Regulation, Compensation and Risk Taking in Banks – Evidence from the Credit Crises

Draft version

This version: April 6, 2013

Abstract

We examine the effect of regulation and executive compensation on risk taking in banks. Using a novel hand-collected dataset covering 352 banks from 15 countries we find that on average regulation effectively reduces bank risk. However, executive incentives turn out to be more pronounced in countries with stricter bank regulation. This is consistent with the view that shareholders aim to jeopardize the effect of regulation by providing stronger incentives. Also consistent with that view, the level of incentives is positively correlated to the level of bank risk. However, while short-term incentives such as cash bonuses increase all bank risk measures, stock-based compensation primarily affects tail risks as proxied by the bank's stock market performance during the credit crises. Moreover, the risk-increasing effect of short-term incentives is larger in countries with stricter regulation. Overall, our findings suggest that regulatory initiatives should carefully consider their own impact on incentive structures within a bank.

JEL classification: G01 · G21 · G32

Keywords: financial crises · bank risk · corporate governance · executive compensation

1 Introduction

Excessive risk taking in the banking industry is widely considered to be one of the fundamental causes of the recent credit crisis. It has been argued that ill-designed incentives have induced bank executives to engage in high-risk projects. While taking risks is essential to all entrepreneurial activities, pre-crises risk taking in the banking industry has - from our current ex-post perspective - generally been considered to be massive or even excessive. However, arguments that risk taking was induced by (poorly designed) executive incentives rest on shaky foundations. From a theoretical perspective, executives are faced with the problem that the value of their human capital is closely linked to the risk of the bank. Being unable to diversify this risk, it is often argued that they are more risk-averse than shareholders, which eventually results in inefficient low levels of risk taking. Accordingly, shareholders have to implement compensation schemes that provide appropriate risk taking incentives. Incentives, however, are always involved with additional risk exposure for the executives (*Lambert and Larcker, 2001*, *Demsetz and Lehn, 1985*, *Kane, 1985*). In line with this view, *Fahlenbrach and Stulz (2011)* find that bank executives face substantial losses during the recent credit crises, but no strong evidence for excessive risk taking induced by compensation structures.

Neither from an empirical nor from a theoretical background it is clear how compensation relates to risk taking. While recent US related studies on the financial crisis (*Chesney, Stromberg and Wagner, 2011*, *Cheng, Hong and Scheinkman, 2011*, *Suntheim, 2011*) find that CEO incentives had an impact on risk taking, *Fahlenbrach and Stulz (2011)* do not find a strong relationship between compensation practices and stock performance during the crisis. Furthermore, *Aebi, Sabato and Schmid (2011)* find no significant relationship between a bank's performance during the crisis and standard firm-level governance variables such as CEO ownership and board independence.[1]

[1] See *Mehran, Morrison and Shapiro (2011)* for an overview of studies on corporate governance, particularly on executive compensation in banks in the context of the recent credit crisis.

In this paper we argue that since banks were at the center of the financial crisis, attention must be paid to the interaction of compensation structures, the corporate governance system at large and bank-specific regulation. In fact, it has been argued that lax regulatory regimes facilitated managers' wrongdoing and banks' excessive risk taking. Consequently, many governments overhauled corporate law and compensation guidelines and tried to tie compensation to long-term performance. For instance, in the US according to the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 951 n., Federal regulators are endowed with the power to prohibit any compensation structure that encourages inappropriate risk taking in regulated financial institutions. Similarly, European countries such as the UK, France, and Germany have adopted overhauled compensation regulations following recommendations of the Financial Stability Board. Moreover, according to the draft for the CRD IV regulation, the transformation of the Basel III proposals into EU law, detailed rules will govern compensation policies of European banks. However, only little empirical evidence on the recent crisis suggests that regulation of the banking sector had an impact on bank risk taking (*Beltratti and Stulz, 2012*).

This papers aims to make a contribution with respect to this issue. The recent financial crisis as a macroeconomic shock is well suited for carving out the relationship between bank risk, manager's incentives and regulatory aspects. In fact, many banks with different compensation practices as well as many countries with different corporate governance and regulatory settings were affected by the recent crisis. This should give us the ability to analyze country differences in bank regulation by addressing two main questions.

First, we scrutinize whether shareholders react to the level of regulation by adjusting manager's incentives to achieve their desired level of risk exposure. Second, we investigate how banking regulation such as activity restrictions or capital requirements relates to ex-ante risk taking and ex-post losses. It should be noted in this regard that country-specific settings and regulations such as accounting standards and shareholder protection have an impact on corporate decision-making (*La Porta et al., 2002*, *Bushman and Smith, 2001*, *La Porta et al., 2000*). Therefore, we expect

the regulations of the banking industry to moderate the relationship between incentives and risk taking. We use a novel dataset to build up the link between bank risk, bank regulation and incentives. So far, there is only very little evidence on non-US banks (*Erkens, Hung and Matos, 2012*, *Beltratti and Stulz, 2012*) regarding regulation and bank risk. Therefore, we created a comprehensive dataset containing detailed information on firm characteristics, compensation, and regulatory indicators for 352 banks from 14 European countries and the US. The use of a large sample of banks across 15 countries ensures the sufficient heterogeneity of country-specific bank regulatory settings. Following the literature, we define the main crisis period as from July 1, 2007 to December 31, 2008. We incorporate two types of bank risk. On the one hand we, calculate common bank risk measures for the pre-crisis period to capture ex-ante risk taking. On the other hand, we use stock performance as an ex-post proxy for tail risks taken prior to the crisis. We verify our results by using an empirical design that accounts for the endogenous nature of the relationship between firm risk and incentives.

Our results can be summarized as follows. First, we find that shareholders react to regulation by granting higher incentives in banks operating in a high-regulated setting. This suggests that shareholders jeopardize regulation by implementing high pay-for-performance sensitivity to incentivize managers to outperform competitors in a restricted business. Second, managerial incentives had a significant impact on risk taking in banks in the context of the financial crisis. The use of high variable compensation such as cash bonus and stock-based incentives increases risk taking. Third, while we find bank regulation itself to reduce risk taking, tighter regulation has an indirect positive effect on risk taking because of its moderating effect on banks' compensation policies. In fact, we find the incentives for short-termism to be enhanced by tight regulation. Hence, in countries with tight bank regulation, short-term incentives induce managers to select risky projects or projects that bypass regulatory restrictions in order to achieve their goals. The downside of these tail risks was mainly revealed during the financial crisis by negative stock price performance. Interestingly, common risk proxies such as the probability of

default and the z-score were not affected by these tail risk projects. This suggests that managers were incentivized to engage in risky off-balance sheet activities or lending activities, which were not captured by common risk measures.

The paper is structured as follows: Chapter 2 discusses our main hypotheses and gives an overview of existing literature. Chapter 3 describes the dataset and defines the variables we use in the analysis. In Chapter 4 the empirical findings are presented. Finally, Chapter 5 summarizes the results, discusses limitations and gives an outlook for future research.

2 Development of key hypotheses

According to the optimal compensation contract approach executive compensation contracts are viewed as an efficient governance instrument to account for the agency problem between managers and shareholders.[2] It assumes that compensation contracts are designed by boards and negotiated with executives in order to provide incentives for managers to act in the interest of the shareholders. An alternative view, called the managerial power approach, is based on empirical findings that draw another picture (*Bebchuk,and Fried, 2004*, *Bebchuk, Fried and Walker, 2002*). It claims that one aspect of the agency problem is the fact that powerful executives are able to influence both the level and structure of their pay packages. It could be argued that the managerial power approach is simply a special agency situation where governance mechanisms are weak (*Bruce, Hong and Main, 2005*). Hence, at first glance, it is not clear how executive compensation and bank risk taking interacted in the recent financial crisis. Under the view of the optimal contract theory we expect that shareholders of banks would design compensation contracts in a way that managers pursue a value maximizing risk-taking strategy. In principle, this would be achieved by including a significant amount of stock based compensation in the overall compensation package. Under the view of the managerial power approach we would expect that self-interested executives try to extract rents from the bank. Hence, if entrenched

[2] See surveys of *Murphy (1999)* and *Core and Guay (1999)* for an overview of contract theory.

managers are able to influence decisions of the compensation committee they will try to attain a high level of total compensation with less exposure to bank's stock price. In other words, they will try to establish compensation contracts that have a large amount of fixed pay and low pay-for-performance sensitivity (bonus, stock or stock options).

However, it is not clear what this implies for an individual bank's risk taking. On the one hand, shareholders may have an incentive to increase risk taking as the equity position can be considered to be an option on the bank's firm value (*Black and Scholes, 1973*, *Merton, 1973*). This incentive is even stronger as debtholders would not always price their credit risk correctly because of governmental deposit insurance and implicit bail-out guarantees, the latter being especially important for large banks. On the other hand, one can also argue that charter values of banks are high because of market entry barriers due to regulation. This would dampen the risk taking incentives of shareholders as the failure of the bank would cause the loss of the charter value (*Keeley, 1990*).

What makes the problem even more intriguing is the fact that even under the optimal contract approach shareholder incentives are only imperfectly transformed into manager incentives. Depending on the specific structure of the compensation package the management's incentives may lead to an increase or decrease of risk taking with respect to what would be optimal from the shareholders' perspective.

It is evident that the outcome of this contracting problem will be influenced by country-specific regulations, as we know from the law and finance literature (*La Porta et al., 2002*, *Bushman and Smith, 2001*, *Hillier et al., 2011*, *Han et al., 2010*). Recently, *Huettenbrink, Rapp and Wolff (2011)* argue that the institutional setting and regulation also relate to executive incentives. They conclude that shareholder protection and disclosure rules are important determinants of executive pay. We predict that shareholders of banks also consider the regulation of the banking industry when designing compensation contracts. Depending on the tightness of regulation, shareholders could adjust the manager's pay-for-performance sensitivity to achieve their de-

sired risk exposure. For instance, in a setting with high bank activity restrictions managers have a narrowly given set of conservative investment opportunities. To overcome this problem, shareholders might incentivize managers with high pay-for-performance to outperform competitors in a restricted business environment. In the following we discuss these issues in more detail and derive our hypotheses.

