find that the J-statistics associated with the test are statistically insignificant. Therefore, the assumption that the instruments are exogenous is unlikely to be violated. In addition, the partial F-statistics suggest that as a group, our instruments have a significant explanatory power at the one percent level.

The results from the IV regressions (Table 5, Column 1) are qualitatively similar to the results from the panel regressions presented in Table 3. Overall, the results suggest that the relationship between CEO risk taking incentives (vega/cash) and bank risk becomes stronger during macroeconomic contractions.

## 5. Bank Capital

Recent theoretical studies argue that it is optimal to combine compensation regulation with capital regulation to reduce shareholders' risk-shifting incentives (e.g. Eufinger and Gill 2016; Kolm et al., 2017). The idea is that, due to government guarantees, banks whose CEO incentives are more aligned with shareholders tend to shift more risk to debt holders and tax payers. By requiring these banks to hold more capital (compared to banks that do not exhibit such alignment), regulators can counteract the risk-shifting incentives that are passed on to the managers via stock-based compensation (Eufinger and Gill, 2016).

The implication of these models' predictions for our analysis is that, during periods of economic contraction, the risk-increasing effect of CEO's vega/cash ratio should be muted for well-capitalized banks. To test whether bank capital mitigates the risk-inducing effects of the executive's risk-taking incentives, we conduct a sub-sample analysis. In particular, we estimate Equation 2 separately for two groups of banks: (i) banks whose Tier-1 capital ratio is less than or equal to 10 percent and (ii) banks whose Tier-1 capital ratio is above 10 percent.

In line with the predictions of the Eufinger and Gill (2016) model, we observe that risk-shifting is more pronounced among banks that have less than 10 percent Tier-1 capital ratio. In all specifications (except total risk), the coefficient on the interaction term between the vega/cash and GDP variable is insignificant for well-capitalized banks whereas the same coefficient is negative and significant for banks that maintain low capital ratios. This suggests that the risk-amplifying effect of vega/cash is completely muted for well-capitalized banks during periods of negative growth (Table 5). In the total risk specification, the coefficient on the interaction term is negative and significant for both groups of BHCs. However, it is smaller in magnitude (-0.018) for the well-capitalized banks compared to the rest of the banks (-0.029). Hence, our result based on total risk also confirms the prediction that risk-shifting (through manager's option-based incentives) is more pronounced among banks that maintain low capital ratios.

Overall, our analysis in this section suggests that holding sufficiently high amount of bank capital limits the risk-inducing effects of vega during downturns, making the CEO compensation-bank risk relationship less sensitive to the underlying macroeconomic environment. In terms of policy implications, our findings lend support to the necessity of strong capital requirements as they help mitigate the risk shifting incentives generated by option-based managerial incentives.

## 6. Too-Big-To-Fail Banks

In this section, we investigate whether there are any significant differences between the large and small banks. Large banks have a "systematically important" and "too-big-to-fail (TBTF)" status and hence are more likely to receive government support due to the systemic risk they

may pose to the financial system (Afonso et al., forthcoming). As shareholders of TBTF banks are more certain that the government will step in to save these banks in the event of financial distress, they are particularly susceptible to the moral hazard problem that leads to increased risk-shifting incentives in times of economic contraction. Consequently, we expect the counter-cyclical relationship between managerial risk-taking incentives and bank risk that we have uncovered to be more pronounced for TBTF banks.

To test our prediction, we divide the banks into two sub-samples: (i) banks whose assets are lower than the 90$^{th}$ percentile, and (ii) banks whose assets are greater than the 90$^{th}$ percentile value. We then estimate Equation 2 separately for the two subsamples and test whether the vega/cash - bank risk relationship is stronger during periods of negative GDP growth for large banks. As can be seen from Table 7, we find that, even though the coefficient on the interaction term is negative and significant for both groups of BHCs, the absolute value of the coefficient is consistently larger in magnitude for TBTF banks compared to smaller banks in all specifications. Hence, our results in this section confirm our prediction that managers of TBTF banks have a higher tendency to make risky business decisions during economic contractions in response to a given level of vega/cash ratio compared to managers of smaller banks.

**7. CEO Control**

Our analysis suggests a counter-cyclical relationship between the executive's risk incentives (vega/cash ratio) and bank risk. The underlying reason for this counter-cyclical relationship is the presence of state-dependent risk-shifting incentives caused by government guarantees. Banks are financed by a combination of equity and (insured) deposits, which gives shareholders an incentive to engage in risk shifting due to the option value of default. This moral hazard problem becomes more pronounced as macroeconomic conditions deteriorate since the likelihood of receiving government support increases during these periods. More importantly, shareholders can pass their risk-shifting incentives onto the bank manager via a compensation package that includes stock-based components. Reflecting the shareholders' increased risk-shifting preferences, the same manager with exactly the same level of stock-based risk incentives (vega/cash) facing the same bank characteristics would target a higher risk level as the economy

contracts.

If indeed the proposed effect of compensation on bank risk is due to the manager's actions (and not due to some omitted bank-specific or macroeconomic factor), then we would expect our results to be more pronounced in banks that are run by powerful CEOs. The executive's ability to adjust risk depends critically on her managerial power. This is because if the manager has more control, she can influence business decisions to a greater extent and adjust bank risk according to her preferences. Hence, in this section, we examine whether the documented counter-cyclical link between vega/cash ratio and bank risk is sensitive to managerial power.

Following the literature, we focus on CEO tenure as a measure of managerial control.[12] CEO tenure is a suitable proxy for managerial power because as CEOs become more seasoned, boards' control over the manager's actions tends to weaken. For example, number of independent outsiders on the board decreases with the tenure of the CEO (Baker and Gompers, 2003). Also seasoned CEOs are more likely to capture the board because directors that are appointed by a CEO exert less control over that manager (Shivdasani and Yermack, 1999; Baker and Gompers, 2003; Morse et.al., 2011; Coles et al., 2014). Such a weakening in the board's monitoring effectiveness allows the manager to have a greater impact on bank policies and exert more control over bank risk.

To examine whether the documented counter-cyclical link between vega/cash ratio and bank risk is sensitive to managerial power, we divide the banks into two sub-samples: (i) banks whose CEOs have a tenure equal to or exceeding 3 years, and (ii) banks whose CEOs have a tenure less than 3 years. We test whether the vega/cash - bank risk relationship is stronger during periods of negative GDP growth for banks with seasoned CEOs. In line with our prediction, we find that, when the GDP growth rate is below zero, the effect of vega/cash on bank risk is significantly negative for banks with seasoned CEOs (Table 5, columns 1,3,5,7) whereas the interaction coefficient for banks with short-tenured CEOs is statistically insignificant in all

[12] Other studies that use CEO tenure as a proxy for CEO control include Fahlenbrach (2009), Agrawal and Nasser (2009), Chava et al. (2010), Bebchuk et al. (2010), Ferreria et al. (2011) among others.

specifications (Table 5, columns 2,4,6,8). Taken together, these findings indicate that the risk-increasing effects of vega in economic downturns is valid only for those banks that are managed by seasoned CEOs. Hence, our results in this section suggest that powerful managers are more able to shift risk during downturns (in response to a given level of vega/cash ratio) compared to banks that are run by less powerful CEOs.

**8. Managerial Performance Incentives**

In our analyses throughout the paper, the coefficient of delta/cash is negative. This finding suggests that performance incentives have a risk-dampening effect on average, which is consistent with prior literature (Acharya et al., 2014). In addition, the coefficient on the interaction of the macroeconomic state and delta/cash is also significant for most specifications. This result suggests that the relationship between managerial performance incentives and bank risk also varies over the business cycle. In contrast to risk incentives, however, we find the relationship between performance incentives and bank risk to be pro-cyclical. In line with earlier studies, we find that that performance incentives (delta/cash) normally have a depressive effect on bank risk. For example, a one percent increase in delta/cash leads to about 0.14 percent decline in total risk (Table 3, Panel A). However, in quarters when GDP contracts by one percentage point, this depressive effect is amplified by an additional 0.02 percent decrease in bank risk. In economic terms, this implies that, increasing a CEOs delta/cash ratio from its median (16.2 percent) to its 75$^{th}$ percentile value (35.5 percent) is associated with an additional two percent decrease in bank risk in quarters when the GDP growth rate contracts by one percentage point. In quarters when GDP grows by one percentage point, however, the normally depressive effect of performance incentives is dampened by a two percent increase in bank risk.

The pro-cyclical link between delta/cash and bank risk is consistent with the evidence from non-financial sector. In their study of US non-financial firms, Savaser and Sisli Ciamarra (2017) document that manager's stock-based performance incentives have a depressive effect on bank risk during periods of economic contractions. In particular, they find that the same level of stock-based performance incentive leads to lower (higher) firm risk in a contracting (expanding) economy. The authors show that this result is due to the increase (decrease) in

managerial risk aversion coefficient during recessions (expansions) as documented in Guiso et al (2013). However, their results do not indicate any time-variance with respect to the effect of managerial risk incentives on firm risk, which is consistent with the fact that managerial risk-shifting incentives that result from government guarantees are especially pronounced in the banking industry.

The depressive effects of performance incentives on bank risk during recessions suggests that risk-inducing effects of stock-based compensation primarily come from risk-incentives that provide downside protection (convex-payoff) to the bank manager. Hence, the Eufinger and Gill (2016) prescription that banks should hold more capital if they pay their CEOs mostly by stock should be qualified: It is not simply the value of stock-based compensation relative to the manager's salary that is critical for bank risk. Rather, it is the ratio of the stock-based risk-incentives to manager's salary that matters for bank risk, which is line with the prediction of Thanassoulis and Tanaka (2017).

**9. Conclusion**

In this paper, we show that the relationship between risk-taking incentives and bank risk is sensitive to the underlying macroeconomic environment. Our findings suggest that, compared to periods of economic expansion, the same level of risk-taking incentives given to a CEO leads to higher bank risk during economic downturns. This is because, due to increased likelihood of financial distress, shareholder' risk-shifting incentives intensify during economic downturns. Shareholders' increased risk appetite is then passed on to the manager (via option compensation), which increases the sensitivity of bank risk to a unit of CEO risk-taking incentives in a contracting economy. To our knowledge, we provide the first evidence of the counter-cyclical relationship between CEO risk-taking incentives and bank risk, a result which is consistent with the state-dependent nature of shareholders' risk-shifting incentives.

