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Executive Compensation in the Banking Industry and Systemic Risk

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EXECUTIVE COMPENSATION IN THE BANKING INDUSTRY AND SYSTEMIC RISK

by

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ABSTRACT

In this paper, I investigate empirically whether executive compensation structure contributes to the entire systemic risk among 92 firms that highly contribute to systemic risk from 2000 to 2012. Based on Brownlees and Engle (2011) and Acharya, Pedersen, Philippon, and Richardson (2010), I use SRISK and MES as systemic risk measures. Firstly, I find that the ratio of stock options has a positively significant influence on systemic risk. Also, I find weak evidence that the ratio of cash bonus in compensation structure positively related to systemic risk. However, I find no significant evidence that the ratio of stock grants has a negative relation with systemic risk. It might be caused by the growth trend in non-traditional banking activities. Third, I find that TARP fund induces a manager's risk-seeking. This is because the interests of owners and managers are aligned to take more risk for the purpose of maximizing their own wealth. Lastly, I find that the positive relationship between stock-based compensation and systemic risk is stronger during the recent financial crisis.

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CHAPTER 1

INTRODUCTION

The recent subprime lending crisis from the third quarter of 2007 to the fourth quarter of 2009[1] has led to an increased focus on corporate governance and regulation in the financial services industry. Specifically, an increased focus on managerial decisions along with moral hazard issues have once again risen to the surface and are of particular concern to both politicians and academics who are trying to figure out the causes and consequences of the crisis.

In particular, during the recovery stage of the financial crisis, moral hazard may have become even more serious among firms that received the government relief. This is because remedial measures such as deposit insurance and too-big-to-fail protection provide management with moral hazard incentives. Merton (1977) argues that deposit insurance might be considered a put option on the value of a bank's assets at an exercise price equal to the promised maturity value. He also states that banks seeking to maximize the value of their equity will maximize the value of the option by increasing asset risk or minimizing invested capital relative to assets. Thus, Keeley (1990) states that deposit insurance results in the moral hazard of excessive risk taking. Also, Mishkin, Stern, and Feldman (2006) state that deposit insurance providing a government safety net and the too-big-to-fail policy increase moral hazard for major banks. Berger and Turk-Ariss

[1] Berger and Bouwman (2013) describe the financial crises that occurred in the US from the first quarter of 1984 to the fourth quarter of 2010. There are two banking crises and three market crises during the period. The recent crisis is the subprime lending crisis, which is one of the banking crises. See Appendix A of Berger and Bouwman (2013).

(2013) show that government reaction for the recent financial crisis such as expanding deposit insurance and aiding troubled firms may result in mitigation of market discipline. This can explain the increases in moral hazard for firms receiving government's help. Furthermore, Lambert, Noth, and Schuwer (2013) state that banks that are affected by enforcement of the U. S. Emergency Stabilization Act experience increases in their insured deposit, and these banks tend to be riskier because expanding insured deposit might mitigate market discipline and induce the banks to take risky projects.

For example, the case of American International Group (AIG) illustrates one example of a financial institution that spent a lot of money on bonuses for its executives even though it received fund from the Troubled Asset Relief Program (TARP). This is because financial firms that receive TARP funds may be encouraged to take excessive risk (e.g., Black and Hazelwood, 2012; Duchin and Sosyura, 2012).

Thus, among the various problems that financial companies face, one of the most pressing that need to be cared through ample discussion involves executive compensation structure. That is, a compensation structure that contains base salaries, bonuses, and extra incentives for top executives has become a serious problem as moral hazards seem inevitable. If corporate funds are exploited for a manager's private purposes, such as excessive risk taking to maximize his or her wealth, this might have a significant negative influence on firm value and shareholder wealth. Thus, an appropriate compensation structure is necessary to ensure interests are aligned, and interest in this issue is growing.

Diamond and Rajan (2009) states that CEOs are compensated based on the profits they produce and this can have negative influences on other firms. Some large financial firms can make large return in a reasonable way but this compels the other financial firms

to catch up with the large firms. Executives in relatively smaller financial firms might take excessive risks to improve the performance and profits of firms. Even if managers of smaller firms recognize that the projects they invest are negative NPV projects, a desire to skyrocket their stock prices and own wealth might make them to estimate the projects as great opportunities for them. These phenomena in financial industry lead financial firms to default and make the whole economy riskier. It implies that systemic risk might be increased, which means that it would cause the collapse of the entire economy.

Hence, in this paper, I examine the relation between compensation structure and systemic risk. I mainly hypothesize that changes in the stock-based compensation structure such as stock options and stock grants may affect systemic risk. To be specific, I expect that the portion of stock options and systemic risk to be positively related and that the portion of stock grants and systemic risk to be negatively related. This is because the stock options are the options on stock price and the stock grants are the options on firm performance. Managers with stock options might tend to increase short-term firm performance because they need to maximize the margin between the strike price and the stock price before the expiration date of the options. On the other hand, managers with stock grants may tend to focus on long-term firm performance because they can receive a certain amount of stock compensation after the vesting period. Also, I expect that the relationship between cash bonus and systemic risk is positive because higher cash bonus in total compensation package induces managers to pursue short-term performance because managers receive the bonus when they achieve the short-term performance goals. The managers with higher incentive compensations may be motivated to take risks that are not borne by the firm but by the entire economy if the externalities are not

internalized by each firm. Hence, the systemic risk may increase because of firms' risk taking. Furthermore, because both each firm's contribution to the systemic risk and market risk are positively interacted, both factors contribute to increase overall systemic risk. Finally, I examine whether the Troubled Asset Relief Program (TARP) affect the relationship between stock-based compensation and systemic risk. I expect that TARP fund may induce manager's risk-seeking behavior because losses of TARP recipients may be covered by TARP fund. The results show that my hypotheses are generally supported. Higher systemic risk has negative external cost on the entire system, and it causes capital losses of firms. This also increases the probability of default. Thus, firms may need to mitigate systemic risk and the compensation structure may be a tool to mitigate the risk.

In the banking industry, an owner tends to be risk seeking, but a manager tends to be risk averse. Since the owner's wealth is much larger than the manager's and the manager has career and reputation concerns, the impact of losses caused by excessive risk taking on the two groups differs. The losses account for a relatively small portion of the owner's wealth. In contrast, the losses are a relatively large fraction of the manager's wealth and the losses can result in executive turnover. Thus, the owner wants to take excessive risk to maximize his or her rewards, but the manager wants to minimize risk and losses in his or her own wealth and to protect his or her job security. However, these two groups' behavior may change as their compensation structure changes.

Thus, a board of directors must hire appropriate managers based on the board's given conditions and give the managers incentives to pursue the same interests as

shareholders. That is, the board of directors ultimately aims to improve the value of the firm. This objective has been applied in the compensation structure.

To encourage the manager to take the ideal level of risk, which is same as the owner's interest, the board of directors provides incentive compensation, such as stock options as this incentive structure. This is designed to make managers to take on positive NPV projects. However, since managers with excessive stock-based incentive compensation would be more sensitive to stock return volatility and have incentives to maximize their own wealth regardless of the owner's wealth and to engage in debt finance to invest on the projects, granting excessive stock-based incentive compensation may result in excessive risk taking and aggravation of firm value. This creates the moral hazard of excessive risk taking. To avoid the moral hazard of the excessive risk taking, the board of directors determines balanced incentive compensation packages including stock options, stock grants, and cash bonuses in the compensation structure.

Since stock-based compensation of a bank manager is tied to stock price appreciation and banks are generally highly leveraged, bank managers have a strong incentive to take risks to maximize their personal wealth if they have equity based incentive contracts.

In particular, a manager with stock options earn huge compensation as firm's stock price increases, but there is no huge loss on his or her compensation as firm's stock price decreases because the manager can abandon the right to exercise the options when the stock price is below a strike price. This implies that stock options provide limited downside risk and unlimited upside reward. Thus, the manager who has stock options may invest more aggressively.