2.1 Impact of executive compensation on risk

In general, prior studies indicate that compensation practices in the banking industry are different to other industries. In particular, pay-for-performance sensitivity is lower in banks than in other industries (*Becher, Campbell and Frye, 2005*, *John and Qian, 2003*, *Crawford, Ezzell and Miles, 1995*). Before the financial crisis the literature on compensation and risk paid very little attention to the banking industry. Since the recent crisis was associated with extremely high bonuses and alleged excessive risk taking, more research on the relationship between executive pay and risk taking in banks emerged.

Pre-crisis literature is inconclusive with respect to the question whether greater pay-for-performance sensitivity increases bank risk. For instance, *Mehran and Rosenberg (2007)* find that option grants to CEOs are associated with lower debt but higher asset volatility. *Chen, Steiner and Whyte (2006)* investigate in a sample of US banks from 1992 to 2000 the relationship of option-based compensation and risk taking in banks. The authors find evidence that option-based compensation induces risk taking. Other authors reach contrary conclusions (*Ross, 2004*, *Carpenter, 2000*). For instance, Ross shows that option's private value to the holder can decline with volatility. *Lewellen (2006)* suggests that options that are in the money could encourage risk-averse managers to reduce risk taking. Also *Harjoto and Mullineaux (2003)* find a negative relationship between greater pay-performance sensitivity and variability of returns.

Most evidence on the recent financial crisis relies on ex-post proxies for ex-ante risk taking. Recent work on causes of the financial crisis from *Fahlenbrach and Stulz (2011)* analyzes the impact

of pay-for-performance on stock returns and return on assets of US banks. While their results provide weak evidence that stronger ownership incentives in 2006 correlated with worse stock performance during the crisis 2007-2008, no evidence is found on the influence of annual compensation practices. By contrast, *Bebchuk and Spamann (2010)* present evidence for the case of Bear Stearns and Lehman Brothers that bank managers were able to extract large bonuses prior to the crisis. *Chesney, Stromberg and Wagner (2011)* use write-downs to measure bank risk taking before the crisis. Their results suggest that ownership incentives were generally negatively associated with write-downs, but banks that granted high bonuses suffered from larger write-downs. *Cheng, Hong and Scheinkman (2011)* show that short-term incentives such as bonuses and options are related to higher bank risk taking. *Mehran, Morrison and Shapiro (2011)* document that top five bank executives immediately exercised stock options following vesting. Based on this fact, they conclude that stock option plans were not designed for long-term orientation and the protection of creditors and taxpayers.

In our empirical analysis we want to examine whether compensation packages granted prior to the crisis induced managers to take excessive risks. Particularly, we test the prediction that compensation systems that rely heavily on cash bonus could encourage executives to focus on short-term results since bonuses are typically tied to annual achievements. Usually annual achievements like accounting profits are backward-looking and short-run targeted (*Murphy, 1999*).

In fact, several authors show that certain compensation components such as cash bonuses or stock options encourage managers to focus on short-termism. *Healy (1985)* shows that managers manipulate earnings to "game" bonus schemes. Other evidence suggests that managers may be able to game the capital markets (*Collins and Hribar, 2000*, *Sloan, 1996*) and CEOs with large incentives are more engaged in earnings management (*Bergstresser and Philippon, 2006*) or misreporting (*Burns and Kedia (2006)*). This may arise from the fact that managers usually understand how to affect accounting profits rather than stock prices. Similarly, *Guidry, Leone and*

Rock (1999) showed that incentive compensation tend to induce managers to maximize their short-term bonuses by focusing on short-term performance at the expense of long-term value. Under this view, we predict that investors who incentivize executives to make bets on risky investments by granting short-term incentives suffered from larger losses during the crisis. Consequently, we predict that these risk-inducing incentives granted prior to the crisis should also affect pre-crisis risk measures of banks. Given the endogenous nature of the relationship between firm risk and incentives we test our hypotheses in our robustness section using a simultaneous approach that includes both incentives and risk taking.

2.2 Impact of bank regulation on risk taking

There is no clear theoretical or empirical link between bank regulation and risk taking. In the first place, because of the moral hazard problem induced by explicit or implicit government guarantees, banking regulation is indented to reduce a bank's risk taking, for instance by enforcing shareholders to increase their equity stake in the bank (*Koehn and Santomero, 1980*). However, specific regulatory restrictions might have an impact on the risk profile of the business model chosen by the bank. For instance, activity restrictions imposed by the regulator at the one side reduce risk taking by not allowing banks to operate in risky businesses; at the other side, however, banks in this way are losing diversification opportunities which increases firm specific risks (*Mishkin, 1999*). In fact, many countries try to mitigate excessive bank risk taking by restricting banks from engaging in non-lending activities (*Boyd, Chang and Smith, 1998*). By contrast, *Eisenbeis and Wall (1984)* and *Kwan and Ladermann (1999)* argue that since profits from providing different financial services are not highly correlated, there are diversification benefits from giving banks more latitude. Recently, *Klomp and de Haan (2011)* show that activity restrictions and supervision control reduce bank risk. Furthermore, they find this effect more pronounced for banks with high risk profiles. *Haw et al. (2010)* find that legal institutions moderate the effects of internal governance mechanisms such as concentrated ownership on bank

risk taking.

There is little evidence on the relationship between bank regulation and bank risk in the context of the financial crisis 2007-2008. Since most studies use single-country data from US banks, cross-country comparisons of regulatory regimes are not possible. Only a few authors study the effect of regulation and supervision on bank performance during the credit-crises using a cross-country sample. *Beltratti and Stulz (2012)* find some evidence that banks from countries with high restrictions on banks performed better during the crisis, but no evidence is found that high-regulated banks took less ex-ante risk. *Erkens, Hung and Matos (2012)* rather use general country-level governance than bank-specific regulation and do not find a significant impact of these factors on bank performance. Regarding bank risk *Laeven and Levine (2009)* find that bank regulations reduce bank insolvency risk depending on bank's ownership structure. Since we are interested in how institutions had an effect on performance and risk taking of banks during the recent crisis we focus on regulations that are related to the banking industry. But one has to be careful since different aspects of regulation interact. For instance, countries with weaker supervisory systems could compensate by imposing more restrictions on bank activities (*Barth, Caprio and Levine, 2004*). Therefore, we test our hypotheses with an aggregated index including several regulation indices that reflect different aspects of regulation.

Our hypothesis is that strict regulations impose rules and barriers for banks to take excessive risks. By contrast, banks in countries with low regulation might be tempted to take higher risks (off-balance sheet activities or risky lending activities) that either were in the interests of shareholders or not. Thus, we would expect that tighter regulation has reduced managers' abilities to engage in high-risk activities and therefore led to better bank performance during the crisis.

2.3 Interaction between executive compensation and bank regulation

A recent study from *Laeven and Levine (2009)* argues that the relation between bank risk and bank regulation such as capital regulations and restrictions on bank activities depends on each bank's ownership structure. We adopt this approach and predict that the impact of executive compensation on risk taking varies with different levels of government regulation. We assume that shareholders use compensation incentives to induce managers to act according to their interests and simultaneously consider regulation rules and restrictions of the banking sector when designing these incentives. Further, we argue that the impact of incentives on bank's risk taking depends on the managers' investment opportunities given by law. There are two possibilities for the managers to behave in this setting. They could either choose projects that are in line with the regulatory rules or take actions that bypass restrictions or manipulate earnings to achieve their incentive goals. Essentially, we predict that incentives and regulation exhibit two patterns: weakening and enhancing interactions. For illustration purposes we assume that bonus as a short-term incentive increases risk taking. Figure 1 illustrates the moderating effect of bank regulation on the positive impact of bonus on risk.

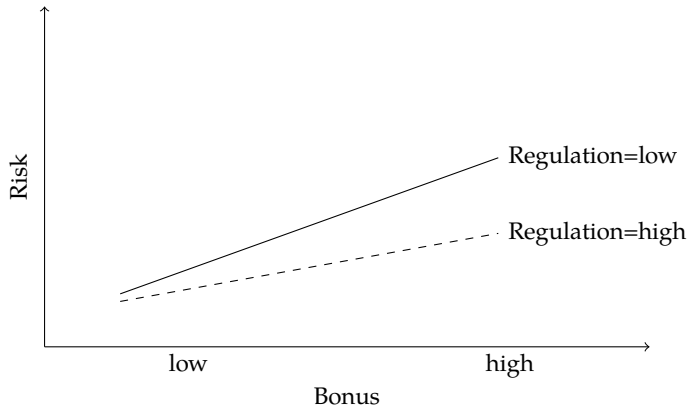


Figure 1: Prediction of weakening effect of bank regulation

By contrast, the enhancing interaction in which the bank regulation strengthens the impact of incentives on stock performance is shown in figure 2. As argued by several studies, in a setting

where the shareholders tie the manager's potential total compensation more closely to the value of stock, options and cash bonus, the manager could be encouraged to focus on short-termism in order to maximize his own wealth. In this situation, it could be even more difficult to achieve high returns in a regulatory environment with tight bank activity restrictions or high capital requirements. Consequently, managers could be encouraged by both high regulation and high incentives to engage in trading complex and risky financial products to meet investor demands or achieve own incentive goals.