Our results also suggest that holding sufficiently high amount of bank capital limits the risk-inducing effects of vega during downturns, making the CEO compensation-bank risk relationship less sensitive to the underlying macroeconomic environment. By highlighting the

interaction between capital requirements and compensation design over the business cycle, this finding underscores the necessity of strong capital requirements as they help mitigate the risk shifting incentives generated by option-based managerial incentives.

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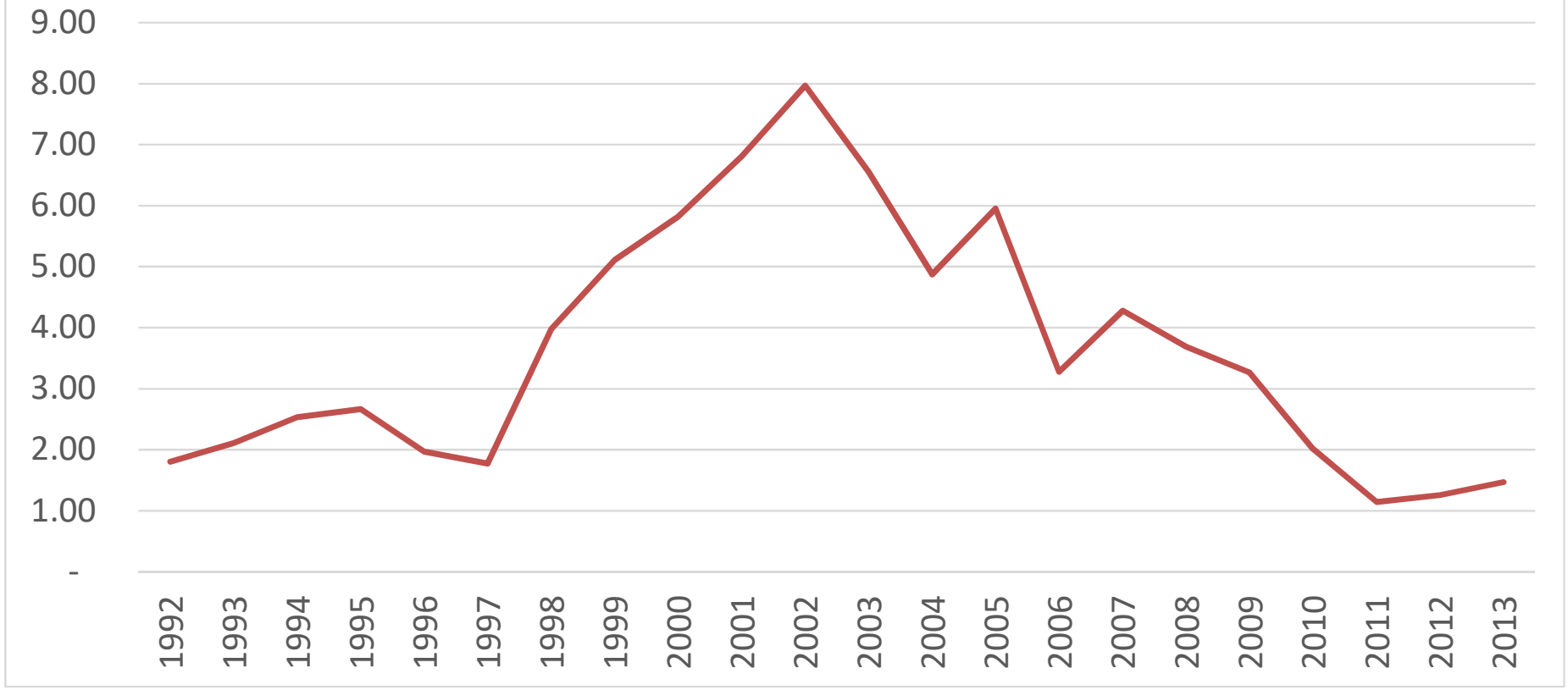
**Figure 1**
**Vega / Cash Compensation**
**(Median Values by Year)**



## Figure 2
## Macroeconomic Activity

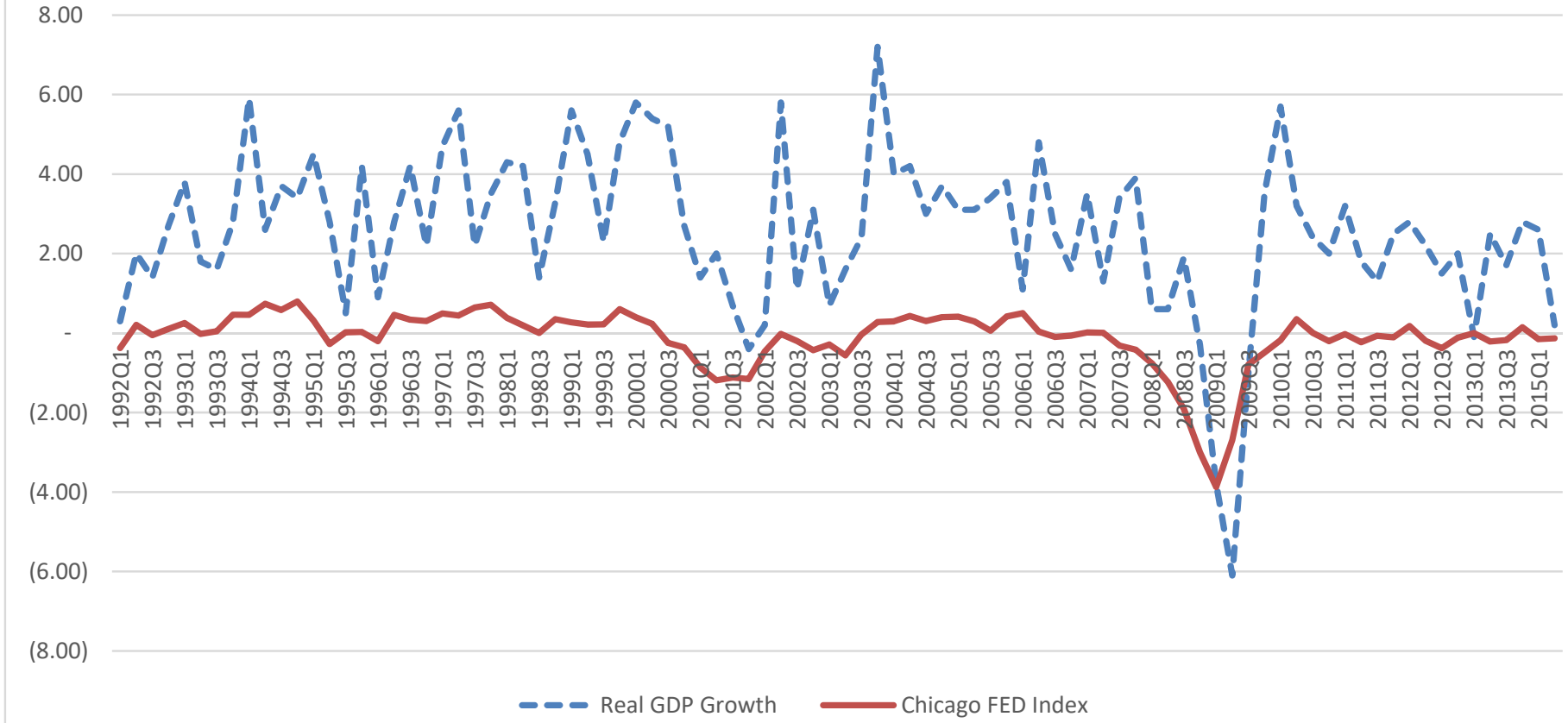


**Table1. Summary Statistics**

This table presents the summary statistics for the variables used in the analyses. The definition of the variables and the data sources are provided in Appendix.

| | N | Mean | Standard Deviation | p25 | p50 | p75 |
|---|---|---|---|---|---|---|
| **A. CEO Compensation Measures** | | | | | | |
| Salary ($000s) | 6,013 | 541.94 | 243.80 | 366.81 | 517.05 | 673.08 |
| Bonus ($000s) | 6,013 | 739.66 | 1,137.30 | 53.03 | 326.00 | 846.42 |
| Cash Compensation ($000s) | 6,013 | 1,292.98 | 1,291.50 | 519.01 | 832.78 | 1,503.66 |
| Delta ($000s) | 6,013 | 483.88 | 1,056.40 | 45.34 | 153.47 | 470.93 |
| Vega ($000s) | 6,013 | 114.37 | 191.65 | 8.01 | 30.74 | 119.40 |
| Delta/Cash Compensation | 6,013 | 64.41 | 475.47 | 6.79 | 16.20 | 35.46 |
| Vega/Cash Compensation | 6,013 | 15.17 | 105.65 | 1.16 | 3.71 | 9.57 |
| Tenure as CEO (years) | 6,013 | 9.21 | 7.13 | 4.00 | 7.00 | 13.00 |
| High CEO Control | 6,013 | 0.85 | 0.36 | 1.00 | 1.00 | 1.00 |
| **B. Risk Measures** | | | | | | |
| Total Risk | 6,013 | 19.96 | 42.18 | 4.52 | 8.25 | 17.64 |
| Tail Risk | 6,013 | 3.83 | 2.59 | 2.27 | 3.06 | 4.46 |
| Systematic Risk | 6,013 | 6.57 | 13.13 | 1.39 | 2.76 | 5.84 |
| Unsystematic Risk | 6,013 | 12.63 | 26.65 | 2.80 | 5.27 | 11.38 |
| **C. Bank Financial Characteristics** | | | | | | |
| Total Assets ($000s) | 6,013 | 93,800,000 | 293,000,000 | 5,372,615 | 11,700,000 | 45,400,000 |
| ROA | 6,013 | 0.003 | 0.005 | 0.002 | 0.003 | 0.004 |
| Deposits/Assets | 6,013 | 0.68 | 0.16 | 0.64 | 0.71 | 0.79 |
| Tier 1 Capital / Assets | 6,013 | 0.09 | 0.05 | 0.07 | 0.08 | 0.09 |
| Loans / Assets | 6,013 | 0.61 | 0.17 | 0.55 | 0.66 | 0.72 |
| Bad Loans / Assets | 6,013 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| Non-interest Income / Assets | 6,013 | 0.27 | 0.19 | 0.15 | 0.23 | 0.33 |
| Insurance Assets / Assets | 6,013 | 0.01 | 0.07 | 0.00 | 0.00 | 0.00 |
| Derivative Trading Assets / Assets | 6,013 | 1.47 | 6.31 | 0.00 | 0.00 | 0.10 |
| Derivative Hedging Assets / Assets | 6,013 | 0.11 | 0.31 | 0.00 | 0.03 | 0.10 |
| Underwriting Assets / Assets | 6,013 | 0.01 | 0.08 | 0.00 | 0.00 | 0.00 |
| RMI | 4,087 | 0.67 | 0.31 | 0.41 | 0.62 | 0.90 |