On the other hand, different from stock options, stock grants, which means that a manager is endowed with firm's shares, do not have a strike price. So, a manager who has stock grants receives huge rewards when the stock price increases and also earns rewards that are generally at least larger than zero profit even though the stock price decreases sharply and the amount of reward is pretty small. Thus, stock grants may make the manager more prudent in making investment decisions because the manager's interests are closely aligned with the shareholders' interests and the amount of compensation is tied to the change in stock price symmetrically. Hence, because of its symmetric compensation structure, a manager who has stock grants is less likely to take excessive risk than the manager who has stock options.

Many studies examine the relation between executive compensation and market risk. The discussion concerning financial institutions' risk is important because the relation between risk and the compensation structure is closely related to legislation, enactment, and the enforcement of regulation. However, few studies examine the relation between executive compensation and systemic risk even though previous financial crises demonstrate the importance of systemic risk.

Systemic risk is different from systematic risk. Systematic risk, which is sometimes called market risk, is the risk inherent in the aggregate market that cannot be eliminated through diversification. While systematic risk cannot be eliminated by diversification, it can be mitigated by appropriate hedges. For example, if an investor builds a well-diversified portfolio with products in the United States, the idiosyncratic risk of the investor's portfolio may be mitigated but systematic risk exists. If the dollar value changes, the value of portfolio is also changed. However, the systematic risk may

be mitigated if the investor includes some products that are appreciated by the other currency in his or her portfolio.

On the other hand, systemic risk is generally described as risk caused by an event at the firm level that is severe enough to cause instability in the financial system. This means that an externality exists. Thus, unless the external costs of systemic risk are internalized by each firm, firms will have incentive to take risks that are not borne by the firm but by the entire economy. Hence, the financial firm's risk is a negative externality for the whole system. Also, unlike systematic risk, systemic risk cannot be mitigated by diversification or hedging. These two risks combine and interact in a complementary way to increase overall systemic risk, which is the probability of a crisis in the financial industry. From the perspective of measures of the risks, the difference between systemic risk measure and beta, which is a widespread measure of market risk, arises from the fact that systemic risk is based on tail dependence rather than average covariance.

Brunnermeier, Dong, and Palia (2012) show that commercial banks with higher non-interest income such as trading income and investment banking/venture capital income to interest income ratios have higher systemic risk. This implies that higher level of investment banking activities, which are not traditional commercial banks' activities, are associated with a larger contribution to systemic risk. In addition, the authors state that there is a large increase in the average non-interest income to interest income ratio from 2000 to 2008. This indicates that the portion of investment banking services of most major banks has increased over time. As such, the link between collapses in financial system and negative externalities of the collapses to the entire economy will play a prominent role in this study.

Since systemic risk is the risk of the collapse of an entire financial system and compensation structure is affected by firms' condition and firm value, the relation between systemic risk and firm value cannot be ignored when firms design their managers' compensation structures. This is because the collapse in financial system might cause negative impact on firms' condition and value. Also, because the systemic risk measure shows its predictive power (e.g., eight of ten firms with higher contribution to systemic risk have really troubled when systemic risk measure was high and the financial crisis occurred[2]), a board of directors can use compensation policies as a tool to prevent a manager from taking excessive risk and elevating systemic risk before financial crisis occurs. This may cause relatively stable firm value and lower level of systemic risk.

Some previous studies suggest that non-interest income is more volatile than interest income over time in the United States so it increases revenue volatility and systemic risk. (e.g., Smith, Staikouras and Wood, 2003; DeYoung and Roland, 2001; Brunnermeier, Dong, and Palia, 2012). Since stock-based compensation usually occupies a significant portion of the entire pay package for bank executives and non-traditional activities are prevalent among the major banks, managers may engage in non-traditional activities to maximize both firm value and his or her total compensation. Thus, this activity might affect the growth trend in non-interest income and systemic risk.

The main contributions of my study are as follows: First of all, to the best of my knowledge, the study that examines the relation between compensation structure and systemic risk is rare. Thus, the findings in this paper may show how firms sensitively

[2] Brownlees and Engle (2011) state that one year and a half before the Lehman bankruptcy, eight firms that are ranked on top ten in the SRISK turned out to be troubled institutions. They do not specify the eight institutions but they provide the list of top ten SRISK firms. These top ten institutions are as follows: Morgan Stanley, Merrill Lynch, Freddie Mac, Fannie Mae, Goldman Sachs, Lehman Brothers, Bear Stearns, Metlife, Prudential Financial, and Hartford Financial Service.

react to mitigate the systemic risk when the firms design their management's compensation structure. Second, if the clear relationship between the systemic risk and the compensation is empirically established, this would be helpful in constructing the optimal compensation structure for the perspective of firms and in designing a policy that could prevent the managers from pursuing only their own wealth, protect firm stability, and reduce the externalities on the entire economy for the perspective of regulators.

The remainder of this paper is organized as follows. I first review the existing literatures on executive compensation in financial firms and systemic risk. In Section 3, I develop testable hypotheses. Section 4 describes the data and sample selection procedures and the methodology and discusses possible outlines for my research. Section 5 provides empirical results and Section 6 concludes.

CHAPTER 2

LITERATURE REVIEW

2.1 Stock-based compensation

If an owner of the firm is the CEO, management and shareholder interests are aligned, so there is no agency cost at the CEO level. However, if ownership and management are separated, shareholders need to monitor managerial behavior and prohibit manager's rent-seeking behavior. Incentive compensation such as stock-based compensation may help resolve any conflict of interest between shareholder and managers and to maximize the wealth of shareholders (e.g., Jensen and Murphy, 1990).

There are two general types of stock-based compensation: stock option and stock grants. Stock options have traditionally been considered as appropriate incentive policy in order to mitigate the principal-agent problem between a manager and shareholders (e.g., Haugen and Senbet, 1981; Jensen and Murphy, 1990; Morgan and Poulsen, 2001). For the purpose of improving firm value, stock options were introduced in 1920s. In 1980s, stock options were widely spread to promote shareholder's interest and to motivate managers during the economic slump. As a result, 83 percent of the 100 largest firms in the U.S. had option plans for their managers in 1980s (e.g., Defusco, Zorn, and Johnson, 1991). According to Murphy (1999), stock options occupied the largest portion of CEO compensation packages in the early 1990s. Also, the dollar-valued amount of stock options takes above a half portion of total compensation in dollar terms during the period.

These show that stock options are used as one of the most important compensation methods for management.

Stock options, since they are call options, present managers with limited downside risk and unlimited upward potential due to their asymmetric payoffs. Stock options thus provide managers incentives to engage in risk-seeking (e.g., Brookfield and Ormrod, 2000). Hence, excessive stock option might cause excessive risk taking, and this may cause a decrease in firm value and default.

For the perspective of stock grants, the wealth of a manager follows firm performance and firm value. It means that the manager's wealth is closely related to long-term firm performance instead of short-term stock return volatility. That is, stock grants provide more symmetric payoffs than stock options, so the manager with stock grants tends to be prudent when he or she make investment decisions.

The findings of previous research that examine the impact of stock options are mixed. Some previous studies state that stock options, which is one of the most popular incentive compensation, ease agency costs; the manager's moral hazard is reduced when the manager receives stock options. This, in turn, leads to improvement of firm performance. (e.g., Jensen and Meckling, 1976, Haugen and Senbet, 1981, Barnea, Haugen, and Senbet, 1981)

On the other hand, Bebchuk and Fried (2003) find that conferring stock options might cause agency problems. They show that bad corporate governance leads to excessive stock options compensation for managers. This is because both the firm's corporate governance and incentive compensation for managers can mitigate the managers' moral hazard, and these two are closely related. Thus, to mitigate the agency

problem, more stock options for managers are needed when the firm's corporate governance is bad.