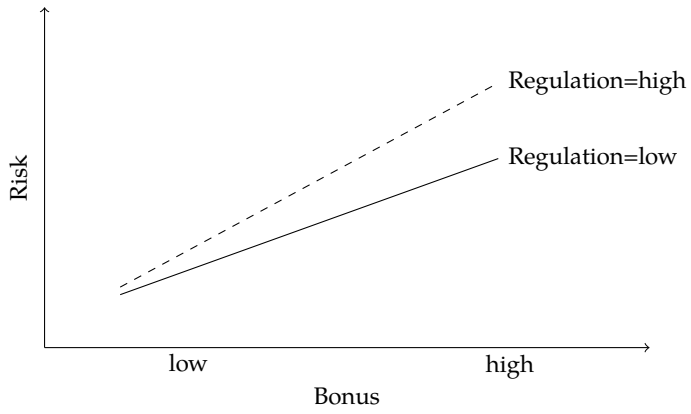


Figure 2: Prediction of enhancing effect of bank regulation

3 Methodology and data

3.1 Sample construction

Our sample consists of large, publicly traded European and US banks. We select all banks from the Thomson Reuters Database that were listed in the Industry Classification Benchmark (ICB) Subsector 8355 and with assets in excess of 0.8 billion Euros which corresponds to $1 billion at the end of 2006.[3] We exclude banks without detailed balance sheet information, stock price data and information on bank regulation. Particularly, we exclude banks when we could not obtain information on executive compensation either from annual reports for European banks

[3]The Industry Classification Benchmark (ICB) is an industry classification system developed by Dow Jones and FTSE. Individual companies are categorized into subsectors based primarily on the source of the majority of revenues.

or from ExecuComp for US banks. We end up with a sample of 352 banks from Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherland, Portugal, Spain, Sweden, Switzerland, United Kingdom and the US. Table 1 provides the geographical distribution of banks in our sample.

[– Table 1 goes about here –]

3.2 Bank risk

We use both ex-ante risk taking measures and ex-post tail risk measures to show whether incentives had any impact on risk taking prior to the crisis. Since firm risk appears in many types of risk, it is difficult to calculate a universal proxy for ex-ante risk taking. Therefore, we use several measures to cover different aspects of bank risk. Additionally, for reasons of clarity and comprehensibility, we construct an aggregated ex-ante risk score that indicates the overall bank risk.

Equity risk: Our first group of risk measures describes equity risk as a proxy for bank risk. First, equity risk measures are used as risk proxies for banks by other studies on bank risk (*Low, 2009*, *Pathan, 2009*, *Chen, Steiner and Whyte, 2006*). Second, using equity risk is appropriate since equity-based compensation is tied to bank's equity. Our two measures of equity risk are TOTAL_RISK and FIRM_RISK. To calculate our two measures we implement a two-index market model following prior studies on bank risk (*Chen, Steiner and Whyte, 2006*, *Pathan, 2009*). We use monthly stock returns from January 2004 to December 2006 and estimate for each bank the following model:

$$Return_{i,t} = \alpha_i + \beta_{1,i}(Market\ Return)_t + \beta_{2,i}(Interest)_t + \epsilon_{i,t} \tag{1}$$

Where:

i and *t* denote bank i at time t.

Market Return = S&P 1500, MSCI Europe, and FTSE 350 for US, EU and UK banks respectively; *Interest* = three-month US T-bill, three-month EURIBOR, three-month LIBOR for US, EU and UK banks respectively;

By estimating this model, FIRM_RISK is calculated as the standard deviation of the residuals $\epsilon_{i,t}$. TOTAL_RISK is proxied by the standard deviation of the monthly stock returns. Both variables for total risk and firm risk are annualized.

Probability of default: Our second dimension of bank risk taking includes the probability that a bank will default within one year. This risk measure is recently used by empirical research related to the financial crisis 2007/2008 (*Erkens, Hung and Matos, 2012*, *Camara, Popova and Simkins, 2012*). The variable we use is called EDF (Expected Default Frequency) created by Moody's KMV. The probability of default is derived from a modification of Merton's (1974) structural credit risk model and commonly used by risk managers and investors. By definition the EDF scale ranges from 0.01% to 35%. Because the EDF is skewed, we follow *Covitz and Downing (2007)* and *Cheng, Hong and Scheinkman, 2011* by using the natural logarithm of EDF in our analysis.

Insolvency risk: We incorporate the bank's Z-SCORE to account for an accounting based measure of bank insolvency. The Z-SCORE indicates bank's distance from bankruptcy (*Roy, 1952*, *Boyd, Graham and Hewitt, 1993*). The variable is calculated with the average bank's return on assets plus the capital asset ratio divided by the standard deviation of asset returns over the period 2003-2006. It measures how many standard deviations of ROA are needed to take the capital ratio to zero. It indicates how thick or thin the bank's capital cushion is relative to its earnings risk. To make interpretations of this variable comparable with our other risk measures we use the inverse form of the z-ccore to ensure that higher values indicate higher risk.

Pre-crisis risk: Finally, we construct an aggregated pre-crisis risk score that indicates overall risk taking. To compare our measured risk values with respect to their (relative) position

in the distribution we use the z-transformation (standardization) to convert the values in Z-SCORE: $z_i = \frac{x_i - \bar{x}}{\sigma_x}$. The mean (standard deviation) of a z-transformed variable is zero (one). The PRE_RISK_SCORE is calculated as the equally-weighted average of the z-transformation of the above ex-ante risk measures. An alternative method to calculate an aggregated risk score using a principal components analysis yields loadings that are very similar to the average score. Higher values of this risk proxy indicate higher overall bank risk.

Stock performance: The financial crisis as a large macroeconomic shock was likely to reveal tail risks taken by the managers prior to the crisis. Hence, stock performance can be interpreted as an ex-post outcome of ex-ante risk taking. In other words, the downside of pre-crisis risk taking was exposed by stock performance during the crisis. We measure bank performance as buy-and-hold stock returns during the financial crisis. In line with other studies (*Aebi, Sabato and Schmid, 2011*, *Beltratti and Stulz, 2012*,*Erkens, Hung and Matos, 2012*, *Fahlenbrach and Stulz, 2011*) we define our crisis period as starting in July 2007 and ending in December 2008.

3.3 Executive compensation

To test our hypotheses, we are interested in measuring short-term incentives and equity incentives. Compensation data for US banks is available from commercial databases. Since there is no database that covers our European bank sample, we had to collect compensation data from individual annual reports. For US firms we used ExecuComp, which is frequently used in most compensation studies. We measure the level of total pay as salary, bonus, value of stock, stock option grants, and other compensation (e.g. perks). For US firms, we follow the standard approach of *Fahlenbrach (2009)* and others and use the ExecuComp fair value figures for restricted stock and stock options (ExecuComp items OPTION_AWARDS_FV and STOCK_AWARDS_FV). For our measure of total compensation for US firms, we use the item TDC1 in the ExecuComp database, which is frequently used in other studies. For European firms, we take the fair value of stock and option grants as reported in the annual statements if available, and otherwise follow the

Black/Scholes option pricing approach as closely as possible. This is the only feasible approach since the equity-based incentive programs of European firms are significantly more complex than programs used by US firms (see *Rapp, Schaller and Wolff, 2009* and *Sautner and Weber, 2008* for an analysis of incentive programs in European firms). Due to the complex program structure and the limited transparency concerning the option parameters, we could not use simple calculations that value option grants by multiplying the number of options times one fourth of the strike price (*Core and Guay, 1999*; *Finkelstein and Boyd, 1998*).

Moreover, because of different disclosure policies, European firms do not have to disclose individual compensation information for all executives. However, nearly all firms in our sample report the level of executive compensation aggregated over all executives. Hence, we use average values for all executives. Therefore, we collect compensation data for all executives in the bank, as well as the time served on the management boards for each of the executives. This method allows us to calculate executive man years, which we use to normalize the aggregate compensation level. Additionally, we calculate all compensation measures for CEO data.

Measures of compensation structure: We use three different measures to describe bank compensation structure both for an average executive and CEO data. First, we calculate the ratio of total incentives (stock-based incentives + cash bonus) to total compensation in 2006:

$$INC\_REL_i = \frac{Value\ of\ Stock\ and\ Option\ Grants_i + Annual\ Cash\ Bonus_i}{Total\ Compensation_i} \tag{2}$$

Second, we use bonus compensation that is tied to annual performance in 2006 as proxy short-term incentives. We normalize annual cash bonus by total compensation:

$$BONUS\_REL_i = \frac{Annual\ Cash\ Bonus_i}{Total\ Compensation_i} \tag{3}$$

Third, for our stock-incentive measures, we follow *Bergstresser and Philippon (2006)*, *Cornett, Mc-*

Nutt and Tehranian (2010), *Fernandes et al. (2010)*, *Mehran (1995)* and others and normalize the time value of stock and option grants by the level of total compensation:

$$SBI\_REL_i = \frac{Value\ of\ Stock\ and\ Option\ Grants_i}{Total\ Compensation_i} \tag{4}$$

Another approach is to measure the incentives evolved from the equity portfolio held by executives. This ownership incentive measure is calculated by the sum of equity percentage and delta weighted options owned (e.g., *Core and Guay*, *1999*, *Fahlenbrach*, *2009*). We could not adopt this approach, because there is no detailed option plan information for European Banks available. However, we take account of equity risk exposure of bank executives by including the ownership stake of all executives (OW_MANAGEMENT) divided by total shares outstanding. Moreover, *Anderson and Fraser (2000)* document that managerial shareholdings have an impact on bank's risk policy. Controlling for outside ownership concentration as a proxy for the monitoring ability of blockholders, we take the ownership stake held by the five largest outside investors (OW_OUTSIDE). Furthermore, shareholder concentration also relates to bank risk taking. For instance, *Haw et al. (2010)* show in an international sample that banks with concentrated control exhibit higher risks and poorer performance, relative to widely held banks.

Controlling for an absolute pay level we use a measure of annual fix compensation (salary + other compensation). We take residual fixed compensation (FIX_EX) from a simple regression model containing size-, country- and industry-effects. Essentially, excess fixed compensation is calculated by the residuals of a simple regression of fix compensation (salary + others) on market capitalization, country and industry dummies. We use this measure because fixed compensation itself would lead to multicollinearity problems as fixed compensation is highly correlated with other control variables such as market capitalization.