**Table1. Summary Statistics (cont'd)**

| | N | Mean | Standard Deviation | p25 | p50 | p75 |
|---|---|---|---|---|---|---|
| **D. Macroeconomic State Measures** | | | | | | |
| GDP Growth Rate | 6,013 | 2.46 | 2.17 | 1.40 | 2.50 | 3.70 |
| Chicago Fed Index | 6,013 | -0.26 | 0.84 | -0.38 | -0.06 | 0.28 |
| Confidence Index | 6,013 | 0.01 | 1.00 | -0.77 | -0.07 | 0.54 |
| Economic Policy Uncertainty Index | 6,013 | 0.13 | 1.04 | -0.72 | -0.11 | 0.72 |
| **E. Instruments** | | | | | | |
| FAS Cost | 6,533 | 0.02 | 0.15 | 0.00 | 0.00 | 0.01 |
| Delta (non-financial firms, $000s) | 6,523 | 169.34 | 100.38 | 85.35 | 123.51 | 248.52 |
| Vega (non-financial firms, $000s) | 6,533 | 46.45 | 36.72 | 12.28 | 35.89 | 69.78 |
| Cash Compensation (non-financial firms, $000s) | 6,533 | 924.50 | 417.40 | 538.69 | 978.72 | 1,362.21 |

**Table 2. CEO Risk Taking Incentives and Bank Risk**

This table presents the results for the estimation of Equation 1 in the text. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk. The main variable of interest is Vega/Cash Compensation, and represents the managerial risk taking incentives. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | -0.014 | -0.005 | -0.001 | -0.029 |
| | [0.579] | [0.713] | [0.983] | [0.307] |
| Delta / Cash Compensation $_{-1}$ | -0.095 | -0.047 | -0.016 | -0.103 |
| | [0.000]*** | [0.000]*** | [0.590] | [0.000]*** |
| Cash Compensation $_{-1}$ | -0.211 | -0.119 | -0.084 | -0.283 |
| | [0.000]*** | [0.000]*** | [0.021]** | [0.000]*** |
| CEO Tenure | 0.005 | 0.003 | 0.006 | 0.004 |
| | [0.064]* | [0.020]** | [0.166] | [0.178] |
| Log(Total Assets) | 0.035 | 0.016 | 0.297 | -0.001 |
| | [0.580] | [0.611] | [0.001]*** | [0.986] |
| ROA | -12.999 | -7.770 | -13.611 | -12.827 |
| | [0.027]** | [0.007]*** | [0.039]** | [0.017]** |
| Deposits / Assets | 0.055 | 0.105 | -0.665 | 0.568 |
| | [0.876] | [0.554] | [0.088]* | [0.120] |
| Tier 1 Capital / Assets | -0.194 | 0.888 | 2.968 | 0.853 |
| | [0.808] | [0.022]** | [0.032]** | [0.282] |
| Loans / Assets | -0.159 | -0.173 | 0.449 | -0.477 |
| | [0.597] | [0.263] | [0.177] | [0.126] |
| Bad Loans / Assets | 10.973 | 5.111 | 5.379 | 13.182 |
| | [0.000]*** | [0.000]*** | [0.020]** | [0.000]*** |
| Non-interest Income / Assets | -0.320 | -0.102 | -0.256 | -0.271 |
| | [0.033]** | [0.216] | [0.130] | [0.088]* |
| Insurance Assets / Assets | 0.522 | 0.258 | 1.046 | 0.634 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | -0.000 | -0.002 | -0.010 | 0.004 |
| | [0.978] | [0.346] | [0.138] | [0.494] |
| Derivative Hedging / Assets | -0.123 | -0.061 | -0.152 | -0.103 |
| | [0.104] | [0.118] | [0.022]** | [0.275] |
| Underwriting Assets / Assets | -0.871 | -0.538 | -1.959 | -0.666 |
| | [0.044]** | [0.029]** | [0.015]** | [0.087]* |
| Constant | 2.835 | 1.491 | -4.258 | 3.453 |
| | [0.007]*** | [0.005]*** | [0.004]*** | [0.004]*** |
| N | 6,013 | 6,013 | 6,013 | 6,013 |
| R-sq | 0.604 | 0.601 | 0.521 | 0.643 |
| adj. R-sq | 0.602 | 0.599 | 0.518 | 0.641 |

**Table 3. CEO Risk Taking Incentives and Bank Risk over Macroeconomic Cycles**

This table presents the results for the estimation of Equation 2 in the text. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk. The main variable of interest is the interaction of Vega/Cash Compensation and teh Macroeconomic State. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

**Panel A. Macroeconomic State Measured with GDP Growth Rates**

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | 0.042 | 0.014 | 0.026 | 0.022 |
| | [0.130] | [0.274] | [0.436] | [0.458] |
| Delta / Cash Compensation $_{-1}$ | -0.136 | -0.061 | -0.054 | -0.140 |
| | [0.000]*** | [0.000]*** | [0.064]* | [0.000]*** |
| GDP Growth | -0.081 | -0.041 | -0.111 | -0.046 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| (Vega/Cash Compensation $_{-1}$) * GDP Growth | -0.024 | -0.008 | -0.012 | -0.021 |
| | [0.000]*** | [0.000]*** | [0.007]*** | [0.000]*** |
| (Delta/Cash Compensation $_{-1}$ ) * GDP Growth | 0.017 | 0.006 | 0.016 | 0.015 |
| | [0.000]*** | [0.001]*** | [0.000]*** | [0.002]*** |
| Cash Compensation $_{-1}$ | -0.208 | -0.118 | -0.087 | -0.279 |
| | [0.000]*** | [0.000]*** | [0.018]** | [0.000]*** |
| CEO Tenure | 0.005 | 0.003 | 0.007 | 0.004 |
| | [0.040]** | [0.016]** | [0.140] | [0.121] |
| Log(Total Assets) | 0.036 | 0.017 | 0.304 | -0.002 |
| | [0.559] | [0.573] | [0.000]*** | [0.978] |
| ROA | -13.370 | -7.937 | -13.847 | -13.074 |
| | [0.021]** | [0.005]*** | [0.034]** | [0.015]** |
| Deposits / Assets | 0.111 | 0.136 | -0.571 | 0.594 |
| | [0.754] | [0.444] | [0.146] | [0.105] |
| Tier 1 Capital / Assets | -0.090 | 0.923 | 3.055 | 0.948 |
| | [0.914] | [0.020]** | [0.025]** | [0.241] |
| Loans / Assets | -0.177 | -0.187 | 0.403 | -0.478 |
| | [0.554] | [0.229] | [0.228] | [0.127] |
| Bad Loans / Assets | 11.439 | 5.307 | 5.676 | 13.524 |
| | [0.000]*** | [0.000]*** | [0.012]** | [0.000]*** |
| Non-interest Income / Assets | -0.304 | -0.094 | -0.239 | -0.261 |
| | [0.039]** | [0.234] | [0.141] | [0.091]* |
| Insurance Assets / Assets | 0.606 | 0.298 | 1.160 | 0.685 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | -0.001 | -0.003 | -0.010 | 0.004 |
| | [0.883] | [0.262] | [0.119] | [0.523] |
| Derivative Hedging / Assets | -0.140 | -0.068 | -0.165 | -0.115 |
| | [0.068]* | [0.087]* | [0.016]** | [0.222] |
| Underwriting Assets / Assets | -0.757 | -0.488 | -1.890 | -0.587 |
| | [0.071]* | [0.040]** | [0.015]** | [0.120] |
| Constant | 2.945 | 1.544 | -4.120 | 3.519 |
| | [0.005]*** | [0.004]*** | [0.005]*** | [0.003]*** |
| N | 6,013 | 6,013 | 6,013 | 6,013 |
| R-sq | 0.620 | 0.617 | 0.538 | 0.648 |
| adj. R-sq | 0.617 | 0.614 | 0.535 | 0.646 |

**Table 3. CEO Risk Taking Incentives and Bank Risk over Macroeconomic Cycles**
**Panel B. Macroeconomic State Measured with Economic Activity as Determined by Chicago FED**