Amihud and Lev (1981) argue that compensating with stock grants gives a manager strong incentive to receive their maximized compensation because the interest of the manager and the shareholders is aligned. The manager tends to be risk-averse to avoid losses in his or her own stock. The authors also state that it might cause lower firm value in the long run. On the other hand, since a manager who has received stock options can choose whether he or she exercises the option based on the difference between the stock price and the exercise price, stock options may provide a manager a shield in that he can avoid a risk of decreasing compensation as stock price falls. It can reduce the manager's risk-averse tendency, so the manager can invest actively. The progressive investment behavior by the manager make firms avoid the losses in firm value due to passive decision making. Thus, the stock options in the executive compensation structure contribute to improve firm performance in the long run. (e.g., Haugen and Senbet, 1981, Core and Guay, 1999)

In addition, Yermack (1995) shows that stock options are more attractive compensation method than stock grants for the perspective of the manager. Thus, the author argues that the ratio of stock option in the executive compensation package might increase if the manager can affect the decision for the executive compensation structure. That implies that the manager prefer to have more stock options. The excessive stock options may cause a reduction in firm value because excessive stock options give the manager an incentive to be risk-seeking. (e.g., Cassidy, 2002; Hall & Murphy, 2002; Berrone, 2008)

Also, DeFusco, Zorn, and Johnson (1991) and Yeo, Chen, Ho, and Lee (1999) find that conferring stock options to executives does not affect long-term performance of firms or even negatively affect the firms' performance in the long run.

Furthermore, according to recent research on this issue by Dittmann and Maug (2007), to reduce compensation costs, CEOs should have lower base salaries and receive stock grants instead of stock options. The contracts would reduce average compensation costs by 20% while providing the same incentives and the same utility to CEOs.

Hence, according to previous studies, stock options, stock grants, and base salaries are important factor to determine a manager's incentive to take excessive risk, so these compensation policies are also crucial to improve firm value by reducing a manager's moral hazard.

2.2 Systemic risk

According to Brunnermeier, Dong, and Palia (2012), commercial banks that pursue more non-traditional banking activities such as investment banking, venture capital, and trading activities cause increases in systemic risk in comparison with commercial banks that concentrate on traditional banking activities such as deposit taking and lending. This is because the return of non-traditional banking is more volatile than traditional banking.

Although there are several kinds of systemic risk measures, it is still debatable which one is the most efficient and appropriate measure of systemic risk. Acharya, Pedersen, Philippon, and Richardson (2010) propose a simple model of systemic risk. They argue that its systemic expected shortfall (SES) can measure each financial institution's contribution to systemic risk. SES is defined by bank's propensity to be

undercapitalized when the system as a whole is undercapitalized. SES measure captures a bank's exposure given that there is a systemic crisis. The authors also state that the Marginal Expected Shortfall (MES), which is the equity loss of each individual firm in the tail of the aggregate system's loss distribution, is simple to compute and forecast systemic risk. The MES measures how firm's risk taking adds to the bank's overall risk. That is, the MES might be measured by estimating firm's losses when the firm is suffering economy slump. They show that the MES and leverage forecast each firm's contribution to the entire systemic risk.

Brownlees and Engle (2011) define the systemic risk of a financial institution as its contribution to the total capital shortfall of the financial system that can be expected in a future crisis. Also, the authors propose a systemic risk measure (SRISK) that captures the expected capital shortage of a firm given its degree of leverage and Marginal Expected Shortfall (MES) based on a study of Acharya, Pedersen, Philippon, and Richardson (2010).

In this paper, I would like to measure the expected capital loss of each individual firm given its degree of leverage and the average expected return of each individual firm if the systemic crisis occurs. Since both MES and SRISK focus on the magnitude of a bank's exposure to a systemic crisis, it is proper measures for my issues. Thus, I use SRISK from Brownlees and Engle (2011) to measure individual firm's contribution to the entire systemic risk. Also, because of its easiness to compute and forecast systemic risk, I run the robustness tests with MES from Acharya, Pedersen, Philippon, and Richardson (2010) for the alternative measures to systemic risk. Furthermore, both measures are

easily accessible through the volatility institute of Stern business school (http://vlab.stern.nyu.edu/analysis/RISK.USFIN-MR.MES).

In addition to SRISK and MES, there are various systemic risk measures. To measure systemic risk, Brunnermeier, Dong, and Palia (2012) considered several kinds of widely used measures for systemic risk. Among several kinds of measurements, they decided to use two measures: ΔCoVaR and Systemic expected shortfall (SES).

Adrian and Brunnermeier (2011) describe CoVaR as the value at risk of the financial system conditional on institutions being in distress. They define an institution's contribution to systemic risk as the difference between CoVaR conditional on the institution being in distress and CoVaR in the median state of the institution. Thus, it can be expressed as ΔCoVaR.

Allen, Bali, and Tang (2012) develop an alternative measure for systemic risk, CATFIN. CATFIN is a measure of aggregate systemic risk using the 1% VaR measures of a cross-section of financial firms that complements bank-specific systemic risk measures by forecasting macroeconomic downturns six months into the future using out-of-sample tests conducted with U.S., European, and Asian bank data. The authors state that micro-level measures of systemic risk focus on the interrelationships across individual financial institutions. On the other hand, macro-level measures of systemic risk focus on whether interbank externalities are substantial enough to threaten real macroeconomic conditions. Hence, they argue that CATFIN can be used in conjunction with micro-level measures to calibrate regulatory limits and risk premiums on individual bank systemic risk taking.

Furthermore, Rodríguez-Moreno and Peña (2012) argue that a simpler measure is better than a complicated measure. They argue that the best indicators of systemic risk are the first Principal Component of the single-name CDSs, followed by the LIBOR-OIS and LIBOR-TBILL spreads. They also insist that the least reliable indicators are the Co-Risk measures and the systemic spreads extracted from the CDO indexes and their tranches. Using three different criteria such as causality tests, price discovery tests and their correlation with an index of systemic events, the authors examine the comparison among six different sets of systemic risk measures: Principal components of the bank's Credit Default Swaps (CDSs), Interbank interest rate spreads, Structural credit risk models, Collateralized Debt Obligations (CDOs) indexes and their tranches, Multivariate densities computed from CDS spreads and Co-Risk measures.

Systemic risk measures that I use in this paper show that we can capture systemic risk level by measured the losses of the market value of equity of financial firms in the prior year's 5% worst case periods of aggregate stock market losses. It implies that the systemic risk measures explain changes in market capitalization, which is the proxy for firm value, so it means that higher systemic risk causes falls in firm value (e.g., Acharya, Lester, Pedersen, Philippon and Richardson, 2009). Since drops in firm value is important problem for the owner, shareholders, and even managers, the board of directors may take care of systemic risk and construct compensation structure to mitigate systemic risk.

CHAPTER 3

HYPOTHESIS DEVELOPMENT

According to Brunnermeier, Dong, and Palia (2012), there is the growth trend in non-interest income, and it results in higher systemic risk. Since traditional banking has less pay-performance sensitivity and pay-risk sensitivity than non-traditional banking, increases in non-interest income are related to aggressive investment of the manager. I think that more incentive compensation for executives may result in the manager's excessive risk taking for several risky projects that are related to non-traditional banking. It also lead to higher systemic risk.

Berle and Means (1932) state that agency cost decreases as a manager's ownership increases when ownership and management are separated, and the study also show that decreasing the agency cost gives managers an incentive to align their interest with shareholders. It means that stock grants for executive compensation might positively affect firm value. Furthermore, according to Dittmann and Maug (2007), to reduce compensation costs and to maximize the firm value, CEOs should have lower base salaries and receive stock grants instead of stock options.

Thus, the portion of stock options in the compensation package of management might increase systemic risk because excessive stock options give management an incentive to be risk-seeking when they make decisions for investment with the goal to maximize its own compensation. On the other hand, the portion of stock grants in the compensation policy of management might reduce systemic risk. Because of its vestin

period, firms pay for the executive's stock grants later. So, managers need to make firms performance better to avoid default. Thus, the managers might be prudent when they make investment decisions. Otherwise, the portion of stock grants may have positive relation to systemic risk. Since the stock grants are also one of incentive compensation, it induce the managers to take positive NPV projects to maximize the wealth of shareholders and their own wealth.

Hence, a board of directors may reduce the portion of stock options for executive compensation and increase the portion of stock grants instead of stock options to mitigate agency problem and to avoid a loss of shareholders' profit and firm value.