3.4 Bank regulation

There are many country-level indices available from the law and finance literature, characterizing a variety of government regulation aspects (e.g., anti-director rights, anti-self dealing). Empirical studies on bank performance and risk taking, so far, provide little evidence on the role of regulatory environment. Related work on bank performance during the financial crisis 2007-2008 (e.g., *Erkens, Hung and Matos, 2012*, *Beltratti and Stulz, 2012*) also examine the impact of regulatory indicators that are not related to bank-specific regulation (e.g., anti-director rights from *La Porta et al., 1998*). We focus on country-level indicators that characterize bank-specific regulation and might directly affect bank decision-making. We incorporate the following indices on bank regulation presented in *Barth, Caprio and Levine (2004, 2006)*.[4]

(I) *Official:* Index of the capabilities and power of the bank supervisory authority. It includes the rights of auditors, possibility of changing the internal organizational structure, suspension of board decisions, and power to intervene in a bank. The scale is from 1 to 14 (higher values indicate stronger supervisory power).

(II) *Restrict:* Index of regulatory restrictions on bank activities. This index measures regulatory barriers to banks engaging in real estate activities (e.g. real estate investments), securities market activities (e.g., underwriting, brokering, dealing), insurance activities (e.g., insurance underwriting), and the ownership of nonfinancial firms. The scale is from 1 to 14 (higher values indicate tighter restrictions in bank activities).

(III) *Independence:* Index of independence of supervisory authority from the government. It measures the extent to which the supervisory agency is legally secured from the banking system and independent from the government. The scale is from 1 to 6 (higher values indicate a higher independence of supervisory authority).

[4]The country-level regulations and supervisory practices were gathered in a survey of *Barth, Caprio and Levine (2004)* using data primarily from 1999. We take the regulation indices based on this survey reported in *Caprio, Laeven and Levine (2007)*.

(IV) *Capital:* Index of bank capital regulation. The index incorporates regulatory restricts on bank capital and capital stringency. It measures the regulatory approach to assessing and verifying the degree of capital at risk in a bank. The scale is from 1 to 9 (higher values indicate stricter capital requirements).

(V) *Regulation:* Average of the four bank regulation indices above. Hence, higher values indicate a greater overall bank regulation.

Since the law and finance literature contends the importance of shareholder protection, we include the revised anti-director index (ADRI_DLLS) from *Djankov et al. (2008)* as control variable. To control for the development of stock markets we calculate the ratio of market capitalization of listed firms to GDP (MCAP_GDP).

4 Empirical results

4.1 Summary statistics on bank regulation, performance and risk

Table 2 shows summary statistics of the entire sample. We summarize relevant facts about bank risk, compensation of bank executives, regulation and bank characteristics.

[– Table 2 goes about here –]

The average (median) market capitalization at the end of 2006 is 7.96 billion Euros (0.70 billion Euros). The relatively low median value compared to the mean suggests that our sample covers a lot of small and mid-size banks, but also some very large banks. As *Fahlenbrach and Stulz (2011)* note, studies that only use the ExecuComp database for compensation data suffer from a bias towards larger firms. Since we also obtained compensation data from annual reports by hand we are able to incorporate smaller banks into our study. Regarding bank risk, average total shareholder return during the crisis as our proxy for excessive tail risks is significantly negative with -40.64% for the period July 2007 - December 2008. Thus, the majority of European and US banks were heavily hit by the financial crisis. Only 57 banks in our sample had positive stock re-

turn for the crisis period. Average TOTAL_RISK and FIRM_RISK for December 2006 as proxies for risk taking prior to the crisis are 18.70% and 16.86% respectively. This relatively low stock volatility is due to the high stock market growth in the years 2004-2006, because volatility tends to go down when stock prices increase (*Dumas, Fleming and Whaley, 1998*). The mean (median) logarithm of the one-year probability of default is -2.76 (-2.69) which equals a 0.06% (0.07%) default probability. By definition Moody's KMV Expected Default frequency is capped at 35%. Hence, if the probability of default within one-year exceeds 35%, it is winsorized to the 35% level. The mean (median) of the Z-SCORE, the inverse of banks distance to bankruptcy, is 0.03 (0.02). These values are similar to those reported by *Beltratti and Stulz, 2012* for the same period. The mean value of our pre-crisis risk indicator (PRE_RISK_SCORE) is almost zero by definition, since it is calculated by the average of the z-transformations of the ex-ante risk measures.[5]

The mean value of total compensation for an average executive is 1,251 thousand Euros while the average total compensation for a CEO is 2,153 thousand Euros. Although there are executives receiving no variable pay, on average (median) a bank executive receives 39.24% (38.11%) of total compensation in form of variable pay. The mean (median) value of relative bonus compensation for 2006 performance for an average executive is 23.27% (22.56%) and the mean (median) value of relative stock-based compensation granted in 2006 is 15.45% (8.73%). The difference between the mean and median value of stock-based incentives suggests that there are some banks which grant relatively high stock-based packages. Moreover, annual bonus compensation as a short-term incentive seems to play an important role in motivating and incentivizing bank managers.

Summary statistics of our regulatory indicators show that there is a large variation in bank regulation in our sample. Moreover, the variables of bank regulation are negatively skewed. Table 3 provides more details on country-level regulation. It gives an overview of the bank regulation across the countries and underlines the heterogeneity across countries. We observe the highest regulation of the banking sector in the US. The banking system in the US has the most pow-

[5] As we could not calculate all risk measures for every bank we end up with a different number of observations for each risk measure. Otherwise the mean of the average of z-transformed variables would be exactly zero.

erful supervisory authorities, the tightest bank activity restrictions, the highest independence of the supervisory, and the strictest capital requirements (except for Austria). Thus, the overall bank regulation index (REG) of the US ranks highest with a score of 8.30. Surprisingly, Portugal has the second highest overall regulation score. France and Denmark exhibit the most lax regulatory system. Interestingly, there are some countries such as Italy and Austria that have a great heterogeneity across different regulatory dimensions. For instance, while Austria implemented a powerful supervisory authority it has only minor bank activity restrictions. By contrast, Italy has a weak banking supervisory authority, but implemented tight restrictions on bank activities. This incident suggests that countries compensate differences in the regulatory system. For instance, when it's hard to establish a powerful supervisory authority, imposing tighter restrictions might achieve the desired level of regulation of the banking system.

[– Table 3 goes about here –]

Table 4 provides country-level statistics for our bank risk measures. Average stock performance is negative for all countries. Thus, every European country and the US were hit more or less by the financial crisis. Banks from Ireland, Belgium, UK and France (all <-70%) suffered from the highest losses while banks from the Netherlands, Switzerland and Austria were far less affected by the crisis (>-30%). Although there are many factors determining bank risk, the high variation across countries might be a first indication that country-level effects play a role in bank risk taking. The fact that also ex-ante risk taking variables vary heavily across countries supports this conjecture.

[– Table 4 goes about here –]

4.2 Compensation strucure, bank regulation and risk taking

In this section we analyze if shareholders consider the regulatory setting their bank operates in when it comes to designing compensation contracts. In other words, do shareholders respond to regulation in the banking sector either by increasing or decreasing managers' incentives?

Existing literature discusses a variety of firm-specific governance mechanisms that determine executive compensation. Recently, *Bryan, Nash and Patel (2010)* and *Huettenbrink, Rapp and Wolff (2011)* find evidence that compensation is also affected by country-level governance. We use a similar approach by regressing compensation on our aggregated measure of bank regulation. We also use common firm characteristics and general country-level indicators such as shareholder protection and macroeconomic variables as control variables. Effectively, we estimate variants of the following model:

$$\begin{aligned} \textit{Compensation} = \beta_0 + \beta_1(\textit{Regulation}) + \beta_2(\textit{Board/Ownership}) + \beta_3(\textit{Bank characteristics}) \\ + \beta_4(\textit{Industry dummies}) + \epsilon_i \end{aligned} \tag{5}$$

Where:

Compensation = INC_REL, SBI_REL, BONUS_REL;

Regulation = REG, ADRI_DLLS, MCAP_GDP;

Bank characteristics = MCAP_LN, LEVERAGE , TSR, TSR_LAG, ROE, ROE_LAG;

Board/Ownership = CEO_DUAL, BOD_EXEC, BOD_NON_EXEC, OW_MANAGEMENT, OW_OUTSIDE;

Table 5 reports regression results on three models for both the entire sample and the subsample containing the European banks. The coefficient estimate on overall bank regulation (REG) is positive and is statistically significant at the one percent level for total incentives, bonus and stock-based compensation for the entire sample.[6] This suggests that stronger regulation increases the amount of pay that is performance related, but reduces the fraction of fixed pay. Thus, shareholders of banks seem to grant more short-term incentives and long-term incentives when the banking system is highly regulated. This result supports the conjecture that shareholders of high-regulated banks react to regulation and implement contracts with higher pay-

[6] In unreported regressions we find that our aggregated regulation index is negative and significant for fixed compensation. This supports the argument that regulation increases overall incentives.

for-performance sensitivity to encourage managers to outperform competitors in a restricted business environment. Regression results for the subsample of European banks corroborate this conjecture.[7] To sum up, the results clearly indicate that shareholders consider bank regulation when designing compensation contracts. Shareholders of banks operating in a high-regulated environment tend to grant both higher short-term and long-term incentives to their managers by increasing the fraction of bonus and stock-based compensation.

[– Table 5 goes about here –]

4.3 Risk taking during the crisis, compensation and bank regulation

We are interested in how compensation has affected bank risk taking prior to the crisis and accordingly to what extent banks were hit during the crisis because of ex-ante risks. Therefore, we regress different ex-ante risk measures and cumulative stock returns of European and US banks during the crisis period on pre-crisis compensation variables and control variables. To make interpretations of our tail risk measure (stock performance) comparable with our other ex-ante risk measures we use the negative total shareholder return. Thus, as the other risk measures, higher values of -TSR_07/08 indicate higher tail risks. Total risk and firm risk are proxies for stock market risks while probability of default and z-score rather act as accounting-based risk measures. To control for differences in capital structure and size effects we include several bank characteristics, such as market capitalization, tier-1-ratio, loans-to-assets ratio, market-to-book ratio. Further, we include accounting performance measured by the return on equity and stock returns in 2006.[8] We also include ownership variables to capture potential effects of outside or managerial ownership. Moreover, we control for industry effects by including industry dummies (4-digit SIC). We examine whether existing bank regulation rules mitigate excessive bank risk taking by extending our models to our country-level indicator (REG) that assesses different dimensions of bank regulation. To address the potential cross-sectional dependence in the error

[7] We also find similar results for a subsample of large banks (median split of market capitalization).