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | -0.043 | -0.016 | -0.019 | -0.050 |
| | [0.106] | [0.226] | [0.541] | [0.085]* |
| Delta / Cash Compensation $_{-1}$ | -0.079 | -0.041 | -0.003 | -0.090 |
| | [0.000]*** | [0.001]*** | [0.921] | [0.000]*** |
| Chicago FED Index | -0.528 | -0.200 | -0.551 | -0.373 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| (Vega/Cash Compensation $_{-1}$) * FED Index | -0.047 | -0.018 | -0.010 | -0.043 |
| | [0.000]*** | [0.004]*** | [0.368] | [0.005]*** |
| (Delta/Cash Compensation $_{-1}$) * FED Index | 0.024 | 0.008 | 0.009 | 0.027 |
| | [0.077]* | [0.178] | [0.421] | [0.075]* |
| Cash Compensation $_{-1}$ | -0.183 | -0.108 | -0.064 | -0.262 |
| | [0.000]*** | [0.000]*** | [0.090]* | [0.000]*** |
| CEO Tenure | 0.005 | 0.003 | 0.006 | 0.004 |
| | [0.066]* | [0.022]** | [0.192] | [0.163] |
| Log(Total Assets) | 0.033 | 0.015 | 0.304 | -0.004 |
| | [0.586] | [0.624] | [0.000]*** | [0.952] |
| ROA | -8.749 | -6.148 | -9.060 | -9.947 |
| | [0.019]** | [0.005]*** | [0.049]** | [0.015]** |
| Deposits / Assets | 0.295 | 0.196 | -0.400 | 0.735 |
| | [0.403] | [0.275] | [0.296] | [0.047]** |
| Tier 1 Capital / Assets | -0.701 | 0.692 | 2.388 | 0.539 |
| | [0.371] | [0.066]* | [0.061]* | [0.493] |
| Loans / Assets | -0.334 | -0.239 | 0.256 | -0.594 |
| | [0.270] | [0.133] | [0.442] | [0.063]* |
| Bad Loans / Assets | 11.938 | 5.490 | 6.077 | 13.885 |
| | [0.000]*** | [0.000]*** | [0.007]*** | [0.000]*** |
| Non-interest Income / Assets | -0.261 | -0.079 | -0.206 | -0.230 |
| | [0.081]* | [0.321] | [0.170] | [0.138] |
| Insurance Assets / Assets | 0.496 | 0.247 | 1.030 | 0.622 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | 0.000 | -0.002 | -0.009 | 0.004 |
| | [0.958] | [0.348] | [0.162] | [0.431] |
| Derivative Hedging / Assets | -0.130 | -0.064 | -0.153 | -0.110 |
| | [0.081]* | [0.100] | [0.017]** | [0.240] |
| Underwriting Assets / Assets | -0.661 | -0.455 | -1.826 | -0.514 |
| | [0.114] | [0.056]* | [0.019]** | [0.163] |
| Constant | 2.724 | 1.451 | -4.434 | 3.381 |
| | [0.009]*** | [0.006]*** | [0.002]*** | [0.005]*** |
| N | 6,013 | 6,013 | 6,013 | 6,013 |
| R-sq | 0.669 | 0.641 | 0.577 | 0.674 |
| adj. R-sq | 0.667 | 0.639 | 0.574 | 0.672 |

**Table 3. CEO Incentives and Risk over Macroeconomic Cycles**

**Panel C. Macroeconomic State measured with Confidence Index**

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | -0.018 | -0.010 | -0.022 | -0.031 |
| | [0.506] | [0.424] | [0.480] | [0.272] |
| Delta / Cash Compensation $_{-1}$ | -0.085 | -0.040 | 0.003 | -0.096 |
| | [0.000]*** | [0.001]*** | [0.912] | [0.000]*** |
| Confidence Index | -0.293 | -0.241 | -0.496 | -0.321 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| (Vega/Cash Compensation $_{-1}$ ) * Confidence Index | -0.058 | -0.023 | -0.025 | -0.042 |
| | [0.000]*** | [0.000]*** | [0.080]* | [0.001]*** |
| (Delta/Cash Compensation $_{-1}$) * Confidence Index | 0.041 | 0.024 | 0.013 | 0.052 |
| | [0.004]*** | [0.001]*** | [0.329] | [0.000]*** |
| Cash Compensation $_{-1}$ | -0.198 | -0.112 | -0.072 | -0.273 |
| | [0.000]*** | [0.000]*** | [0.044]** | [0.000]*** |
| CEO Tenure | 0.005 | 0.003 | 0.005 | 0.004 |
| | [0.067]* | [0.028]** | [0.211] | [0.184] |
| Log(Total Assets) | 0.032 | 0.022 | 0.314 | 0.004 |
| | [0.604] | [0.458] | [0.000]*** | [0.949] |
| ROA | -11.679 | -6.598 | -10.822 | -11.463 |
| | [0.034]** | [0.009]*** | [0.063]* | [0.021]** |
| Deposits / Assets | 0.160 | 0.207 | -0.402 | 0.676 |
| | [0.660] | [0.241] | [0.297] | [0.065]* |
| Tier 1 Capital / Assets | -0.116 | 0.956 | 3.242 | 0.875 |
| | [0.886] | [0.012]** | [0.015]** | [0.264] |
| Loans / Assets | -0.196 | -0.199 | 0.406 | -0.518 |
| | [0.521] | [0.197] | [0.215] | [0.096]* |
| Bad Loans / Assets | 11.104 | 5.144 | 5.408 | 13.246 |
| | [0.000]*** | [0.000]*** | [0.016]** | [0.000]*** |
| Non-interest Income / Assets | -0.294 | -0.085 | -0.215 | -0.252 |
| | [0.053]* | [0.307] | [0.150] | [0.118] |
| Insurance Assets / Assets | 0.634 | 0.351 | 1.208 | 0.773 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | 0.000 | -0.002 | -0.009 | 0.005 |
| | [0.947] | [0.416] | [0.155] | [0.435] |
| Derivative Hedging / Assets | -0.104 | -0.049 | -0.127 | -0.086 |
| | [0.217] | [0.264] | [0.050]* | [0.394] |
| Underwriting Assets / Assets | -0.784 | -0.511 | -1.884 | -0.642 |
| | [0.047]** | [0.018]** | [0.011]** | [0.062]* |
| Constant | 2.654 | 1.226 | -4.946 | 3.174 |
| | [0.010]** | [0.015]** | [0.001]*** | [0.006]*** |
| N | 6,013 | 6,013 | 6,013 | 6,013 |
| R-sq | 0.629 | 0.658 | 0.587 | 0.663 |
| adj. R-sq | 0.627 | 0.656 | 0.585 | 0.661 |

**Table 3. CEO Incentives and Risk over Macroeconomic Cycles**

**Panel D. Macroeconomic State measured with Economic Policy Uncertainty (EPU) Index**

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | -0.029 | -0.008 | -0.016 | -0.032 |
| | [0.271] | [0.520] | [0.595] | [0.253] |
| Delta / Cash Compensation $_{-1}$ | -0.083 | -0.044 | -0.005 | -0.099 |
| | [0.000]*** | [0.000]*** | [0.860] | [0.000]*** |
| EPU Index | 0.310 | 0.089 | 0.257 | 0.154 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| (Vega/Cash Compensation $_{-1}$ ) * EPU Index | 0.042 | 0.023 | 0.034 | 0.036 |
| | [0.000]*** | [0.000]*** | [0.008]*** | [0.001]*** |
| (Delta/Cash Compensation $_{-1}$) * EPU Index | -0.023 | -0.014 | -0.001 | -0.034 |
| | [0.041]** | [0.011]** | [0.940] | [0.003]*** |
| Cash Compensation $_{-1}$ | -0.205 | -0.115 | -0.074 | -0.281 |
| | [0.000]*** | [0.000]*** | [0.044]** | [0.000]*** |
| CEO Tenure | 0.005 | 0.003 | 0.006 | 0.005 |
| | [0.041]** | [0.008]*** | [0.172] | [0.081]* |
| Log(Total Assets) | 0.019 | 0.009 | 0.278 | -0.007 |
| | [0.760] | [0.761] | [0.001]*** | [0.915] |
| ROA | -9.287 | -6.784 | -9.959 | -11.512 |
| | [0.039]** | [0.008]*** | [0.059]* | [0.019]** |
| Deposits / Assets | 0.027 | 0.092 | -0.696 | 0.553 |
| | [0.939] | [0.605] | [0.072]* | [0.131] |
| Tier 1 Capital / Assets | -0.465 | 0.792 | 2.734 | 0.700 |
| | [0.560] | [0.035]** | [0.038]** | [0.369] |
| Loans / Assets | -0.066 | -0.140 | 0.529 | -0.425 |
| | [0.827] | [0.369] | [0.114] | [0.172] |
| Bad Loans / Assets | 11.704 | 5.396 | 6.101 | 13.562 |
| | [0.000]*** | [0.000]*** | [0.007]*** | [0.000]*** |
| Non-interest Income / Assets | -0.260 | -0.083 | -0.197 | -0.246 |
| | [0.103] | [0.326] | [0.210] | [0.128] |
| Insurance Assets / Assets | 0.714 | 0.317 | 1.186 | 0.748 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | 0.001 | -0.002 | -0.009 | 0.004 |
| | [0.871] | [0.373] | [0.196] | [0.473] |
| Derivative Hedging / Assets | -0.137 | -0.067 | -0.168 | -0.109 |
| | [0.104] | [0.111] | [0.014]** | [0.263] |
| Underwriting Assets / Assets | -0.779 | -0.508 | -1.869 | -0.625 |
| | [0.060]* | [0.036]** | [0.020]** | [0.093]* |
| Constant | 3.113 | 1.585 | -3.937 | 3.543 |
| | [0.003]*** | [0.003]*** | [0.007]*** | [0.003]*** |
| N | 6,013 | 6,013 | 6,013 | 6,013 |
| R-sq | 0.655 | 0.619 | 0.563 | 0.651 |
| adj. R-sq | 0.653 | 0.617 | 0.560 | 0.649 |

**Table 4. CEO Risk Taking Incentives and Bank Risk over Macroeconomic Cycles , Controlling for Risk Management Practices at Banks**