Furthermore, if cash bonus is higher, the effect of cash bonus may be similar to that of stock options. This is because the manager who has cash bonus needs to achieve yearly goal or short-term goal to receive the cash bonus. Thus, the manager with higher portion of cash bonus might take more risk to achieve the short-term goal and to increase his or her own wealth. Also, because investment banking part has plenty of high risk and high return projects and is prevalent after the deregulation, non-interest income might increase and systemic risk also increases. Hence, I develop hypotheses that I mainly examine in this paper.

Hypothesis 1: The portion of stock options for executive compensation positively affects a firm's contribution to the entire systemic risk.

Hypothesis 2: The portion of stock grants for executive compensation inversely affects a firm's contribution to the entire systemic risk.

Hypothesis 2A: The portion of stock grants for executive compensation positively affects a firm's contribution to the entire systemic risk.

Hypothesis 3: The portion of cash bonus for executive compensation positively affects a firm's contribution to the entire systemic risk.

However, according to DeYoung, Peng, and Yan (2013), managers and owners of banks that receive government remedies do not have an incentive to be risk-averse even if they only have risky projects. Because of government's funding such as the Troubled Asset Relief Program (TARP), the banks have less downside risk. This implies that the banks, which are TARP recipients, do not lose everything but can lose a certain degree of their value. That is, both the owners and the managers of the TARP recipients prefer to take excessive risky projects because the interest of the owners and the managers are aligned. Thus, a board of directors induces the managers to take risky projects for maximizing firm value. Hence, for the firms with the TARP, the amount of stock grants that is originally intended to make the managers risk averse may not work well, and the amount of stock options might have larger impact on the level of systemic risk, so I develop more specified hypothesis.

Hypothesis 4: The TARP fund induces managers to take risk, so the impact of awarding stock options and stock grants on systemic risk is positive.

For the U.S. financial firms during the crisis, Balachandran, Kogut and Harnal (2010) suggest that CEO equity-based compensation increases the probability of the bank's default. The bank's default may cause the negative externalities to the entire economy. It implies that systemic risk may increase. Thus, I expect that the ratios of stock-based compensation such as stock options and stock grants might have stronger positive relationships to systemic risk in the recent financial crisis as compared to non-crisis periods.

Hypothesis 5: The portion of stock-based compensations for executive might have a stronger positive relationship to systemic risk during the recent financial crisis

CHAPTER 4

DATA AND METHODOLOGY

4.1 Data

To test hypotheses, I need to gather systemic risk data and data about compensation structure of executives. For the systemic risk data, I collect data of systemic risk measures from the volatility institute of Stern business school at New York University (http://vlab.stern.nyu.edu/analysis/RISK.USFIN-MR.MES). The institute provides monthly systemic risk indices such as MES and SRISK for financial firms that highly contribute to the entire systemic risk. I gather MES and SRISK data from 2000 to 2012. After merging all monthly datasets, I have 92 financial firms that contribute to the entire systemic risk during the sample period from 2000 to 2012.

For the compensation data, I collect the top management compensation data through Standard and Poor's Execucomp database. Following sample firms that are covered by systemic risk measures data from the volatility institute of Stern business school, I collect all firm-year observations for the 92 firms from 2000 to 2012. Through the compensation data, I collect data about the dollar value of total compensation, stock options, stock grants, base salary, and bonuses. In addition to compensation data, I obtain balance sheet data and income statement accounting data from COMPUSTAT Fundamentals. The accounting data includes total asset, total equity, total debt, net income. Also, I gather a firm's stock price data and market capitalization data, which is the proxy for firm value, from The Center for Research in Security Prices (CRSP). From

the U.S. Department of the Treasury, I collect the list of TARP recipients among my sample firms. My sample is from 2000 to 2012, and consists of an unbalanced panel of 92 financial firms. The panel represents the most important companies in the banking industry in the U.S. during the sample period.

4.2 Dependent variables and Independent variables

In light of the foregoing discussion of previous literatures, I study several factors that affect my key variables. I use the measure of systemic risk as a key dependent variable. According to past literature, there are several kinds of measures of systemic risk and the accuracy of each measure is still debatable. In this paper, I use SRISK, which are used as proxies for systemic risk from Brownlees and Engle (2011). Since a systemic risk measure (SRISK) that captures the expected capital shortage of a firm given its degree of leverage and Marginal Expected Shortfall (MES), which is the expected loss an equity investor in a financial firm would experience if the overall market declined substantially, the level of SRISK measure shows that firms' contribution to the market undercapitalization in a crisis explains the level of systemic risk of the firms.

My key independent variables are related to compensation structure. I focus on the impact of incentive compensation structure on systemic risk contribution. Also, I decompose incentive compensations into three kinds of components such as stock options, stock grants, and bonuses. I examine the relationship between granting stock options and systemic risk. Similarly, I examine the relationship between stock grants and systemic risk and the relationship between bonuses and systemic risk. I use management stock options variable, which is the dollar amount of shares that the executive can get if he or she exercises the stock options divided by the total amount of the compensation, as

an independent variable. In addition, I use the management stock grants variable. This is the dollar amount of stock grants of the firm that the executive receives as the compensation mean divided by the total amount of the compensation as an independent variable. Lastly, I use the management cash bonus variable, which is the dollar amount of bonuses that the executives receive divided by the total amount of the compensation as an independent variable.

4.3 Control variables

To investigate clear relations between key independent variables and dependent variables, I include some control variables, which are already proved that these influence the dependent variable of this paper such as systemic risk measures. Acharya, Pedersen, Philippon, and Richardson (2010) include leverage, volatility, and log of total asset in their models and Brunnermeier, Dong, and Palia (2012) include market-to-book, leverage, log of total asset, and the squared value of log of total asset. Following Acharya, Pedersen, Philippon, and Richardson (2010) and Brunnermeier, Dong, and Palia (2012), I include natural log of total asset of a firm as firm size variable and its squared variable. Also, I include market to book ratio and leverage. Furthermore, to capture market risk of each firm, I include volatility variable in my model. Detailed sources for each specific variable used in the paper are given in Table 4.1.

4.4 Models

In this paper, to examine the relationship between executive compensation and systemic risk, I use fixed effect models with unbalanced panel data. Since fixed effect model control a problem that biased results might be yielded because of unobserved

individual characteristics if I regress without fixed effect model, the results with fixed effect models may be more accurate. The fixed effect model that I use is as follow.

$$Y_{it} = \mu_i + \nu_t + \beta' X_{it} + \varepsilon_{it} \qquad (1)$$

In the equation (1), μ_i means each firm's individual specific effect, and ν_t means that time specific effect. X_{it} is a set of explanatory variables, and ε_{it} is an error term, which assumes that $E(\varepsilon_{it})=0$ and $Var(\varepsilon_{it})=\sigma^2$. Based on this equation, I regress the individual firm's systemic risk contribution on its three different incentive compensations over total compensation along with other control variables such as volatility, market to book, financial leverage, and firm size and include firm and yearly fixed effects. The base model is as follows.[3]

$$SRISK = \mu + \nu + \beta_0 + \beta_1 RSO + \beta_2 RSG + \beta_3 RBP + \beta_4 MB + \beta_5 STD + \beta_6 SIZE + \beta_7 SIZE^2 \quad (2)$$

Table 4.2 presents the summary statistics. Average of firms' contribution to the market undercapitalization in a crisis is about $40.8 million and the deviation of SRISK is too huge. This implies that a few firms get a large share of the entire systemic risk. Also, the average asset size of the firms is $ 5.2 billion and the standard deviation of asset size is 1.85. The average ratio of incentive compensation including stock-based compensations and bonuses is 0.62. To be specific, the average ratios of stock options and stock grants across sample periods are 0.25 and 0.19, respectively.