[8] We control for stock performance in 2006 because crisis performance might reverberate a reversal of the performance prior to the crisis (*Beltratti and Stulz, 2012*).

terms, we use robust standard errors clustered by firm. The baseline model (eq. (5)) is specified as follows:

$$\begin{aligned} Risk = \beta_0 + \beta_1(Compensation) + \beta_2(Regulation) \\ + \beta_3(Bank\ characteristics) + \beta_4(Industry\ dummies) + \epsilon_i \end{aligned} \tag{6}$$

Where:

Risk = -TSR_07/08, TOTAL_RISK, FIRM_RISK, EDF, Z-SCORE, PRE_RISK_SCORE;

Compensation = INC_REL, SBI_REL, BONUS_REL;

Regulation = REG, ADRI_DLLS, MCAP_GDP;

Bank characteristics = OW_MANAGEMENT, OW_OUTSIDE, MCAP_GDP, TIER1, MTB, STAFF_INC, LEVERAGE, LOANS_TO_ASSETS, TOTAL_RISK, TSR, ROE;

We include excess fixed compensation (FIX_EX) to control for an absolute level of compensation. Table 6 reports regression results for six models in which we examine the effect of total incentives and bank regulation on risk taking. The coefficient for total incentives (INC_REL) is positive in every model and is statistically significant for all models except for the probability of default (EDF). A one-standard deviation increase in INC_REL is associated with a decrease in total shareholder returns of 7.77 percentage points. Volatility of stock returns TOTAL_RISK is increased by almost one percentage point for a one-standard deviation increase of INC_REL. This evidence indicates that increasing manager's incentives is associated with higher risk taking. In other words, increasing the fraction of variable pay in total annual compensation induce bank managers to take higher risks.

Overall regulation of the banking sector (REG) enters the regression with a significantly negative coefficient in all regression models except for probability of default. This effect is economically large. An increase from the lowest REG score to the highest score means an increase in returns of 18.45 percentage points during the crisis. For instance, a bank switching from a country with

lowest bank regulation (e.g., France) to the US would have 3.68 percentage points less stock volatility (TOTAL_RISK) holding all else (firm size, capital structure, etc.) constant. Comparing the economic effect of regulation among risk measures reveals that the regulation of banks strongly affects tail risk activities engaged by bank managers. Regular risks that are captured by common risk indicators such as probability of default or volatility of stock returns are rather less mitigated by regulation than excessive tail risks such as off-balance sheet activities or risk lending activities.[9] The key implication of these results is that regulation can decrease bank risk in general and effectively diminish excessive risk taking activities.

[– Table 6 goes about here –]

For further examination of incentive effects on bank risk taking we substitute our total incentive variable for its components, bonus (BONUS_REL) and stock-based compensation (SBI_REL). The results presented in table 7 reinforce the findings of table 6. As it turns out, the main driver of incentives regarding risk taking prior to the crisis is the annual bonus compensation. The coefficient for relative bonus compensation (BONUS_REL) is positive in every model and is statistically significant for all models. Stock-based compensation (SBI_REL) seems to play a minor role in determining ex-ante risk taking, but an important role in excessive tail risks. A one-standard deviation increase in BONUS_REL is associated with an increase in TOTAL_RISK (EDF) of 1.37 percentage points (0.15%). For instance, increasing the relative amount of bonus compensation by one-standard deviation from 23% (mean) to 40% means that the probability of default within one year increases by 0.15%. These results support our hypothesis that short-term incentives such as bonuses increase manager's risk appetite. The outcome of the effect that managers are incentivized to focus on the short run is reflected by all risk measures. Interestingly, our results indicate that stock-based incentives encourage managers to engage in excessive tail risks. This effect is only captured by stock performance during the crisis as our tail risk proxy and could not be revealed by common risk measures like probability of default

[9] Relative marginal effects for TSR_07/08 (TOTAL_RISK) is -0.11 (-0.05).

and z-score. This suggests that there was a certain rationale behind stock-based packages and excessive risks. One explanation for these results is that managers with incentives tied to banks stock performance invested in projects that they believed would increase shareholder wealth, but these risky projects turned out to be worse during the crisis. This is in line with findings of *Fahlenbrach and Stulz (2011)* who find that CEOs did not reduce their holdings of shares in anticipation of poor performance.

Again, overall regulation of the banking sector (REG) is significantly negative in all regression models except for probability of default. The effects are economically large and similar to the effects of the previous regressions. For instance, an increase from the lowest REG score to the highest score is associated with an increase in returns of 18.42 percentage points during the crisis and a decrease of stock volatility of 3.54 percentage points.

[– Table 7 goes about here –]

4.4 Interaction of bank regulation and compensation

Since we predict that the impact of compensation on bank risk taking varies with different levels of government regulation, we incorporate interaction terms of compensation and regulation variables. By including interaction terms we test how incentives induce risk taking depending on outside regulation. To reduce common multicollinearity problems with interaction terms we center all interacted variables. The enhanced model is specified as follows:

$$\begin{aligned} Risk = {} & \beta_0 + \beta_1(Compensation) + \beta_2(Regulation) \\ & + \beta_3(Compensation\ x\ Regulation) + \beta_4(Bank\ characteristics) \\ & + \beta_5(Industry\ dummies) + \epsilon_i \end{aligned} \tag{7}$$

Where:

Risk = -TSR_07/08, PRE_RISK_SCORE;

Compensation = INC_REL, SBI_REL, BONUS_REL;

Regulation = REG, ADRI_DLLS, MCAP_GDP;

Bank characteristics = OW_MANAGEMENT, OW_OUTSIDE, MCAP, TIER1, MTB, STAFF_INC, LEVERAGE, LOANS_TO_ASSETS, TOTAL_RISK, TSR, ROE;

Table 8 reports regression results on bank risk, compensation structure and bank regulation. For the sake of brevity we report only results for regressions estimating -TSR_07/08 and PRE_RISK_SCORE. The main effect of bonus and total incentives is still positive and significant for all risk measures. The argument holds that a higher fraction of incentives to total compensation and particularly bonus compensation increases risk taking by banks. Stock-based incentives remain significant and risk-enhancing only for -TSR_07/08. As in all previous regressions, overall regulation of the banking sector (REG) is significantly negative in all regression models except for probability of default. The effects remain economically large and similar to the effects of the previous regressions

The coefficient of the interaction term of bonus and regulation is positive and significant at the 5% level for -TSR_07/08. This result supports the hypothesis that predicts an enhancement effect of regulation. As the interpretation of interaction terms is sometimes not intuitive, figure A illustrates the marginal effect of the BONUS_REL over different levels of bank regulation (effect of column 3 in table 8). The Figure A shows that the risk-increasing effect of bonuses becomes stronger when bank regulation increases. An illustration of the predicted level of risk under different incentive and regulation levels (figure C) shows that tighter regulation generally reduces risk taking, but also demonstrates the downside of restricting and supervising banks with respect to executive incentives. The steeper slope of the high-regulation line indicates that short-term incentives lead to higher risk taking in a tight regulatory environment compared to lax regulatory regimes. We argue that highly incentivized managers who focus on short performance find it hard to achieve high returns in a regulatory environment with tight bank activity restrictions or high capital requirements. As we showed earlier, shareholders aim to mitigate

the effect of regulation by providing stronger incentives to overcome managerial risk aversion. Consequently, managers who face both high regulation and high incentives are induced to engage in high-yield and risky financial activities to meet shareholders' demands or achieve own incentive goals. These high-risk investments ("tail risks") were particularly affected by the financial crisis, even though they were not captured by common risk indicators. Figure B highlights that the marginal effect of short-term incentives on our aggregated measure for ex-ante risk taking is not connected to the level of bank regulation and supervision. Moreover, the absolute effect of our estimated model (figure D) shows that there seems to be no significant moderation of the regulation regarding the relationship between incentives and risk. One explanation could be that these short-term incentives induced managers to engage in risky off-balance sheet activities which were exposed only because of the exceptional crisis situations, but they were not being assessed by accounting based risk measures.

[– Table 8 goes about here –]

4.5 Robustness tests

In this section, we discuss three robustness checks of the results reported in this paper: endogeneity of risk and incentives, robustness of risk measures and sample variation.

Simultaneous approach of risk and compensation: To control for the endogenous nature of the relationship between firm risk and incentives we test our hypothesis that short-term incentives increase risk taking using a simultaneous approach that includes compensation and risk taking variables. We use three-stage regressions (3SLS) to diminish the endogeneity problem (if any) from simultaneity bias by fully incorporating the information that is related to the error covariances. Doing so, the three-stage estimates are asymptotically most efficient and converges to the true parameters faster than the two-stage least square and the ordinary least square estimate (*Judge et al., 1988*). Our instruments for SBI_REL and BONUS_REL are based on common determinants documented by existing literature that do not directly have an impact on firm risk.

We estimate the following model for SBI_REL and BONUS_REL, respectively:

$$\begin{aligned} SBI\_REL &= \alpha + \beta_1(PRE\_RISK\_SCORE) + \beta_2(REG) + \beta_3(ADRI\_DLLS) + \beta_4(MCAP\_GDP) \\ &+ \beta_5(MCAP) + \beta_6(TSR\_LAG) + \beta_7(TSR) + \beta_8(ROE\_LAG) + \beta_9(ROE) \\ &+ \beta_{10}(BOD\_NEXEC) + \beta_{11}(Industry\ Dummies) + \epsilon \end{aligned} \tag{8}$$

$$\begin{aligned} BONUS\_REL &= \alpha + \beta_1(PRE\_RISK\_SCORE) + \beta_2(REG) + \beta_3(ADRI\_DLLS) + \beta_4(MCAP\_GDP) \\ &+ \beta_5(MCAP) + \beta_6(TSR\_LAG) + \beta_7(TSR) + \beta_8(ROE\_LAG) + \beta_9(ROE) \\ &+ \beta_{10}(BOD\_NEXEC) + \beta_{11}(Industry\ Dummies) + \epsilon \end{aligned} \tag{9}$$

Finally, we treat PRE_RISK_SCORE, BONUS_REL and SBI_REL as endogenous by simultaneously solving both equations eq. (8) and eq. (9) together with eq. (5) using the three-stage least squares (3SLS) estimation method. Our results in table 9 underline our previous results presented in table 7. We find that overall risk taking prior to the crisis is positively and significantly related to annual bonuses. In addition, the effect of banking regulation remains significant for both compensation structure and pre-crisis risk taking. Using other ex-ante risk measures yields similar results. This reinforces the hypothesis that short-term incentives for managers led to higher risk taking in the context of the financial crisis in 2007/2008, while tighter regulatory rules dampened excessive risk taking in the banking industry.