This table presents the results for the estimation of Equation 2 in the text. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk. The main variable of interest is the interaction of Vega/Cash Compensation and GDP Growth Rate. Macroeconomic state is measured with the GDP growth rates. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | Tail Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | 0.042 | 0.018 | 0.008 | 0.033 |
| | [0.185] | [0.220] | [0.848] | [0.352] |
| Delta / Cash Compensation $_{-1}$ | -0.110 | -0.047 | -0.036 | -0.123 |
| | [0.000]*** | [0.001]*** | [0.307] | [0.000]*** |
| GDP Growth | -0.075 | -0.038 | -0.108 | -0.042 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.001]*** |
| (Vega/Cash Compensation $_{-1}$) * GDP Growth | -0.024 | -0.009 | -0.013 | -0.022 |
| | [0.000]*** | [0.000]*** | [0.019]** | [0.000]*** |
| (Delta/Cash Compensation $_{-1}$ ) * GDP Growth | 0.016 | 0.006 | 0.016 | 0.015 |
| | [0.000]*** | [0.006]*** | [0.001]*** | [0.008]*** |
| Cash Compensation $_{-1}$ | -0.184 | -0.098 | -0.059 | -0.253 |
| | [0.000]*** | [0.000]*** | [0.163] | [0.000]*** |
| CEO Tenure | 0.006 | 0.003 | 0.006 | 0.006 |
| | [0.080]* | [0.054]* | [0.260] | [0.081]* |
| Risk Management Index (RMI) | -0.059 | 0.002 | -0.105 | 0.119 |
| | [0.770] | [0.983] | [0.672] | [0.582] |
| Log(Total Assets) | 0.074 | 0.041 | 0.374 | 0.048 |
| | [0.319] | [0.266] | [0.000]*** | [0.537] |
| ROA | -24.076 | -12.323 | -25.987 | -22.146 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Deposits / Assets | 0.218 | 0.107 | -1.022 | 0.697 |
| | [0.630] | [0.636] | [0.033]** | [0.136] |
| Tier 1 Capital / Assets | 1.707 | 1.747 | 4.346 | 2.743 |
| | [0.060]* | [0.000]*** | [0.020]** | [0.001]*** |
| Loans / Assets | -0.338 | -0.186 | 0.425 | -0.551 |
| | [0.378] | [0.313] | [0.294] | [0.138] |
| Bad Loans / Assets | 10.705 | 5.105 | 3.692 | 13.939 |
| | [0.001]*** | [0.000]*** | [0.080]* | [0.000]*** |
| Non-interest Income / Assets | -0.201 | -0.069 | -0.212 | -0.154 |
| | [0.277] | [0.380] | [0.405] | [0.355] |
| Insurance Assets / Assets | 0.581 | 0.294 | 1.171 | 0.665 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** |
| Derivative Trading / Assets | 0.004 | 0.001 | 0.003 | 0.006 |
| | [0.595] | [0.655] | [0.672] | [0.339] |
| Derivative Hedging / Assets | -0.124 | -0.063 | -0.163 | -0.107 |
| | [0.145] | [0.160] | [0.022]** | [0.282] |
| Underwriting Assets / Assets | -1.891 | -1.115 | -4.086 | -1.411 |
| | [0.007]*** | [0.001]*** | [0.000]*** | [0.032]** |
| Constant | 2.092 | 0.970 | -5.186 | 2.312 |
| | [0.092]* | [0.121] | [0.004]*** | [0.075]* |
| N | 4,087 | 4,087 | 4,087 | 4,087 |
| R-sq | 0.654 | 0.658 | 0.583 | 0.684 |
| adj. R-sq | 0.651 | 0.655 | 0.579 | 0.681 |

**Table 5. Instrumental Variables Regressions**

This table presents the results for the estimation of Equation 2 in the text using 2-stage least squares. The dependent variable for the second stage regression is total equity risk.The main variable of interest is the interaction of Vega/Cash Compensation and GDP Growth Rate. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | Vega / Cash Compensation | Delta / Cash Compensation | Cash Compensation | Vega / Cash Compensation * GDP Growth | Delta / Cash Compensation * GDP Growth | Cash Compensation * GDP Growth |
|---|---|---|---|---|---|---|---|
| Vega / Cash Compensation $_{-1}$ | 1.164<br>[0.004]*** | | | | | | |
| Delta / Cash Compensation $_{-1}$ | -1.700<br>[0.002]*** | | | | | | |
| Cash Compensation $_{-1}$ | -1.277<br>[0.016]** | | | | | | |
| GDP Growth Rate | -0.500<br>[0.048]** | -0.168<br>[0.073]* | -0.140<br>0.152 | 0.072<br>0.118 | 4.281<br>[0.003]** | 4.873<br>[0.003]** | 4.413<br>[0.000]*** |
| (Vega/Cash Compensation ) * GDP Growth | -0.213<br>[0.002]*** | | | | | | |
| (Delta/Cash Compensation ) * GDP Growth | 0.257<br>[0.001]*** | | | | | | |
| Cash Compensation * GDP Growth | 0.009<br>[0.860] | | | | | | |
| CEO Tenure | 0.058<br>[0.014]** | 0.017<br>[0.045]** | 0.044<br>[0.000]*** | 0.010<br>[0.008]*** | 0.042<br>0.128 | 0.067<br>[0.009]*** | 0.028<br>[0.026]** |
| Log(Total Assets) | 0.252<br>0.294 | | | 0.105<br>0.141 | | | |
| ROA | -1.148<br>0.912 | 5.328<br>0.119 | 9.636<br>[0.013]** | 6.891<br>[0.056]* | -1.382<br>0.923 | 16.191<br>0.342 | 25.966<br>[0.040]** |
| Deposits / Assets | 0.470<br>0.508 | -0.157<br>0.795 | -0.393<br>0.517 | 0.420<br>0.255 | -1.380<br>0.556 | -2.522<br>0.290 | 1.289<br>0.345 |
| Tier 1 Capital / Assets | 0.888<br>0.706 | 2.567<br>0.211 | 1.202<br>0.564 | 0.701<br>0.554 | 11.715<br>[0.042]** | 2.833<br>0.735 | -3.511<br>0.258 |
| Loans / Assets | 0.107<br>0.882 | -0.732<br>[0.077]* | -0.912<br>[0.054]* | 0.573<br>[0.045]** | -0.796<br>0.532 | -1.862<br>0.271 | 2.584<br>[0.010]*** |

**Table 5. Instrumental Variables Regressions (cont'd)**

| | Total Risk | Vega / Cash Compensation | Delta / Cash Compensation | Cash Compensation | Vega / Cash Compensation * GDP Growth | Delta / Cash Compensation * GDP Growth | Cash Compensation * GDP Growth |
|---|---|---|---|---|---|---|---|
| Bad Loans / Assets | 2.496 | -7.429 | -7.556 | -6.603 | 1.447 | -2.514 | -11.762 |
| | 0.739 | [0.003]*** | [0.043]** | [0.001]*** | 0.869 | 0.843 | [0.079]* |
| Non-interest Income / Assets | -0.156 | 0.346 | 0.465 | -0.015 | 0.494 | 1.121 | 0.520 |
| | 0.701 | 0.121 | 0.111 | 0.947 | 0.444 | 0.178 | 0.511 |
| Insurance Assets / Assets | 1.903 | 1.185 | 1.758 | -0.227 | -0.525 | -0.921 | 0.557 |
| | [0.025]** | [0.000]*** | [0.007]*** | 0.103 | 0.369 | 0.558 | 0.216 |
| Derivative Trading / Assets | -0.045 | 0.004 | -0.010 | -0.032 | -0.062 | -0.098 | -0.048 |
| | 0.121 | 0.710 | 0.678 | 0.263 | [0.063]* | [0.000]*** | 0.428 |
| Derivative Hedging / Assets | -0.209 | 0.053 | -0.043 | 0.073 | 0.110 | 0.154 | -0.183 |
| | [0.099]* | 0.414 | 0.644 | 0.214 | 0.615 | 0.596 | 0.429 |
| Underwriting Assets / Assets | -1.845 | -0.419 | -0.323 | -1.169 | 1.190 | 1.373 | -4.544 |
| | 0.124 | 0.519 | 0.753 | [0.096]* | 0.599 | 0.657 | 0.024 |
| ***Instruments*** | | | | | | | |
| FAS Cost | | 0.322 | 0.103 | -0.334 | -2.899 | -3.179 | -0.514 |
| | | 0.371 | 0.661 | [0.000]*** | [0.017]** | [0.004]*** | [0.036]** |
| Median Delta (Nonfinancial Firms) | | 0.384 | -0.068 | 0.588 | 3.246 | -1.841 | -2.414 |
| | | 0.370 | 0.877 | [0.025]** | [0.017]** | 0.202 | [0.001]*** |
| Median Vega (Nonfinancial Firms) | | 0.239 | -0.061 | -0.425 | -2.106 | -1.213 | -0.413 |
| | | 0.315 | 0.796 | [0.012]** | [0.002]*** | 0.137 | 0.351 |
| Cash Compensation (Nonfinancial Firms) | | -1.360 | -0.329 | 0.308 | -2.668 | 2.213 | 2.823 |
| | | [0.027]** | 0.632 | 0.345 | 0.202 | 0.292 | [0.012]** |
| FAS Cost * GDP Growth Rate | | 0.028 | 0.033 | 0.093 | 1.476 | 1.343 | 0.111 |
| | | 0.710 | 0.557 | [0.002]*** | [0.005]*** | [0.010]** | 0.244 |
| Median Delta (Nonfinancial Firms) * GDP Growth | | 0.025 | 0.027 | -0.043 | -0.305 | 0.710 | 0.979 |
| | | [0.073]* | 0.106 | [0.000]*** | 0.135 | [0.004]*** | [0.000]*** |
| Median Vega (Nonfinancial Firms) * GDP Growth | | -0.027 | -0.039 | 0.037 | 1.020 | 0.376 | -0.051 |
| | | [0.049]** | [0.010]*** | [0.000]*** | [0.000]*** | [0.051]* | 0.622 |
| Cash Compensation (Nonfinancial Firms) * GDP Growth Rate | | 0.021 | 0.022 | 0.001 | -0.706 | -1.025 | -0.348 |
| | | 0.131 | 0.124 | 0.838 | [0.012]** | [0.001]*** | [0.038]** |
| N | | | | 6011 | | | |
| Hansen J Statistics (Chi-sq(2) P-val) | | | | 2.940 (0.2299) | | | |
| F-stat (p-value) of excluded instrument | | 3.10 (0.0027) | 3.20 (0.0020) | 4.62 (0.0000) | 13.28 (0.0000) | 8.95 (0.0000) | 18.47 (0.000) |