In Table 4.3, I find that the correlation between the two systemic risk measures SRISK and MES is 0.401, suggesting that these two measures capture some similar

[3] The base model includes following variables. RSO is the ratio of stock options, which is the dollar amount of stock options over total compensation. RSG is the ratio of stock grants, which is the dollar amount of stock grants over total compensation. RBP is the ratio of cash bonus, which is the dollar amount of cash bonus over total compensation. MB is market-to-book ratio, LVG is leverage, STD is volatility, SIZE is natural log of total asset, and SIZE2 is squared natural log of total asset. μ and v mean firm specific effect and time specific effect, respectively.

patterns in systemic risk. Also, the correlation matrix reports correlation between systemic risk measures and market risk measures such as the Altman's Z-score and beta. These correlation results show that systemic risk and market risk have same direction. I find that higher volatility, leverage and size result in higher systemic risk. Furthermore, the ratio of incentive compensations and that of stock-based compensation have positive correlation with systemic risk. One important finding from the correlation matrix is that the ratio of stock options is negatively correlated with systemic risk. This contradicts the regression results of this paper. However, in this correlation matrix, we do not control any other variables. On the other hand, we do control various variables in the regression tests. Thus, the results from the regression tests are more important. Other incentive compensations have positive correlation with systemic risk.

Table 4.1 Variable definitions

Variable	Name	Calculation	Sources
SRISK	Firm's contribution to systemic risk	Please see Appendix	The Volatility institute at New York University
MES	Marginal expected shortfall	Please see Appendix	Same as above
LVG	Leverage	(AT-SEQ+MV)/MV	Compustat Fundamentals, CRSP
MV	Market capitalization	Prc * Shrout	CRSP
MB	Market to book	MV/SEQ	Compustat Fundamentals
AT	Logarithm of total book asset	Log (AT)	Compustat Fundamentals
AT^2	Square term of AT	$[Log (AT)]^2$	Compustat Fundamentals
RSG	The ratio of stock grants	(Stock Awards + Restricted Stock Awards)/Total Compensation (TDC1)	Compustat Execucomp
RSO	The ratio of stock options	Option Awards/Total Compensation (TDC1)	Compustat Execucomp
RBS	The ratio of base salary	Salary/Total Compensation (TDC1)	Compustat Execucomp
RBP	The ratio of bonuses	Bonus/Total Compensation (TDC1)	Compustat Execucomp
RIN	The ratio of incentive compensation	RSO + RSG + RBP	Compustat Execucomp
RSBIN	The ratio of stock-based compensation	RSO + RSG	Compustat Execucomp
STD	Volatility	A standard deviation of the daily logarithmic stock returns/the time period of returns	CRSP
ZBS	Altman's Z-Score	(ROA+CAR)/STDEV(ROA)[4]	Compustat Fundamentals, CRSP
TARP	TARP dummy	The value is 1 if a firm received TARP fund, 0 otherwise	Department of the Treasury
Financial_crisis	Financial crisis dummy	The value is 1 if the data belong to time period of the recent financial crisis from 2007 to 2009, 0 otherwise	

[4] ROA is return on average assets of a firm calculated as net income divided by the average total assets during the year; CAR is equity adequacy ratio of a firm calculated as the ratio of Equity to Total Assets; STDEV (ROA) is the standard deviation of ROA over the sample period of a firm.

Table 4.2 Summary Statistics

	Mean	Median	STDEV
SRISK	40.78	-1956.5	19425.66
MES	3.07	2.70	1.49
ZSB	254.12	129.05	400.26
BETA	1.13	1.03	0.47
STD	37.91	31.45	23.51
Size	10.86	10.88	1.85
LVG	1.01	1.00	0.01
MB	0.55	1.69	57.29
RIN	0.62	0.63	0.42
RSBIN	0.46	0.45	0.42
RSO	0.25	0.21	0.40
RSG	0.19	0.12	0.22
RBP	0.16	0.09	0.20
RBS	0.20	0.16	0.17
N	5879		

Table 4.3 Correlation Matrix

This table reports correlation coefficients for the key variables such as systemic risk measures, market risk measure, firm characteristics, and compensation structure for the regression analysis. The definition of key variables is on Table 4.1. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	SRISK	MES	Z	BETA	STD	SIZE	LVG	MB	RSO	RSG	RBP	RBS
SRISK	1											
MES	0.406***	1										
Z	-0.094***	-0.198***	1									
BETA	0.429***	0.952***	-0.195***	1								
STD	0.287***	0.841***	-0.225***	0.737***	1							
Size	0.311***	0.123***	-0.0237	0.151***	-0.00580	1						
LVG	0.422***	0.481***	-0.099***	0.499***	0.433***	0.360***	1					
MB	0.0104	0.0234	0.0174	0.0161	0.00478	0.0227	0.00691	1				
RSO	-0.075***	-0.078***	0.00958	-0.108***	-0.00796	-0.0163	-0.079***	-0.0130	1			
RSG	0.239***	0.202***	-0.059***	0.217***	0.095***	0.197***	0.117***	0.0176	-0.213***	1		
RBP	0.0239	-0.087***	0.077***	-0.0398**	-0.128***	0.00295	0.00968	0.0150	-0.069***	-0.241***	1	
RBS	-0.0341*	0.00295	0.00683	-0.0335*	0.106***	-0.188***	0.0129	-0.0423**	-0.091***	-0.190***	-0.165***	1

CHAPTER 5

EMPIRICAL RESULTS

I run a multivariate regression to examine the impact of incentive compensations and that of stock-based compensation on systemic risk first. The results of which are given in Table 5.1 and 5.2. The key dependent variable is the systemic risk measure SRISK, and I include MES for the robustness test. Columns 1 and 2 are the tests with SRISK, and columns 3 and 4 are the tests with MES. All independent variables are estimated with a one year lag, and also include both firm and yearly fixed-effects. Columns 5 and 6 are the tests without both fixed effects for the robustness tests. Since I use the fixed effect model to avoid biased results caused by omitted variable, the results are robust if my hypotheses are still supported even though I drop the fixed effect. This implies that there is no omitted variable that closely affects the result.

In the Table 5.1, I examine columns 1 and 3 with only the ratio of incentive compensations, which is the main explanatory variable in the test. Through these two tests, I ensure that the results are not resulted by other independent variables and spurious correlation between independent variables. I find that the ratio of incentive compensations is significantly positive to both SRISK and MES. It means that the higher incentive compensation ratio leads to higher systemic risk. In columns 2 and 4, I add control variables to check the results from tests in columns 1 and 3. I still find that the ratio is significantly positive to both systemic risk measures but the values of coefficient are little bit decreased. For the robustness tests, I examine the tests without both firm and

time fixed effects in columns 5 and 6. The results are still unchanged. These also show the significantly positive relationship between systemic risk and the ratio of incentive compensations.

In Table 5.2, I examine same tests that I do in Table 5.1 with different key independent variable, which is the ratio of stock-based compensations. I find quite similar results to results in Table 5.1. I find the positive relationship between the ratio of stock-based compensations and systemic risk, and the results are robust through the robustness tests with different systemic risk measure, which is MES, and without fixed effects, respectively.

In Table 5.3, which is the main table of this paper, I subdivide the ratio of stock-based compensations and include the ratio of cash bonus in the models. The ratio of stock-based compensations is divided into the ratio of stock options and the ratio of stock grants. Through tests in Table 5.3, I find that the ratio of stock options is significantly positive to systemic risk and find weak evidence that the ratio of cash bonus is positively affect systemic risk. But, I find that the ratio of stock grants has significantly positive relation with systemic risk only when I examine the test including only the key independent variable. That is, I find no significant evidence concerning the relationship between the ratio of stock grants and systemic risk. Although the result about the ratio of stock grants in columns 4 and 7 are insignificant, the signs of coefficients support my hypothesis 2A, which expect that the impact of stock grants on systemic risk might be positive. Also, the effects of both hypotheses 2A and 2B may be either weak or strong. If both are strong, then both effects may offset each other. Thus, the results could be explained.