[– Table 9 goes about here –]

Risk measures: Since we argue that tail risks taken by banks prior to the crises were exposed by the crisis and result in poor stock performance, we apply alternative measures of tail risks. We calculated the total shareholder return for the year 2008 (TSR_08) and for the period January

2007 to the bankruptcy of Lehman on September 15, 2008 (TSR_LEHMAN). Panel A of table 10 presents results of regressions based on eq. (7) with our previous tail risk measure and two alternative tail risk measures. We find similar results when using TSR_08. Bank regulation has a risk-reducing effect while bonuses and the interaction of bonuses with regulation increase the extent to which banks where hit during the crisis. By contrast to TSR_07/08, the interaction of SBI_REL and BONUS_REL is significant for TSR_08. Although the results for TSR_LEHMAN exhibit insignificant correlations, the coefficient of the main effects and interaction terms are qualitatively similar to results of the other tail risk measures.

Sample selection: Since we have a broad sample that consists of many small banks, we want to test whether the results were driven by small banks. Panel B of table 10 reports regression results based on eq. (7) for large banks only. These regression models produce results which remain qualitatively and also quantitatively similar to those presented earlier. Our previous results suggest that country differences do matter regarding the impact of compensation on performance and risk. Thus, we want to test whether our results are driven by US banks only. Therefore, we test our regression with interaction terms on a subsample excluding US banks as the US exhibits the highest regulation of the banking industry. Panel C of table 10 reports regression results based on eq. (7) for European banks. Due to the reduced number of observation we did not expect similar statistical significance. Notwithstanding the reduced sample, the results for the interaction terms of BONUS_REL and REG are significant and similar to those of our base regressions. These findings underline our previous hypothesis that incentives for short-termism are enhanced by tight regulation and seem to encourage managers to take even more excessive risks. Therefore, in countries with strong capital requirements and tight restrictions, short-term incentives induce managers to select risky projects or projects that bypass restrictions in order to achieve their goals.

Table 10 presents regression results only for European banks.

[– Table 10 goes about here –]

5 Conclusion

In the aftermath of the recent crisis much attention is paid to bank's risk behavior. It is widely believed that excessive risk taking by banks, due to the systemic risk they pose on the whole economy, were the root of the economic crisis. On the basis of anecdotal evidence many critics argue that ill-designed compensation contracts of executives were the driver of excessive risks taken by many banks. Until recently, the literature on compensation and risk for the banking industry was remarkably sparse. Emerging empirical evidence on the financial crisis regarding the relationship between risk taking and incentives is mixed. In this paper we shed more light on this issue and contribute to the literature by analyzing a novel dataset of 352 banks of 14 European countries and the US. Our results suggest that bank risk is influenced by the structure of executive pay. While extant literature focuses on stock-based compensation as risk taking incentive we show that also bonuses substantially act as a risk taking incentive in banks.

Our analysis highlights that short-term incentives in form of bonuses increase risk taking in banks. We find this relationship for both ex-ante risk measures and stock performance during the crisis as ex-post proxy for excessive "tail risks". Stock-based incentives only seem to encourage managers to engage in certain tail risks that were captured by stock performance during the crisis but not by common risk measures like probability of default and z-score. A potential explanation for these results is that managers with incentives tied to bank's stock prices invested in projects that they believed would increase shareholder wealth, but these risky projects turned out to be worse during the crisis. This is in line to the finding of *Fahlenbrach and Stulz (2011)* who showed that bank CEOs did not reduce their stockholdings ahead of the crisis.

Our paper further points to the role of bank regulation and shareholders for bank risk. We find that shareholders consider the existing regulation of the banking industry when deciding on executive incentives. Shareholders of high-regulated banks tend to grant higher bonuses and more stock-based compensation. One explanation is that by doing so bank managers operating

in a restricted environment are incentivized to outperform competitors and generate higher short-term profits.

Moreover, our analysis identifies bank regulation as an instrument that moderates bank risk. Our results suggest that powerful supervisory authorities or tight regulation rules (e.g., capital requirements, activity restrictions) could prevent banks from taking excessive risks. But higher regulation has a drawback regarding the impact of incentives on bank risk as the effect of incentives for short-termism is enhanced by tight regulation and seems to encourage managers to take even more excessive risks. Thus, managers who face both high regulation and high incentives are induced to engage in risky projects such as off-balance activities to either meet shareholders' demands or achieve own incentive goals. The fact that accounting-based risk measures like probability of default or z-score do not display this relationship supports the view that highly incentivized managers invest in risky off-balance sheet activities.

The main implication of our results for policymakers and regulators is that they should consider shareholders' reaction to regulation. The interactions of regulation and incentives could jeopardize the efforts to stabilize and regulate the banking system in order to prevent the next financial collapse.

Appendix

A Variable Description

Table 1: Definition of variables

Variable	Description
	Bank Risk
TSR_07/08	Total shareholder return (defined as capital gains plus dividends) from July 2007 to December 2008
TSR_08	Total shareholder return (defined as capital gains plus dividends) from January 2008 to December 2008
TSR_LEHMAN	Total shareholder return (defined as capital gains plus dividends) from January 2007 to September 15, 2008 (bankruptcy of Lehman Brothers)
TOTAL_RISK	The standard deviation of the monthly bank stock returns from January 2004 to December 2006
FIRM_RISK	The standard deviation of the error terms in Eq. (1)
EDF	Natural logarithm of average of monthly Expected Default Frequency (one-year) from Moody's KMV in 2006
Z-SCORE	The inverse z-score which is the bank's return on assets plus the capital asset ratio divided by the standard deviation of asset returns over the period 2003-2006
PRE_RISK_SCORE	Pre-crisis period risk is calculated as the equally-weighted average of the above z-transformed ex-ante risk measures
	Compensation
TOTAL	Average total compensation (salary, other, bonus, stocks, options) per executive (in tsd. EUR) in 2006
LN_TOTAL	Natural logarithm of 1 plus total average compensation per executive (in tsd. EUR)
INC_REL	Total relative amount of incentives. Fraction of overall pay that is granted in form of equity-based compensation and cash bonus
BONUS_REL	Annual cash bonus granted in 2006 divided by total compensation
BONUS_FIX_REL	Annual cash bonus granted in 2006 divided by fix compensation (salary + other)
SBI_REL	Stock-based compensation (LTIP, restricted shares, and stock options) granted in 2006 divided by total compensation
SBI_FIX_REL	Stock-based compensation granted in 2006 divided by fix compensation (salary + other)
FIX_EX	Residuals of regression of logarithm of fix compensation (salary + other) on market capitalization, industry and country dummies in 2006
CEO_TOTAL	CEO total compensation (in tsd. EUR) in 2006
CEO_BONUS_REL	Annual CEO cash bonus granted in 2006 divided by CEO total compensation
CEO_SBI_REL	CEO stock-based compensation (LTIP, restricted shares, and stock options) granted in 2006 divided by total compensation

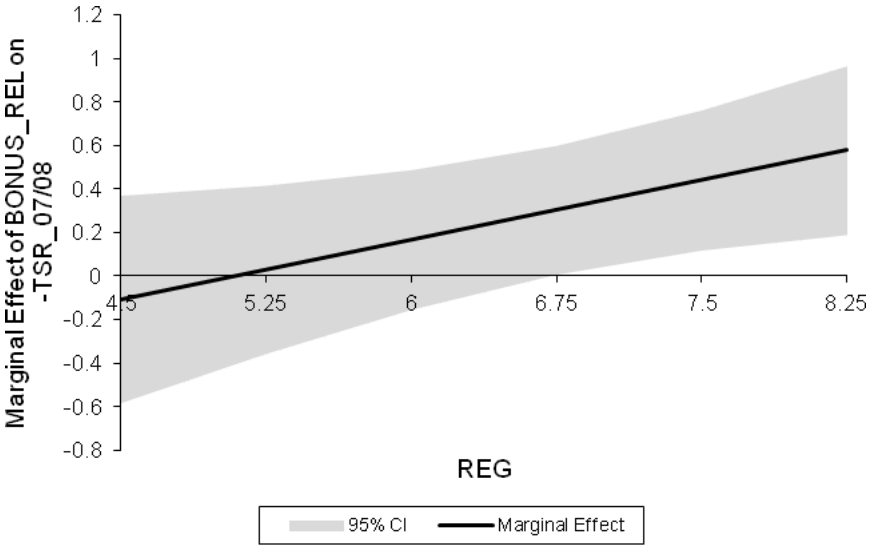
continued on next page...