**Table 6. Regulatory Capital**

This table presents the results for the estimation of Equation 2 in the text for banks that hold different levels of regulatory capital. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk.The main variable of interest is the interaction of Vega/Cash Compensation and GDP Growth Rate. Regulatory capital is measured with Tier 1 capital (reported) scaled by total assets. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | |
| | <10% | >10% | <10% | >10% | <10% | >10% | <10% | >10% |
| Vega / Cash Compensation $_{-1}$ | 0.066 | -0.086 | 0.025 | -0.036 | 0.033 | 0.023 | 0.042 | -0.085 |
| | [0.028]** | [0.226] | [0.066]* | [0.284] | [0.377] | [0.760] | [0.137] | [0.280] |
| Delta / Cash Compensation $_{-1}$ | -0.128 | -0.166 | -0.054 | -0.114 | -0.033 | -0.171 | -0.126 | -0.231 |
| | [0.000]*** | [0.026]** | [0.000]*** | [0.002]*** | [0.310] | [0.041]** | [0.000]*** | [0.012]** |
| GDP Growth Rate | -0.062 | -0.137 | -0.033 | -0.065 | -0.092 | -0.157 | -0.036 | -0.064 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.001]*** | [0.014]** |
| (Vega/Cash Compensation ) * GDP Growth | -0.029 | -0.017 | -0.012 | -0.001 | -0.015 | -0.000 | -0.026 | -0.011 |
| | [0.000]*** | [0.034]** | [0.000]*** | [0.890] | [0.006]*** | [0.991] | [0.000]*** | [0.237] |
| (Delta/Cash Compensation ) * GDP Growth | 0.017 | 0.017 | 0.007 | 0.004 | 0.014 | 0.017 | 0.016 | 0.008 |
| | [0.001]*** | [0.028]** | [0.003]*** | [0.154] | [0.004]*** | [0.041]** | [0.002]*** | [0.368] |
| Cash Compensation $_{-1}$ | -0.181 | -0.355 | -0.104 | -0.213 | -0.064 | -0.248 | -0.252 | -0.484 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.081]* | [0.023]** | [0.000]*** | [0.000]*** |
| CEO Tenure | 0.008 | -0.004 | 0.005 | 0.001 | 0.007 | -0.001 | 0.008 | -0.003 |
| | [0.003]*** | [0.627] | [0.001]*** | [0.707] | [0.146] | [0.959] | [0.007]*** | [0.760] |
| Log(Total Assets) | 0.032 | 0.186 | 0.022 | 0.040 | 0.335 | 0.117 | 0.001 | 0.120 |
| | [0.640] | [0.169] | [0.501] | [0.504] | [0.001]*** | [0.569] | [0.986] | [0.465] |
| ROA | -18.011 | -3.643 | -11.899 | -1.204 | -24.172 | 3.336 | -18.381 | -2.729 |
| | [0.001]*** | [0.646] | [0.000]*** | [0.559] | [0.000]*** | [0.653] | [0.002]*** | [0.589] |

**Table 6. Regulatory Capital (cont'd)**

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | | Tier 1 Capital / Assets | |
| | <10% | >10% | <10% | >10% | <10% | >10% | <10% | >10% |
| Deposits / Assets | -0.137 | 0.406 | 0.028 | 0.438 | -0.872 | 0.315 | 0.391 | 0.960 |
| | [0.684] | [0.618] | [0.873] | [0.299] | [0.028]** | [0.766] | [0.283] | [0.258] |
| Tier 1 Capital / Assets | -0.382 | -0.632 | 0.110 | 0.637 | 5.023 | 0.114 | -0.044 | 0.819 |
| | [0.835] | [0.567] | [0.901] | [0.110] | [0.022]** | [0.938] | [0.983] | [0.337] |
| Loans / Assets | -0.065 | 0.231 | -0.091 | -0.050 | 0.394 | 0.034 | -0.297 | -0.076 |
| | [0.808] | [0.790] | [0.516] | [0.910] | [0.195] | [0.971] | [0.307] | [0.932] |
| Bad Loans / Assets | 13.680 | 5.073 | 5.903 | 5.258 | 5.620 | 2.627 | 15.539 | 13.122 |
| | [0.000]*** | [0.160] | [0.000]*** | [0.007]*** | [0.008]*** | [0.556] | [0.000]*** | [0.005]*** |
| Non-interest Income / Assets | -0.188 | -0.754 | -0.009 | -0.332 | 0.008 | -0.694 | -0.104 | -0.866 |
| | [0.235] | [0.049]** | [0.924] | [0.032]** | [0.965] | [0.102] | [0.503] | [0.024]** |
| Insurance Assets / Assets | 0.596 | -19.948 | 0.290 | -0.223 | 1.164 | 29.622 | 0.675 | -8.909 |
| | [0.000]*** | [0.559] | [0.000]*** | [0.991] | [0.000]*** | [0.377] | [0.000]*** | [0.825] |
| Derivative Trading / Assets | 0.001 | 0.976 | -0.001 | 0.320 | -0.008 | 1.065 | 0.006 | 0.763 |
| | [0.850] | [0.098]* | [0.781] | [0.106] | [0.303] | [0.059]* | [0.355] | [0.146] |
| Derivative Hedging / Assets | -0.215 | 0.088 | -0.087 | -0.009 | -0.167 | -0.155 | -0.174 | 0.096 |
| | [0.010]** | [0.388] | [0.028]** | [0.851] | [0.050]** | [0.241] | [0.075]* | [0.296] |
| Underwriting Assets / Assets | -0.738 | 0.309 | -0.515 | 0.269 | -1.779 | -0.898 | -0.500 | -0.503 |
| | [0.163] | [0.574] | [0.075]* | [0.319] | [0.052]* | [0.040]** | [0.306] | [0.318] |
| Constant | 2.815 | 2.387 | 1.373 | 2.097 | -4.756 | 0.391 | 3.231 | 3.752 |
| | [0.015]** | [0.280] | [0.016]** | [0.041]** | [0.005]*** | [0.888] | [0.012]** | [0.195] |
| N | 5,000 | 1,013 | 5,000 | 1,013 | 5,000 | 1,013 | 5,000 | 1,013 |
| R-sq | 0.615 | 0.609 | 0.614 | 0.605 | 0.525 | 0.495 | 0.651 | 0.625 |
| adj. R-sq | 0.612 | 0.595 | 0.611 | 0.591 | 0.522 | 0.477 | 0.649 | 0.611 |

**Table 7. Too-big-to-fail Banks**

This table presents the results for the estimation of Equation 2 in the text for large and small banks separately. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk. The main variable of interest is the interaction of Vega/Cash Compensation and GDP Growth Rate. A bank is "Large" if its total assets are in the 90th percentile of the distribution. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | Bank Size | | Bank Size | | Bank Size | | Bank Size | |
| | Large | Small | Large | Small | Large | Small | Large | Small |
| Vega / Cash Compensation $_{-1}$ | 0.142 | 0.037 | 0.069 | 0.012 | 0.150 | 0.030 | 0.029 | 0.014 |
| | [0.173] | [0.207] | [0.165] | [0.355] | [0.058]* | [0.396] | [0.764] | [0.654] |
| Delta / Cash Compensation $_{-1}$ | -0.262 | -0.117 | -0.104 | -0.057 | -0.086 | -0.045 | -0.188 | -0.131 |
| | [0.004]*** | [0.000]*** | [0.012]** | [0.000]*** | [0.253] | [0.130] | [0.003]*** | [0.000]*** |
| GDP Growth Rate | -0.136 | -0.078 | -0.040 | -0.042 | -0.019 | -0.121 | -0.063 | -0.050 |
| | [0.002]*** | [0.000]*** | [0.075]* | [0.000]*** | [0.539] | [0.000]*** | [0.208] | [0.000]*** |
| (Vega/Cash Compensation ) * GDP Growth | -0.045 | -0.020 | -0.013 | -0.006 | -0.036 | -0.008 | -0.046 | -0.015 |
| | [0.018]** | [0.000]*** | [0.085]* | [0.010]** | [0.030]** | [0.106] | [0.038]** | [0.007]*** |
| (Delta/Cash Compensation ) * GDP Growth | 0.044 | 0.015 | 0.008 | 0.006 | 0.018 | 0.017 | 0.029 | 0.014 |
| | [0.006]*** | [0.000]*** | [0.337] | [0.003]*** | [0.163] | [0.000]*** | [0.151] | [0.003]*** |
| Cash Compensation $_{-1}$ | -0.158 | -0.217 | -0.088 | -0.131 | -0.018 | -0.083 | -0.297 | -0.288 |
| | [0.027]** | [0.000]*** | [0.013]** | [0.000]*** | [0.811] | [0.050]** | [0.000]*** | [0.000]*** |
| CEO Tenure | 0.008 | 0.004 | 0.002 | 0.003 | 0.015 | 0.004 | 0.007 | 0.003 |
| | [0.259] | [0.143] | [0.585] | [0.091]* | [0.217] | [0.451] | [0.332] | [0.341] |
| Log(Total Assets) | 0.239 | 0.038 | -0.002 | 0.026 | 0.276 | 0.333 | 0.031 | 0.009 |
| | [0.348] | [0.564] | [0.988] | [0.419] | [0.226] | [0.000]*** | [0.892] | [0.902] |
| ROA | -59.008 | -12.782 | -32.815 | -7.637 | -107.612 | -13.210 | -63.030 | -12.400 |
| | [0.076]* | [0.023]** | [0.022]** | [0.005]*** | [0.006]*** | [0.038]** | [0.041]** | [0.016]** |
| Deposits / Assets | -0.478 | 0.128 | 0.036 | 0.160 | 0.957 | -0.530 | -0.157 | 0.632 |
| | [0.530] | [0.736] | [0.939] | [0.391] | [0.100] | [0.197] | [0.837] | [0.108] |