Since past literature shows that non-traditional activities are prevalent among the major banks after deregulation, which means that there are lots of projects related to non-traditional banking, and the stock grants also provides a manager an incentive to take risky project and aligns the interests between the manager and the owner, the manager with stock grants may have an incentive to maximize both their own wealth and shareholders' wealth, and the manager might engage in non-traditional banking projects when he or she choose the project to maximize both firm value and his or her total wealth. Non-traditional banking not only improves firm value but also increases revenue volatility and systemic risk. Thus, firms with the managers who engage in investment banking activities to improve firm value may make systemic risk high regardless of the amount of stock options and stock grants in the manager's compensation package even though stock options induce the managers to take more risky projects and the impact of stock options in compensation structure might be greater than that of stock grants. Hypothesis 3, which states that the higher portion of cash bonus may increase systemic risk, is weakly supported by the results.

For the perspective of economic significance of the coefficients, the results show that each unit increase in the ratio of stock options causes systemic risk measures to rise by $ 4,535 million, which is the expected capital shortage and each unit increase in the ratio of cash bonus causes systemic risk measures to rise by $ 2,382 million. For the robustness tests, I examine same tests with MES, without firm fixed effect, and without time fixed effect, respectively. The results are in Table 5.4, 5.5, and 5.6, respectively. These results suggest that the ratio of stock options contributes positively to systemic risk whether I use SRISK as my systemic risk measure or use MES as the key dependent

variable. Also, the regressions without either firm fixed effect or time fixed effect show that the results are generally remained the same. Specifically, the regression tests in column 7 of each table that includes all control variables and key independent variables suggest that almost all results in column 7 for Table 5.4, 5.5, and 5.6 are statistically significant and support my hypotheses. It implies that there is no significant omitted variable that results in biased results.

In addition, I split the sample firms into four groups such as depository, broker-dealer, insurance, and others and run the main test. The tables are not included in the paper, but the results suggest that only depository has the positive impact of the ratio of stock options on systemic risk but it is not statistically significant. These could be explained that shareholders and managers in depository may have more risk-taking behavior because of deposit insurance and the significance may be diluted because of too small sample size. The impact of the other key variables are also mixed. This may support the explanation that the impact of hypotheses 2A and 2B are both strong and offset each other.

Table 5.7 includes the results of the models when considering the effect of the TARP. The TARP fund may affect the effect of granting stock options, stocks, and cash bonus on systemic risk. Almost all results concerning about stock options and stock grants are statistically significant and the signs of coefficients are all positive. It implies that TARP induces a management to take risky projects so it affects the level of systemic risk. This supports my hypotheses that both managers and owners of firms receiving TARP tend to be more risk-seeking because they do not lose everything they have even if they take lots of risky projects and almost all of the projects are failed. Of course, they

lose some amount of their wealth but the amount is not that huge because TARP fund covers the loss. However, the impact of cash bonus has different direction. The interaction terms between TARP recipient dummy and the ratio of cash bonus have negative signs. It is statistically significant when I include the ratio of cash bonus variable, its interaction variable with TARP recipient dummy, and control variables but the significance disappears when I include all other key independent variables and interaction terms. For the robustness test, I exclude firm fixed effect from the models. All results are still statistically significant and suggest positive relationship between the ratios of stock options and stock grants and systemic risk.

Lastly, I examine the relationship between systemic risk and the ratios of stock options, stock grants, and cash bonus during the recent financial crisis. The results suggest that all interaction terms such as Crisis_RSO, Crisis_RSG, Crisis_RBP have positively significant relation to systemic risk measure. These results imply that risk-taking behavior of managers with higher stock options or higher stock grants is even stronger during the crisis.

Table 5.1. Systemic Risk and Incentive Compensations

This table reports the regression estimates of the relation between the ratio of incentive compensation and systemic risk using SRISK as a key dependent variable. I also use Marginal Expected Shortfall (MES) for the robustness test in columns 3 and 4. I define the incentive compensation measure as the ratio of incentive compensation (RIN) and determine it as the dollar amount of incentive compensation including stock options, stock grants, and bonuses over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 4.1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SRISK	SRISK	MES	MES	SRISK	SRISK
MB_lag		1.614		0.000592**		-0.960
		(2.546)		(0.000)		(0.821)
STD_lag		0.000418***		3.63e-10		0.000728***
		(0.000)		(0.000)		(0.000)
Size_lag		-58778***		-2.117***		-29806***
		(2,639.832)		(0.240)		(3,566.964)
Sizesq_lag		3159***		0.100***		1612***
		(130.106)		(0.012)		(184.036)
RIN_lag	4964***	3621***	0.217***	0.183***	4266***	3041**
	(661.769)	(595.476)	(0.055)	(0.054)	(1,587.008)	(1,356.663)
Constant	1205*	253405***	3.260***	14.12***	-1513	126096***
	(721.145)	(13,920.007)	(0.059)	(1.265)	(1,057.993)	(16,919.416)
Firm Fixed Effect	Yes	Yes	Yes	Yes	No	No
Time Fixed Effect	Yes	Yes	Yes	Yes	No	No
Obs.	4,021	4,021	4,021	4,021	4,021	4,021
R-squared	0.158	0.327	0.567	0.579		
Pan_id	1,005	1,005	1,005	1,005	1,005	1,005

Table 5.2. Systemic Risk and Stock-Based Compensations

This table reports the regression estimates of the relation between the ratio of stock-based compensation and systemic risk using SRISK as a key dependent variable. I also use Marginal Expected Shortfall (MES) for the robustness test in columns 3 and 4. I define the stock-based compensation measure as the ratio of stock-based compensation (RSBIN) and determine it as the dollar amount of stock-based compensation including stock options and stock grants over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(5)	(6)	(7)	(8)
VARIABLES	SRISK	SRISK	MES	MES	SRISK	SRISK
MB_lag		1.490		0.000579**		-1.449
		(2.548)		(0.000)		(1.138)
STD_lag		0.000424***		7.07e-10		0.000722***
		(0.000)		(0.000)		(0.000)
Size_lag		-58810***		-2.112***		-30000***
		(2,641.161)		(0.240)		(3,539.824)
Sizesq_lag		3157***		0.0997***		1616***
		(130.221)		(0.012)		(182.009)
RSBIN_lag	4719***	3399***	0.230***	0.198***	7073***	5496***
	(645.733)	(582.400)	(0.053)	(0.053)	(1,071.410)	(936.670)
Constant	1556**	254236***	3.264***	14.13***	-2019***	127175***
	(702.949)	(13,920.503)	(0.058)	(1.264)	(688.555)	(16,790.198)
Firm Fixed Effect	Yes	Yes	Yes	Yes	No	No
Time Fixed Effect	Yes	Yes	Yes	Yes	No	No
Obs.	4,021	4,021	4,021	4,021	4,021	4,021
R-squared	0.158	0.327	0.567	0.579		
Pan_id	1,005	1,005	1,005	1,005	1,005	1,005

Table 5.3. SRISK and the Use of Stock Options, Stock grants, and Cash Bonus

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), and cash bonus (RBP) and systemic risk using SRISK as a key dependent variable. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. The ratio of cash bonus is defined as the dollar amount of cash bonus in compensation package over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 4.1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Standard errors in parentheses ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK
M2B_lag		1.193		1.693		1.462	1.251
		(0.641)		(0.527)		(0.572)	(0.627)
STD_lag		65.80***		59.83***		64.37***	65.53***
		(0.000)		(0.000)		(0.000)	(0.000)
Size_lag		-60571***		-60623***		-60614***	-60484***
		(0.000)		(0.000)		(0.000)	(0.000)
$Size^2$lag		3271***		3268***		3287***	3269***
		(0.000)		(0.000)		(0.000)	(0.000)
RSO_lag	4776***	4373***					4650***
	(0.000)	(0.000)					(0.000)
RSG_lag			2782***	-501.8			323.7
			(0.006)	(0.586)			(0.745)
RBP_lag					13.04	741.6	2714*
					(0.993)	(0.589)	(0.055)
Constant	-1.9e+06***	-80416	-1.5e+06***	140583	-1.7e+06***	120844	-163737
	(0.000)	(0.689)	(0.000)	(0.466)	(0.000)	(0.554)	(0.428)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,021	4,021	4,508	4,508	4,021	4,021	4,021
R-squared	0.157	0.321	0.134	0.295	0.143	0.310	0.322
pan_id	1,005	1,005	1,043	1,043	1,005	1,005	1,005