Table 1 (continued)

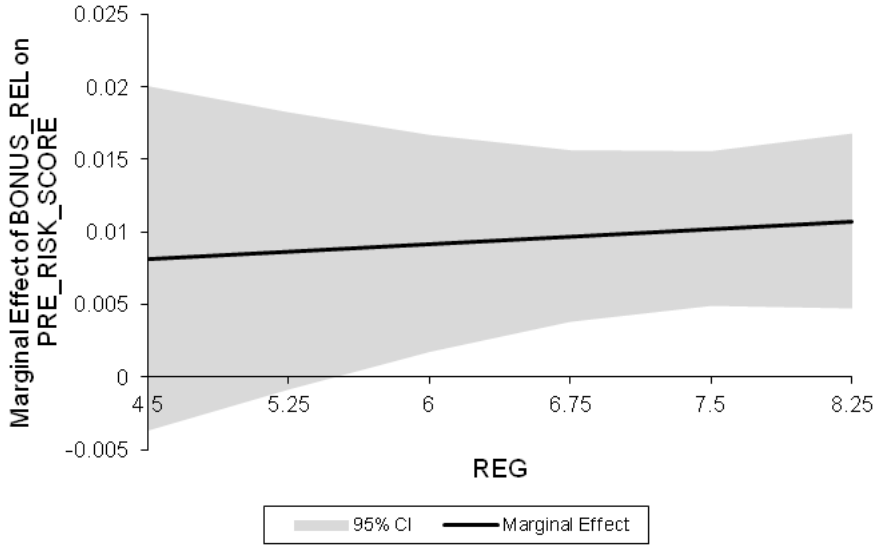
Variable	Description
	Bank Characeristics
MCAP	Market capitalization (in mil. EUR) as at the end of fiscal year 2006
MCAP_LN	Natural logarithm of 1 plus market capitalization at the end of fiscal year 2006
TIER1	Tier-1-capital divided by risk weighted assets at the end of fiscal year 2006
LOANS_TO_ASSETS	Loans divided by total assets at the end of fiscal year 2006
MTB	Market-to-book value of equity measured as year end market cap divided by common equity at the end of fiscal year 2006
ROE	Net income divided the book value of common equity at the end of fiscal year 2006
ROE_LAG	Net income divided the book value of common equity at the end of fiscal year 2005
LEVERAGE	Leverage measured by long-term debt to common equity at the end of fiscal year 2006
STAFF_INC	Sensitivity of average employee salary to return on equity. Measured by the coefficient of return on equity in a simple regression of staff costs per employee on market capitalization and return on equity for the period 2002-2006.
TSR	Total shareholder return (defined as capital gains plus dividends) for the year 2006
TSR_LAG	Total shareholder return (defined as capital gains plus dividends) for the year 2005
OW_MANAGEMENT	Fraction of voting rights held by the management board
OW_OUTSIDE	Fraction of voting rights held by outside investors
CEO_DUAL	Dummy variable which takes the value 1 in case that the CEO also chairs the board of directors during the fiscal year
BOD_EXEC	Number of executive directors serving on the board
BOD_NON_EXEC	Number of non-executive directors serving on the board
	Regulation
OFFICIAL	Index of bank supervisory power taken from *Caprio, Laeven and Levine (2007)*
RESTRICT	Index of regulatory restrictions on bank activities taken from *Caprio, Laeven and Levine (2007)*
INDEPENDENCE	Index of independence of supervisory authority from the government taken from *Caprio, Laeven and Levine (2007)*
CAPITAL	Index of bank capital regulation taken from *Caprio, Laeven and Levine (2007)*
REG	Average of the four bank regulation indices above
ADRI_DLLS	Anti-director rights index pioneered by *La Porta et al., 1998* and recently revised by *Djankov et al. (2008)*
MCAP_GDP	Market capitalization of all listed firms in a country divided by the gross domestic product (GPD)

Notes: The table describes the set of variables that we use in our empirical analysis. We use accounting and capital market data from Thomson Financial Worldscope and Datastream. For US firms we gathered compensation data from the ExecuComp database. All other firm-specific governance variables are hand-collected from annual reports and SEC filings, respectively. The governance indices are from the literature as cited in the table.

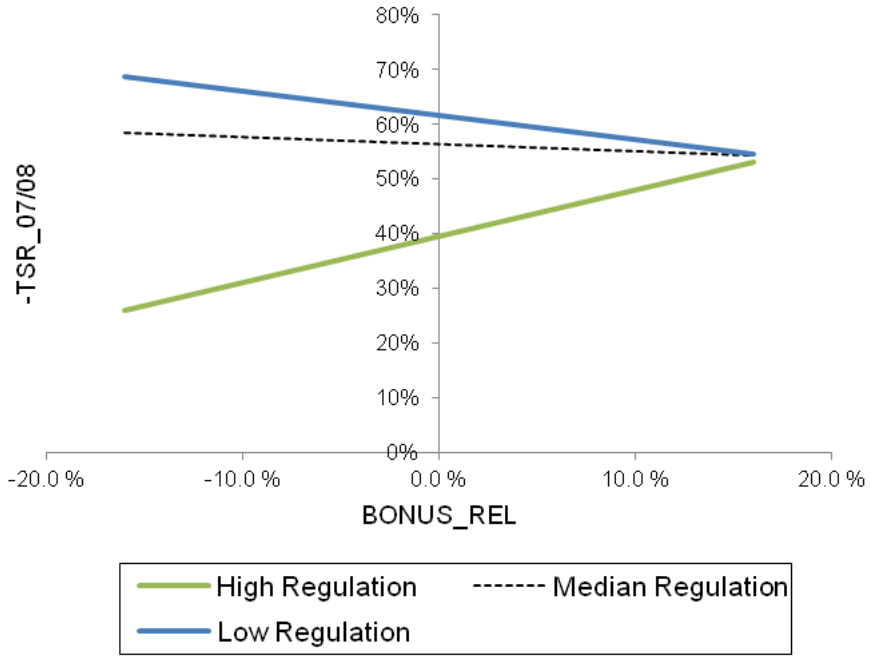
A Marginal Effect of bonus on -TSR_07/08



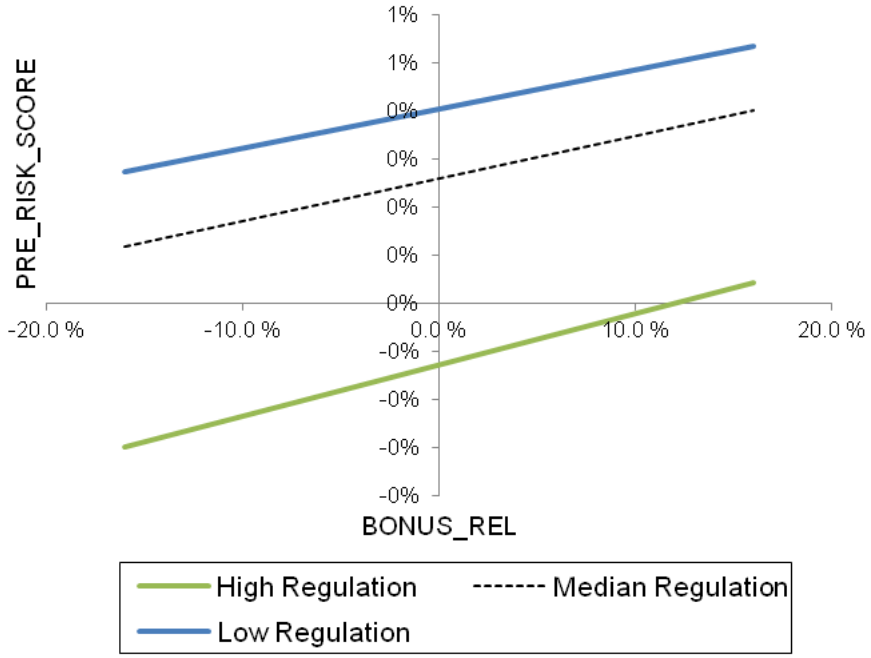
B Marginal Effect of bonus on PRE_RISK_SCORE



C Absolute Effect of bonus on -TSR_07/08



D Absolute Effect of bonus on PRE_RISK_SCORE



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A Tables

Table 1: Sample

Country	No. of small banks	No. of large banks	No. of all banks
Austria	3	5	8
Denmark	11	4	15
Finland	1	0	1
France	1	4	5
Germany	4	8	12
Greece	0	4	4
Ireland	0	3	3
Italy	2	10	12
Netherland	0	2	2
Portugal	1	4	5
Spain	0	7	7
Sweden	0	4	4
Switzerland	8	14	22
United Kingdom	0	9	9
Europe	**31**	**78**	**109**
United States	145	98	243
Total	**176**	**176**	**352**

Notes: The table reports the geographical distribtion of our sample. It also provides the distribution of small and large banks across countries. Large (small) banks are banks located above (equal or below) the median of the sample distribution of market capitalization. All variables are described in table A.

Table 2: Summary statistics

VARIABLE	MEAN	MEDIAN	MIN	MAX	Obs.
Bank Risk					
TSR_07/08	-40.64	-43.56	-99.99	67.37	349
TSR_08	-31.94	-34.48	-99.99	67.91	349
TSR_LEHMAN	-31.41	-31.07	-99.87	56.81	349
TOTAL_RISK	18.7	17.56	2.1	68.89	331
FIRM_RISK	16.86	15.56	2.09	68.03	329
EDF	-2.76	-2.69	-4.61	3.56	334
Z-SCORE	0.03	0.02	0.001	0.27	293
PRE_RISK_SCORE	0.001	-0.06	-1.22	4.08	317
Compensation					
TOTAL	1251.75	471.26	0.53	25274.96	352
INC_REL	39.24	38.11	0	97.42	329
BONUS_REL	23.27	22.56	0	79.74	329
BONUS_FIX_REL	63.43	37.5	0	956	329
SBI_REL	15.45	8.73	0	97.41	352
SBI_FIX_REL	64.91	14.96	0	3778.6	329
FIX_EX	0	-44.5	-957.32	4930.83	329
CEO_TOTAL	2153.42	787.19	0	43822.04	307
CEO_BONUS_REL	25.42	23.74	0	79.67	298
CEO_SBI_REL	18.49	8.22	0	96.5	302
Bank Characteristics					
MCAP	7963.65	699.97	25.34	218000	352
MCAP_LN	7.01	6.55	3.23	12.29	352
TIER1	10.96	10.25	6.54	23.65	328
LOANS_TO_ASSETS	69.46	70.92	30.67	91.44	352
MTB	2.03	1.98	0.46	3.65	352
ROE_LAG	13.18	13.16	2.01	24.54	350
ROE	12.78	12.62	2.64	26.08	351
STAFF_INC	-0.04	0.00	-14.04	2.05	352
LEVERAGE	22.83	18.72	3.35	67.79	352
TSR_LAG	9.17	4.45	-27.82	74.87	338
TSR	17.72	16.03	-17.43	81.82	347
OW_MANAGEMENT	4.39	1.43	0	86.65	352
OW_OUTSIDE	16.89	11.08	0	97.09	352
CEO_DUAL	0.37	0	0	1	352
BOD_NON_EXEC	10.99	11	0	27	352
BOD_EXEC	5.36	5	0	23	352
Regulation					
OFFICIAL	12.04	13	6	13	352
RESTRICT	10.37	12	5	12	352
INDEPENDENCE	3.59	4	1	4	352
CAPITAL	3.65	4	1	5	352
REG	7.41	8.25	4.5	8.25	352
ADRI	3.12	3	2	5	352
MCAP_GDP	141.22	145.66	53.44	309.92	352

Notes: The table reports summary statistics for our variables based on a sample of 352 European and US banks. All compensation level values are in thousand Euros. Compensation granted in currencies other than Euro are transformed to Euro by using the average of monthly exchange rates of the corresponding year. All bank characteristic variables except the ownership measures are winzorized at the 2%-level. All variables are described in table A.