**Table 7. Too-big-to-fail Banks (cont'd)**

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | Bank Size | | Bank Size | | Bank Size | | Bank Size | |
| | Large | Small | Large | Small | Large | Small | Large | Small |
| Tier 1 Capital / Assets | 4.468 | -0.564 | 4.064 | 0.641 | 13.708 | 2.439 | 6.146 | 0.407 |
| | [0.462] | [0.496] | [0.145] | [0.098]* | [0.047]** | [0.073]* | [0.264] | [0.611] |
| Loans / Assets | 0.096 | -0.336 | -0.006 | -0.353 | -2.249 | 0.054 | 0.193 | -0.672 |
| | [0.916] | [0.282] | [0.990] | [0.023]** | [0.021]** | [0.865] | [0.812] | [0.041]** |
| Bad Loans / Assets | 13.071 | 11.291 | 3.173 | 5.200 | 8.353 | 5.570 | 12.618 | 13.331 |
| | [0.007]*** | [0.000]*** | [0.360] | [0.000]*** | [0.381] | [0.016]** | [0.021]** | [0.000]*** |
| Non-interest Income / Assets | -0.319 | -0.207 | 0.057 | -0.039 | 0.155 | -0.105 | -0.019 | -0.209 |
| | [0.529] | [0.165] | [0.775] | [0.638] | [0.773] | [0.497] | [0.969] | [0.199] |
| Insurance Assets / Assets | 0.981 | 7.278 | 0.418 | -0.840 | 1.534 | 19.776 | 1.093 | 2.718 |
| | [0.000]*** | [0.594] | [0.000]*** | [0.780] | [0.000]*** | [0.285] | [0.000]*** | [0.710] |
| Derivative Trading / Assets | 0.009 | -0.069 | 0.003 | -0.070 | 0.021 | -0.243 | 0.008 | -0.033 |
| | [0.309] | [0.119] | [0.374] | [0.002]*** | [0.001]*** | [0.000]*** | [0.334] | [0.517] |
| Derivative Hedging / Assets | -0.115 | -0.127 | -0.073 | -0.060 | 0.178 | -0.153 | -0.148 | -0.088 |
| | [0.219] | [0.186] | [0.363] | [0.200] | [0.279] | [0.027]** | [0.172] | [0.456] |
| Underwriting Assets / Assets | -0.685 | -0.217 | -0.548 | -0.171 | -1.786 | -1.070 | -0.704 | 0.047 |
| | [0.288] | [0.307] | [0.162] | [0.073]* | [0.039]** | [0.001]*** | [0.185] | [0.868] |
| Constant | -0.920 | 3.045 | 1.684 | 1.565 | -4.435 | -4.375 | 3.022 | 3.514 |
| | [0.841] | [0.005]*** | [0.471] | [0.004]*** | [0.269] | [0.002]*** | [0.483] | [0.006]*** |
| N | 632 | 5,381 | 632 | 5,381 | 632 | 5,381 | 632 | 5,381 |
| R-sq | 0.716 | 0.612 | 0.704 | 0.612 | 0.655 | 0.539 | 0.749 | 0.639 |
| adj. R-sq | 0.699 | 0.609 | 0.686 | 0.609 | 0.635 | 0.536 | 0.735 | 0.636 |

**Table 8. CEO Control**

This table presents the results for the estimation of Equation 2 in the text for banks separately for banks that are managed by more and less powerful CEOs. The dependent variables are total equity risk, tail risk, systematic risk and unsystematic risk. The main variable of interest is the interaction of Vega/Cash Compensation and GDP Growth Rate. CEO Control is measured with the tenure of the CEO. CEO control is "High" if CEO tenure is greater than or equal to 3 years. The definitions of the rest of the variables are provided in Appendix 2. All regressions control for bank fixed effects and year fixed effects. Robust standard errors are clustered at the bank level. P-values are provided in brackets. *, **, *** mark the 10%, 5% and 1% statistical significance for the estimated coefficients.

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | CEO Control | | CEO Control | | CEO Control | | CEO Control | |
| | High | Low | High | Low | High | Low | High | Low |
| Vega / Cash Compensation $_{-1}$ | 0.048 | 0.035 | 0.013 | 0.023 | 0.034 | 0.029 | 0.010 | 0.008 |
| | [0.121] | [0.653] | [0.332] | [0.495] | [0.321] | [0.682] | [0.742] | [0.910] |
| Delta / Cash Compensation $_{-1}$ | -0.141 | -0.143 | -0.067 | -0.048 | -0.059 | -0.116 | -0.148 | -0.085 |
| | [0.000]*** | [0.017]** | [0.000]*** | [0.048]** | [0.073]* | [0.091]* | [0.000]*** | [0.124] |
| GDP Growth Rate | -0.081 | -0.110 | -0.040 | -0.059 | -0.112 | -0.120 | -0.043 | -0.085 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.000]*** | [0.001]*** |
| (Vega/Cash Compensation ) * GDP Growth | -0.026 | -0.012 | -0.010 | 0.004 | -0.014 | -0.010 | -0.023 | 0.007 |
| | [0.000]*** | [0.468] | [0.000]*** | [0.592] | [0.003]*** | [0.558] | [0.000]*** | [0.641] |
| (Delta/Cash Compensation ) * GDP Growth | 0.018 | 0.026 | 0.007 | 0.006 | 0.017 | 0.025 | 0.015 | 0.015 |
| | [0.000]*** | [0.061]* | [0.001]*** | [0.133] | [0.000]*** | [0.065]* | [0.003]*** | [0.183] |
| Cash Compensation $_{-1}$ | -0.220 | -0.125 | -0.127 | -0.063 | -0.092 | -0.111 | -0.313 | -0.159 |
| | [0.000]*** | [0.016]** | [0.000]*** | [0.011]** | [0.031]** | [0.020]** | [0.000]*** | [0.004]*** |
| CEO Tenure | 0.006 | -0.048 | 0.004 | -0.038 | 0.008 | -0.020 | 0.007 | -0.066 |
| | [0.073]* | [0.266] | [0.004]*** | [0.084]* | [0.115] | [0.664] | [0.030]** | [0.196] |
| Log(Total Assets) | 0.066 | -0.068 | 0.027 | 0.007 | 0.293 | 0.329 | 0.036 | -0.216 |
| | [0.306] | [0.693] | [0.384] | [0.932] | [0.001]*** | [0.112] | [0.605] | [0.231] |
| ROA | -13.884 | -8.429 | -7.983 | -5.470 | -13.412 | -20.020 | -13.463 | -5.863 |
| | [0.038]** | [0.519] | [0.013]** | [0.189] | [0.060]* | [0.078]* | [0.033]** | [0.554] |
| Deposits / Assets | 0.091 | 0.197 | 0.112 | 0.450 | -0.703 | 0.400 | 0.528 | 1.299 |
| | [0.815] | [0.803] | [0.550] | [0.351] | [0.104] | [0.647] | [0.179] | [0.127] |

**Table 8. CEO Control (cont'd)**

| | Total Risk | | Tail Risk | | Systematic Risk | | Unsystematic Risk | |
|---|---|---|---|---|---|---|---|---|
| | CEO Control | | CEO Control | | CEO Control | | CEO Control | |
| | High | Low | High | Low | High | Low | High | Low |
| Tier 1 Capital / Assets | -0.771 | 3.047 | 0.543 | 3.064 | 1.818 | 11.535 | 0.673 | 3.789 |
| | [0.404] | [0.247] | [0.197] | [0.004]*** | [0.134] | [0.001]*** | [0.490] | [0.140] |
| Loans / Assets | -0.035 | -0.582 | -0.174 | -0.149 | 0.490 | -0.256 | -0.441 | -0.300 |
| | [0.915] | [0.282] | [0.247] | [0.556] | [0.139] | [0.633] | [0.172] | [0.534] |
| Bad Loans / Assets | 10.340 | 17.408 | 4.742 | 9.303 | 6.893 | -1.390 | 12.070 | 22.033 |
| | [0.000]*** | [0.000]*** | [0.000]*** | [0.001]*** | [0.005]*** | [0.740] | [0.000]*** | [0.000]*** |
| Non-interest Income / Assets | -0.232 | -0.661 | -0.037 | -0.377 | -0.207 | -0.692 | -0.245 | -0.407 |
| | [0.189] | [0.010]*** | [0.699] | [0.000]*** | [0.281] | [0.152] | [0.190] | [0.055]* |
| Insurance Assets / Assets | 0.658 | -6.404 | 0.294 | -1.813 | 1.114 | 5.278 | 0.728 | -3.677 |
| | [0.000]*** | [0.090]* | [0.001]*** | [0.447] | [0.000]*** | [0.125] | [0.000]*** | [0.368] |
| Derivative Trading / Assets | -0.002 | -0.015 | -0.003 | -0.006 | -0.015 | 0.031 | 0.002 | 0.000 |
| | [0.717] | [0.243] | [0.199] | [0.423] | [0.035]** | [0.101] | [0.722] | [0.976] |
| Derivative Hedging / Assets | -0.166 | -0.039 | -0.085 | -0.029 | -0.170 | -0.138 | -0.153 | 0.032 |
| | [0.015]** | [0.808] | [0.022]** | [0.707] | [0.013]** | [0.484] | [0.077]* | [0.839] |
| Underwriting Assets / Assets | -0.666 | 0.458 | -0.440 | -0.288 | -1.518 | -4.655 | -0.454 | 0.040 |
| | [0.098]* | [0.803] | [0.065]* | [0.692] | [0.034]** | [0.038]** | [0.159] | [0.982] |
| Constant | 2.562 | 4.219 | 1.491 | 1.034 | -3.829 | -5.040 | 3.225 | 5.402 |
| | [0.016]** | [0.144] | [0.005]*** | [0.445] | [0.010]*** | [0.149] | [0.007]*** | [0.101] |
| N | 5,105 | 908 | 5,105 | 908 | 5,105 | 908 | 5,105 | 908 |
| R-sq | 0.617 | 0.544 | 0.611 | 0.594 | 0.537 | 0.448 | 0.648 | 0.596 |
| adj. R-sq | 0.614 | 0.525 | 0.608 | 0.578 | 0.534 | 0.426 | 0.645 | 0.580 |