Table 5.4. Marginal Expected Shortfall (MES) and the Use of Stock Options, Stock Grants, and Cash Bonus

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), and cash bonus (RBP) and systemic risk using MES as a key dependent variable. MES is the marginal expected shortfalls of a stock given that the market return is below its 5th-percentile. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. The ratio of base salary is defined as the dollar amount of base salary in compensation package over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	MES	MES	MES	MES	MES	MES	MES
MB_lag		0.000624***		0.000640***		0.000625***	0.000577**
		(0.000)		(0.000)		(0.000)	(0.000)
STD_lag		-7.01e-11		1.33e-09		5.30e-10	7.59e-10
		(0.000)		(0.000)		(0.000)	(0.000)
Size_lag		-2.169***		-1.997***		-2.166***	-2.109***
		(0.240)		(0.222)		(0.240)	(0.241)
Sizesq_lag		0.103***		0.0941***		0.103***	0.0995***
		(0.012)		(0.011)		(0.012)	(0.012)
RSO_lag	0.162***	0.161***					0.195***
	(0.056)	(0.055)					(0.059)
RSG_lag			0.137*	0.0420			0.208**
			(0.080)	(0.080)			(0.090)
RBP_lag					-0.130	-0.125	-0.000879
					(0.125)	(0.124)	(0.128)
Constant	3.353***	14.43***	3.345***	13.65***	3.385***	14.40***	14.11***
	(0.052)	(1.263)	(0.056)	(1.188)	(0.052)	(1.265)	(1.271)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,021	4,021	4,508	4,508	4,021	4,021	4,021
R-squared	0.566	0.578	0.563	0.574	0.565	0.577	0.579
Pan_id	1,005	1,005	1,043	1,043	1,005	1,005	1,005

Table 5.5. SRISK and the Use of Stock Options, Stock grants, and Cash Bonus - Testing without Firm Fixed Effect

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), and cash bonus (RBP) and systemic risk using SRISK as a key dependent variable. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. The ratio of base salary is defined as the dollar amount of base salary in compensation package over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Robust standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK
MB_lag		1.790**		1.540***		1.979***	1.300
		(0.905)		(0.495)		(0.356)	(1.201)
STD_lag		0.000656**		0.000710***		0.000661***	0.000659***
		(0.000)		(0.000)		(0.000)	(0.000)
Size_lag		-32043***		-31177***		-31612***	-31120***
		(3,635.875)		(3,605.336)		(3,627.317)	(3,555.796)
Sizesq_lag		1697***		1647***		1677***	1648***
		(183.151)		(181.328)		(183.053)	(179.174)
RSO_lag	4100***	3521***					4419***
	(1,581.438)	(1,236.817)					(1,118.141)
RSG_lag			4497***	2237			3233**
			(1,250.51)	(1,387.775)			(1,330.813)
RBP_lag					3902*	1706	4114**
					(1,997.1)	(1,690.915)	(1,634.326)
Constant	4836***	143768***	3353**	139436***	5174***	141910***	138256***
	(1,102.34)	(17,984.4)	(1,402.48)	(18,068.45)	(1,100.81)	(17,923.66)	(17,574.57)
Firm Fixed Effect	No	No	No	No	No	No	No
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,021	4,021	4,508	4,508	4,021	4,021	4,021
Pan_id	1,005	1,005	1,043	1,043	1,005	1,005	1,005

Table 5.6. SRISK and the Use of Stock Options, Stock grants, and Cash Bonus - Testing without Time Fixed Effect

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), and cash bonus (RBP) and systemic risk using SRISK as a key dependent variable. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. The ratio of base salary is defined as the dollar amount of base salary in compensation package over the dollar amount of total compensation. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. The sample period runs from 2000 to 2012. Please see Table 1 and relevant section in the paper for details on the definitions and determination of all variables utilized in the regressions. Standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK
MB_lag		0.154		-0.348		-0.164	-0.493
		(2.675)		(2.788)		(2.691)	(2.671)
STD_lag		0.000447***		0.000507***		0.000454***	0.000451***
		(0.000)		(0.000)		(0.000)	(0.000)
Size_lag		-58286***		-56038***		-57856***	-57540***
		(2,775.526)		(2,674.714)		(2,791.827)	(2,777.176)
Sizesq_lag		3189***		3032***		3108***	3108***
		(134.228)		(129.153)		(135.224)	(135.051)
RSO_lag	4330***	5348***					5326***
	(709.165)	(623.091)					(659.762)
RSG_lag			8412***	1806*			2165**
			(984.121)	(929.840)			(1,030.414)
RBP_lag					13381***	7527***	5390***
					(1,320.070)	(1,226.148)	(1,277.485)
Constant	-1232***	244810***	-1864***	239844***	2136***	252462***	246914***
	(244.794)	(14,404.012)	(229.767)	(13,959.432)	(270.217)	(14,514.448)	(14,421.355)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	No	No	No	No	No	No	No
Obs.	4,021	4,021	4,508	4,508	4,021	4,021	4,021
R-squared	0.012	0.244	0.021	0.219	0.033	0.235	0.252
Pan_id	1,005	1,005	1,043	1,043	1,005	1,005	1,005

Table 5.7. Systemic Risk, the Use of Stock Options, Stock Grants, Cash Bonus, and the Impact of TARP fund

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), cash bonus (RBP) and systemic risk using SRISK with TARP dummy and its interaction terms. The table shows whether TARP fund induce risk-taking behavior and affect systemic risk. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. TARP dummy equals 1 for a firm receiving TARP fund, and zero otherwise. TARP_RSO, TARP_RSG, TARP_RBP are interaction terms and are defined as the ratio of stock options, stock grants, cash bonus multiplies TARP dummy, respectively. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK
MB_lag		0.661	1.094	2.213		1.840
		(0.843)	(0.669)	(0.409)		(0.474)
STD_lag		114.6***	66.90***	57.22***		61.15***
		(0.000)	(0.000)	(0.000)		(0.000)
Size_lag		-83892***	-60232***	-59581***		-57976***
		(0.000)	(0.000)	(0.000)		(0.000)
Sizesq_lag		4373***	3256***	3213***		3139***
		(0.000)	(0.000)	(0.000)		(0.000)
TARP	50786***	2355				
	(0.000)	(0.557)				
RSO_lag			914.4			792.7
			(0.424)			(0.520)
RSG_lag				-2358**		-1943
				(0.040)		(0.125)
RBP_lag					4500***	4535***
					(0.007)	(0.010)
TARP_RSO			4731***			5191***
			(0.000)			(0.000)
TARP_RSG				4749***		4637**
				(0.007)		(0.021)
TARP_RBP					-9079***	-5736
					(0.000)	(0.021)
Constant	-2.1e+06***	-51302***	-35520	143152	52299	-145602
	(0.000)	(0.008)	(0.860)	(0.458)	(0.798)	(0.483)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5,879	4,508	4,021	4,508	4,021	4,021
R-squared	0.476	0.614	0.324	0.296	0.313	0.328
Pan_id			1,005	1,043	1,005	1,005

Table 5.8. Systemic Risk, the Use of Stock Options, Stock Grants, Cash Bonus, and the Recent Financial Crisis