**Appendix 1: List of Banks in the Sample**

AMEGY BANCORPORATION INC
AMERICAN EXPRESS CO
AMERIS BANCORP
AMSOUTH BANCORPORATION
ASSOCIATED BANC-CORP
ASTORIA FINANCIAL CORP
BANCORPSOUTH INC
BANCWEST CORP
BANK MUTUAL CORP
BANK OF AMERICA CORP
BANK OF HAWAII CORP
BANK OF NEW YORK MELLON CORP
BANK OF THE OZARKS INC
BANK ONE CORP
BANKAMERICA CORP-OLD
BANKBOSTON CORP
BANKERS TRUST CORP
BANKNORTH GROUP INC-OLD
BANNER CORP
BARNETT BANKS INC
BB&T CORP
BOATMENS BANCSHARES INC
BOFI HOLDING INC
BOSTON PRIVATE FINL HOLDINGS
BROOKLINE BANCORP INC
CAPITAL ONE FINANCIAL CORP
CARDINAL FINANCIAL CORP
CASCADE BANCORP
CATHAY GENERAL BANCORP
CCB FINANCIAL CORP
CENTRAL FIDELITY BANKS INC
CENTRAL PACIFIC FINANCIAL CP
CENTURA BANKS INC
CHARTER ONE FINANCIAL INC
CHASE MANHATTAN CORP -OLD
CHITTENDEN CORP
CIT GROUP INC
CITIGROUP INC
CITY HOLDING CO
CITY NATIONAL CORP
COLONIAL BANCGROUP
COLUMBIA BANKING SYSTEM INC
COMERICA INC
COMMERCE BANCORP INC/NJ
COMMERCE BANCSHARES INC
COMMUNITY BANK SYSTEM INC
COMMUNITY FIRST BANKSHARES
CONCORD EFS INC
CONTINENTAL BANK CORP
CORESTATES FINANCIAL CORP
CORUS BANKSHARES INC
COUNTRYWIDE FINANCIAL CORP
CRESTAR FINANCIAL CORP
CULLEN/FROST BANKERS INC
CVB FINANCIAL CORP
DAUPHIN DEPOSIT CORP
DEPOSIT GUARANTY CORP
DIME COMMUNITY BANCSHARES
DISCOVER FINANCIAL SVCS INC
E TRADE FINANCIAL CORP
EAST WEST BANCORP INC
F N B CORP/FL
FIFTH THIRD BANCORP
FIRST AMERICAN CORP/TN
FIRST AMERICAN FINANCIAL CP
FIRST BANCORP P R
FIRST CHICAGO CORP
FIRST CHICAGO NBD CORP
FIRST COMMERCIAL CORP
FIRST COMMONWLTH FINL CP/PA
FIRST FIDELITY BANCORP
FIRST FINL BANCORP INC/OH
FIRST FINL BANKSHARES INC
FIRST HORIZON NATIONAL CORP
FIRST INTERSTATE BNCP
FIRST MICHIGAN BANK CORP
FIRST MIDWEST BANCORP INC
FIRST NIAGARA FINANCIAL GRP
FIRST OF AMERICA BANK CORP
FIRST SECURITY CORP/DE
FIRST VIRGINIA BANKS INC
FIRSTAR CORP-OLD
FIRSTMERIT CORP
FLAGSTAR BANCORP INC
FLEETBOSTON FINANCIAL CORP
FRANKLIN RESOURCES INC
FRONTIER FINANCIAL CORP/WA
FULTON FINANCIAL CORP
GBC BANCORP/CA
GLACIER BANCORP INC
GOLD BANC CORP INC
GOLDMAN SACHS GROUP INC
GREATER BAY BANCORP
GREENPOINT FINANCIAL CORP
HANCOCK HOLDING CO
HANMI FINANCIAL CORP
HIBERNIA CORP -CL A
HOME BANCSHARES INC
HUDSON CITY BANCORP INC
HUDSON UNITED BANCORP
HUNTINGTON BANCSHARES
IMPERIAL BANCORP
INDEPENDENT BANK CORP/MA
INDEPENDENT BANK CORP/MI
INTL BANCSHARES CORP
INVESTORS FINANCIAL SVCS CP
IRWIN FINANCIAL CORP
JPMORGAN CHASE & CO
KEYCORP
KEYSTONE FINANCIAL INC
LEGACY TEX FINANCIAL GRP INC
LIBERTY BANCORP INC/OK
LIBERTY NATIONAL BANCORP/KY
M & T BANK CORP
MAGNA GROUP INC
MARK TWAIN BANCSHARES
MARSHALL & ILSLEY CORP
MB FINANCIAL INC/MD
MBNA CORP
MELLON FINANCIAL CORP
MERCANTILE BANCORPORATION
MERCANTILE BANKSHARES CORP
MERIDIAN BANCORP INC
METLIFE INC
MORGAN (J P) & CO
MORGAN STANLEY
N B T BANCORP INC
NATIONAL CITY CORP
NATIONAL COMMERCE FINANCIAL
NATIONAL PENN BANCSHARES INC
NBB BANCORP INC
NEW YORK CMNTY BANCORP INC
NEWALLIANCE BANCSHARES INC
NORTH FORK BANCORPORATION
NORTHERN TRUST CORP
NORTHWEST BANCSHARES INC
OFG BANCORP
OLD KENT FINANCIAL CORP
OLD NATIONAL BANCORP
ONBANCORP INC
ORITANI FINANCIAL CORP
PACWEST BANCORP
PEOPLE'S UNITED FINL INC
PINNACLE FINL PARTNERS INC
PNC FINANCIAL SVCS GROUP INC
POPULAR INC
PREMIER BANCORP
PREMIER BANCSHARES INC
PRIVATEBANCORP INC
PROSPERITY BANCSHARES INC
PROVIDENT BANKSHARES CORP
PROVIDENT FINANCIAL GRP INC
PROVIDENT FINANCIAL SVCS INC
RAYMOND JAMES FINANCIAL CORP
REGIONS FINANCIAL CORP
REPUBLIC BANCORP INC
RIGGS NATIONAL CORP
S & T BANCORP INC
SCHWAB (CHARLES) CORP
SEACOAST FINANCIAL SERVICES
SHAWMUT NATIONAL CORP
SIMMONS FIRST NATL CP -CL A
SOUTH FINANCIAL GROUP INC
SOUTHSIDE BANCSHARES INC
SOUTHTRUST CORP
STATE STREET CORP
STERLING BANCORP
STERLING BANCORP/NY -OLD
STERLING BANCSHARES INC/TX
STERLING FINANCIAL CORP/WA
STIFEL FINANCIAL CORP
SUMMIT BANCORP
SUNTRUST BANKS INC
SUSQUEHANNA BANCSHARES INC
SVB FINANCIAL GROUP
SYNOVUS FINANCIAL CORP
TAYLOR CAPITAL GROUP INC
TCF FINANCIAL CORP
TEXAS CAPITAL BANCSHARES INC
TEXAS REGL BCSHS INC -CL A
TOMPKINS FINANCIAL CORP
TRUSTCO BANK CORP/NY
TRUSTMARK CORP
U S BANCORP
U S BANCORP-OLD
U S TRUST CORP
UCBH HOLDINGS INC
UMB FINANCIAL CORP
UMPQUA HOLDINGS CORP
UNION PLANTERS CORP
UNITED BANKSHARES INC/WV
UNITED COMMUNITY BANKS INC
UST CORP
VALLEY NATIONAL BANCORP
WACHOVIA CORP
WACHOVIA CORP-OLD
WASHINGTON FEDERAL INC
WEBSTER FINANCIAL CORP
WELLS FARGO & CO
WELLS FARGO & CO -OLD
WEST ONE BANCORP
WESTAMERICA BANCORPORATION
WHITNEY HOLDING CORP
WILMINGTON TRUST CORP
WILSHIRE BANCORP INC
WINTRUST FINANCIAL CORP
ZIONS BANCORPORATION

**Appendix 2. Variable Descriptions**

| Variable | Description |
|---|---|
| **A. CEO Incentive Measures** | |
| Salary ($000s) | Base salary of the CEO. |
| Bonus ($000s) | Bonus payments to the CEO. Calculated as "Bonus + Nonequity Incentives" after the fiscal year 2006. |
| Cash Compensation ($000s) | Salary plus bonus. |
| Delta ($000s) | Dollar change in the CEO stock and option portfolio for a 1% change in stock price. |
| Vega ($000s) | Dollar change in the CEO stock and option portfolio for a 1% change in stock return volatility. |
| Delta/Cash Compensation | CEO performance incentives scaled by cash compensation. |
| Vega/Cash Compensation | CEO risk taking incentives scaled by cash compensation. |
| Tenure as CEO | Number of years as CEO. |
| High CEO Control | CEO tenure more than 3 years. |
| **B. Risk Measures** | |
| Total risk | Annualized variance of daily stock returns during a firm's fiscal year. |
| Tail risk | Average return on a bank's equity over the 10% worst return days for the bank's stock in a given quarter. |
| Systematic Risk | Annualized variance of the product of the bank beta and the market daily returns. |
| Unsystematic Risk | Annualized variance of residuals from the market model. |
| **C. Bank Financial Characteristics** | |
| Total Assets ($000s) | Total assets of the bank. |
| ROA | Income before extraordinary items scaled by total assets. |
| Deposits/Assets | Total deposits scaled by total assets. |
| Tier 1 Capital / Assets | Tier 1 capital (reported) scaled by total assets. |
| Loans / Assets | Total loans scaled by total assets. |
| Bad Loans / Assets | Ratio of the sum of loans past due 90 days or more and non-accrual loans to assets. |
| Non-interest Income / Income | Ratio of non-interest income to the sum of interest income and non-interest income. |
| Insurance Assets / Assets | The ratio of the assets of subsidiaries engaged in insurance and reinsurance to assets. |
| Derivative Trading Assets / Assets | The ratio od total gross notional amount of derivative contracts held for trading (interest rate contracts, foreign exchange contracts, equity derivative contracts, and commodity and other contracts) to assets. |
| Derivative Hedging Assets / Assets | Derivative Trading assets scaled by total assets. |
| Underwriting Assets / Assets | The ratio of the assets of subsidiaries engaged in underwriting or dealing securities to assets. |
| RMI | Risk Management Index (Ellul and Yerramilli, 2013). |
| **D. Macroeconomic State Measures** | |
| Gross Domestic Product (GDP) Growth Rate | Advance release values for real GDP growth rate (percentage changes from a year ago), seasonally adjusted. |
| Chicago FED Index | Chicago Fed National Activity Index (CFNAI). |
| Confidence Index | Standardized Yale/Shiller crash confidence index. |
| Economic Policy Uncertainty (EPU) Index | Standardized Baker, Bloom and Davis index. |
| **E. Instruments** | |
| FAS Cost | Ratio of the estimated market value of annual CEO option grants to reported net income. |
| Median Delta (Nonfinancial Firms) | Median value of delta granted in a given year to the CEOs of non-financial firms. |
| Median Vega (Nonfinancial Firms) | Median value of vega granted in a given year to the CEOs of non-financial firms. |
| Median Cash Compensation (Nonfinancial Firms) | Median value of cash compensation granted in a given year to the CEOs of non-financial firms. |