This table reports the regression estimates of the relation between the ratios of stock options (RSO), stock grants (RSG), cash bonus (RBP), and systemic risk using SRISK with Financial_crisis dummy and its interaction terms. The table shows whether the positive relationship between stock-based compensation and systemic risk is stronger during the recent financial crisis, which is occurred from 2007 to 2009. The ratio of stock options is defined as the dollar amount of stock options in compensation package over the dollar amount of total compensation. The ratio of stock grants is defined as the dollar amount of stock grants in compensation package over the dollar amount of total compensation. Financial_crisis dummy equals 1 for sample years during the recent financial crisis, which is occurred from 2007 to 2009, and zero otherwise. Crisis_RSO, Crisis_RSG, and Crisis_RBP are interaction terms and are defined as the ratio of stock options, stock grants, and cash bonus multiplies Financial_crisis dummy, respectively. All independent variables are lagged. MB is a measure of Market-to-book ratio, STD is volatility, Size is the natural log of total asset, and Sizesq is the squared value of the natural log of total asset. I indicate whether I use firm fixed effect and time fixed effect in the table. Standard errors in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SRISK	SRISK	SRISK	SRISK	SRISK	SRISK
MB_lag		1.584	1.623	1.708	1.727	2.162
		(0.553)	(0.527)	(0.524)	(0.502)	(0.399)
STD_lag		59.82***	64.93***	59.81***	57.36***	57.32***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size_lag		-60467***	-59963***	-60625***	-60891***	-60005***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sizesq_lag		3260***	3239***	3268***	3299***	3244***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial_crisis	6496***	-2545***				
	(0.000)	(0.000)				
RSO_lag			2221**			654.9
			(0.031)			(0.574)
RSG_lag				-403.0		-1960
				(0.716)		(0.113)
RBP_lag					-2736*	-2600
					(0.074)	(0.117)
CRISIS_RSO			3170***			5103***
			(0.009)			(0.000)
CRISIS_RSG				-274.4		3819**
				(0.871)		(0.030)
CRISIS_RBP					11398***	12640***
					(0.000)	(0.000)
Constant	-1e+06***	160102	8178	144272	219573	81246
	(0.000)	(0.398)	(0.968)	(0.458)	(0.282)	(0.701)
Firm-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5,879	4,508	4,021	4,508	4,021	4,021
R-squared	0.127	0.295	0.323	0.295	0.315	0.330
Pan_id	1,313	1,043	1,005	1,043	1,005	1,005

CHAPTER 6

CONCLUSION AND DISCUSSION

In this paper, I establish main hypotheses about the relationship between the level of systemic risk and the portion of stock-based compensations for executives. I expect that there may be positive relation between the ratio of stock options and systemic risk and negative relation between the ratio of stock grants and systemic risk. Through the empirical tests, I conclude that the results only support hypothesis 1. It implies that the higher portion of stock option results in higher systemic risk. The results about stock grants are not statistically significant. However, this might be presumed that the relation between systemic risk and the ratio of stock grants has positive coefficient. This is because there are many positive NPV projects concerning non-traditional banking activities, which are relatively high risk and high return projects. Managers could choose the project to maximize firm value and their own wealth even though they are prudent investors, and it also leads to increase in systemic risk. Thus, it is possible that the sign of coefficient of the ratio of stock grants variable could be positive but the magnitude may be smaller than that of stock options. Hence, the portion of stock option decreases and the portion of additional stock awards increases as systemic risk increases for the purpose of mitigate systemic risk. The logic is that board of directors make a contract with their executives with less stock-options and/or more stock awards when board of directors have realized the changes in systemic risk. That is why I use the lagged data variables.

In this paper, I investigate empirically whether executive compensation structure contributes to the entire systemic risk among 92 firms that highly contribute to systemic risk. Based on Brownlees and Engle (2011), I use SRISK and MES as systemic risk measures. I find some evidences of a relation between executive compensation and systemic risk during the sample period from 2000 to 2012. I find that the ratio of incentive compensations and the ratio of stock-based compensations have a positively significant impact on systemic risk. The ratio of stock options has a positively significant influence on systemic risk but the ratio of stock grants variables have mixed signs of coefficients and statistically insignificant impact on systemic risk. Also, I find that the ratio of cash bonus in compensation structure positively related to systemic risk. My results thus corroborate past studies that argue stock-based compensations increase executive's risk taking. Furthermore, I find that these relationships are being stronger if firms received TARP fund. This result indicates that firms receiving government protection tend to be more risk-taking. This is because the interests of owners and managers are aligned to take more risk for the purpose of maximizing their own wealth. Lastly, the results suggest that risk-taking behaviors of managers with higher stock options, higher stock grants, or higher cash bonus are even stronger during the recent financial crisis.

In sum, this paper finds some evidences of executive compensation influences on systemic risk contributions of individual firms. Executive compensation, especially stock-based compensation, does correlate with systemic risk measures, so it should be considered in designing any potential regulation of executive compensation to mitigate systemic risk. In addition, systemic risk affects the collapse of the entire economy, and

systemic risk measures suggest that firm's exposure and contribution to systemic risk can be connected to losses in capital of the firm when financial crisis occurs. It implies that higher systemic risk leads to higher probabilities of default and reduction in firm value as well as reduction in each individual's wealth. Thus, firms also need to care about systemic risk and executive compensation may be one of method to mitigate systemic risk.

Although the study has advantage because there is lack of studies about the relationship between the systemic risk and executive compensation and the results generally support my hypotheses, I cannot strongly argue that the results are empirically valid because there are several points I need to fix and reinforce for the purpose of drawing more valid results. Since my sample size is pretty small, it is possible that the results in this paper are biased. Since the difficulties of calculating several popular measures for systemic risk such as CoVaR, SES, and CATFIN, I use only both SRISK and MES data, which are provided by the volatility laboratory form NYU Stern Business School. If I use other systemic risk measures as well as both SRISK and MES, I would collect more sample firms and draw more valid results. Also, collecting more sample firms also could help to capture the negative externalities of systemic risk. In this paper, I just use systemic risk measures that are considered to capture the externalities. However, if I have huge sample firms and can divide the sample firms into different groups, I might capture the externalities by comparing financial firms with higher non-traditional banking activities portion with financial firms with lower non-traditional banking activities portion.

Furthermore, according to Cannella, Fraser, and Lee (1995) and Berger, Imbierowicz, and Rauch (2013), top level management might have less incentive to take excessive risk than lower level management. This is because the chief managers have career and reputation concerns. Different from the case of chief managers, the lower-level management's fault in poor firm performance might be unknown to the general public, so the lower-level management does not have much career and reputation concerns. Thus, the top management earns profits if investment is successful and loses huge portion of their wealth if investment fails. In contrast, the lower level management loses less portion of his or her whole wealth than that of top management because of little burden of career and reputation concerns although he or she earns profits if investment is successful. These differences in upside reward and downside risk between top and lower-level management lead to different tendencies to take risk. If I can collect compensation structure data for lower-level management, it would be beneficial to explain the relationship between both executives and lower level management compensation structure and systemic risk. This also helps to derive strong evidences. For such reasons, there are many aspects to investigate left.

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APPENDIX A – CALCULATION OF MARGINAL EXPECTED SHORTFALL (MES) AND SRISK

In this paper, I do not calculate MES and SRISK by myself because the volatility institute provides monthly data of MES and SRISK measures. Following Acharya, Pedersen, Philippon, and Richardson (2010), the volatility laboratory estimates MES at a standard risk level of α=5% using equity returns data from CRSP. This means that they take the 5% worst days for the market returns (R) in any given year, and they then compute the average return on any given firm (R^b) for these days:

$$\mathrm{MES}^{b}_{5\%} = \frac{1}{\#\text{ of days}} \sum_{t=\text{system is in its 5\% tail}} R^{b}_{t}$$

Following Brownlees and Engle (2011), the volatility institute offers SRISK measure. SRISK captures the expected capital shortage of a firm given its degree of leverage and Marginal Expected Shortfall (MES). The companies with the highest SRISK are the firms that contribute the most to the market undercapitalization in a crisis. It means that these firms are the most systemically risky firms. They compute the SRISK:

$$\mathrm{SRISK}_i = \min(0, \mathrm{CS}_{i0})$$

In this equation, CS_{i0} is the expected capital shortfall, which is calculated by $CS_{i0} = k(f_{i0} + g_{i0}) - (1 - k)\, w_{i0}\, MES_{i0}$, where f_i is a risky debt, g_i is a guaranteed debt, and w_i is initial capital. Please see Acharya, Pedersen, Philippon, and Richardson (2010) and Brownlees and Engle (2011) if you want to see details about the systemic risk calculation.