Table 3: County-level bank regulation

	OFFICIAL	RESTRICT	INDEPENDENCE	CAPITAL	REG	ADRI_DLLS	MCAP_GDP
Austria	13	5	1	5	6.0	2.5	60
Denmark	8	8	1	2	4.8	4	84
Finland	8	7	1	4	5.0	3.5	128
France	7	6	3	2	4.5	3.5	107
Germany	10	5	4	1	5.0	3.5	56
Greece	10	9	1	3	5.8	2	79
Ireland	9	8	4	1	5.5	5	74
Italy	6	10	2	4	5.5	2	55
Netherland	8	6	4	3	5.3	2.5	115
Portugal	13	9	4	3	7.3	2.5	53
Spain	9	7	3	4	5.8	5	107
Sweden	6	9	3	3	5.3	3.5	144
Switzerland	13	5	3	3	6.0	3	310
United Kingdom	11	5	4	3	5.8	5	156
United States	13	12	4	4	8.3	3	146
Median	9	7	3	3	5.5	3.5	107

Notes: The table reports descriptive statistics on our bank regulation indicators. The country-level indicators were taken from *Caprio, Laeven and Levine (2007)*. All variables are described in table A.

Table 4: Country-level bank risk

	TSR_07/08		TOTAL_RISK		FIRM_RISK		EDF		Z-SCORE	
Country	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Austria	-27.44	-11.13	18.22	19.66	15.91	16.97	0.13	0.05	0.05	0.06
Denmark	-70.84	-69.26	21.02	21.42	20.22	20.92	0.05	0.04	0.03	0.03
Finland	-28.72	-28.72	11.24	11.24	10.52	10.52	0.06	0.06	0.02	0.02
France	-71.72	-69.65	15.92	14.84	13.70	11.48	0.05	0.06	0.04	0.03
Germany	-37.35	-31.31	24.29	19.47	24.01	18.13	0.19	0.11	0.13	0.12
Greece	-70.18	-69.63	28.01	22.98	24.99	19.40	0.06	0.07	0.08	0.09
Ireland	-94.06	-93.36	16.25	15.09	12.99	11.95	0.02	0.01	0.04	0.04
Italy	-48.65	-48.46	17.91	17.09	16.02	15.61	0.09	0.05	0.04	0.04
Netherlands	-10.64	-10.64	18.32	18.32	16.21	16.21	0.04	0.04	0.10	0.10
Portugal	-67.88	-71.25	21.92	20.78	20.21	19.39	0.06	0.03	0.08	0.03
Spain	-50.10	-49.06	15.35	14.81	12.97	11.63	0.02	0.02	0.04	0.05
Sweden	-57.14	-59.01	16.18	16.10	14.19	14.30	0.04	0.04	0.06	0.04
Switzerland	-23.45	-20.30	13.56	12.95	12.30	11.42	1.65	0.05	0.02	0.02
United Kingdom	-71.87	-75.32	14.88	15.85	12.38	12.97	0.08	0.04	0.04	0.03
United States	-36.88	-35.17	19.01	17.73	17.12	16.00	0.12	0.09	0.02	0.01
Total	-40.69	-43.92	18.7	17.56	16.86	15.56	0.21	0.07	0.03	0.02

Notes: The table reports descriptive statistics on our bank regulation indicators. The country-level indicators were taken from *Caprio, Laeven and Levine (2007)* downloaded from the World Bank homepage. All variables are described in table A.

Table 5: Regression analysis of compensation structure on regulation in 2006

Dep. variable	INC_REL		BONUS_REL		SBI_REL		INC_REL		BONUS_REL		SBI_REL	
Sample	Full sample						European banks					
Model	(1)		(2)		(3)		(4)		(5)		(6)	
Regulation												
REG	11.538	***	6.783	***	10.018	***	10.600	*	11.199	**	-14.042	
	(7.09)		(4.82)		(5.55)		(1.99)		(2.37)		(-1.50)	
ADRI_DLLS	5.211	**	2.689		7.018	***	4.277		2.779		4.896	
	(2.30)		(1.38)		(2.72)		(1.29)		(0.94)		(1.17)	
MCAP_GDP	-0.012		-0.085	***	0.078	***	0.046		-0.040		0.165	***
	(-0.37)		(-2.98)		(2.98)		(0.98)		(-0.94)		(2.88)	
Board & Ownership												
OW_MANAGEMENT	-0.002		0.147		-0.145		0.154		0.202		-6.795	
	(-0.020)		(1.43)		(-1.09)		(0.36)		(0.53)		(-0.45)	
OW_OUTSIDE	0.097		0.080		0.093		-0.130		-0.186		0.161	
	(1.34)		(1.28)		(1.25)		(-0.89)		(-1.42)		(1.04)	
CEO_DUAL	-1.557		-4.089	*	2.652		-13.665		-9.252		-27.707	
	(-0.62)		(-1.88)		(0.98)		(-1.00)		(-0.76)		(-1.48)	
BOD_NON_EXEC	-0.129		0.356		-0.617	*	1.154		2.523	***	-1.853	
	(-0.39)		(1.25)		(-1.69)		(1.27)		(3.09)		(-1.54)	
BOD_EXEC	-0.443		-0.481		-0.004		-1.200		-0.284		-1.921	
	(-0.94)		(-1.17)		(-0.01)		(-1.23)		(-0.31)		(-1.64)	
Bank Characteristics												
MCAP_LN	9.428	***	4.035	***	7.328	***	10.207	***	6.481	***	10.359	***
	(10.26)		(5.08)		(7.50)		(4.81)		(3.38)		(4.10)	
LEVERAGE	0.282	***	0.207	**	0.049		0.400	*	0.092		0.410	
	(2.80)		(2.40)		(0.45)		(1.74)		(0.45)		(1.43)	
ROE_LAG	0.176		0.441		-0.430		1.213		1.616	*	-0.008	
	(0.50)		(1.45)		(-1.12)		(1.31)		(1.92)		(-0.01)	
ROE	0.192		0.114		35.764		-1.136		-1.121		0.346	
	(0.54)		(0.37)		(0.93)		(-1.45)		(-1.60)		(0.35)	
TSR_LAG	0.093		0.012		0.096		0.064		-0.036		0.247	
	(1.63)		(0.24)		(1.53)		(0.52)		(-0.31)		(1.28)	
TSR	-0.055		0.093		-0.239	***	0.015		0.369	**	-0.870	***
	(-0.79)		(1.55)		(-3.10)		(0.09)		(2.32)		(-3.29)	
Industry-fixed effects	yes		yes		yes		yes		yes		yes	
No of observ.	315		315		335		85		85		116	

Notes: The table reports coefficients of tobit regressions of compensation variables on regulation and firm-specific control variables. Values in parentheses are robust t-statistics. All regression models are complemented by a set of industry dummies based on SIC industry code classification. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01

Table 6: Regression analysis of bank risk on total incentives and bank regulation

Dep. variable	-TSR_07/08		TOTAL_RISK		FIRM_RISK		EDF		Z-SCORE		PRE_RISK_SCORE	
Model	(1)		(2)		(3)		(4)		(5)		(6)	
Compensation												
INC_REL	0.331	***	0.039	**	0.044	***	0.001		0.0001	**	0.005	**
	(3.08)		(2.07)		(2.61)		(0.18)		(2.31)		(2.01)	
FIX_EX	0.008	***	0.001	***	0.001	***	-0.0001		0.0001		0.0001	
	(3.59)		(2.76)		(2.64)		(-0.24)		(0.51)		(1.12)	
Regulation												
REG	-4.920	**	-0.987	**	-1.063	***	-0.033		-0.009	***	-0.162	***
	(-2.05)		(-2.47)		(-2.82)		(-0.49)		(-3.86)		(-2.76)	
ADRI_DLLS	6.798	**	-0.523		-0.690		-0.038		-0.005		-0.092	
	(2.02)		(-0.95)		(-1.49)		(-0.34)		(-1.49)		(-1.28)	
MCAP_GDP	0.091	*	-0.013		-0.010		0.002		-0.0001		-0.0013	
	(1.81)		(-1.19)		(-1.01)		(1.12)		(-0.93)		(-0.81)	
Ownership												
OW_MANAGEMENT	0.236		0.121	***	0.118	***	0.005		0.001	**	0.012	***
	(1.38)		(3.50)		(3.36)		(1.35)		(2.19)		(3.62)	
OW_OUTSIDE	-0.056		0.009		0.004		0.003		0.0001		0.002	
	(-0.40)		(0.36)		(0.17)		(0.80)		(0.84)		(0.58)	
Bank Characteristics												
MCAP_LN	2.420		-1.718	***	-1.785	***	-0.337	***	-0.003	**	-0.217	***
	(1.44)		(-5.89)		(-6.75)		(-7.69)		(-2.18)		(-6.82)	
TIER1	-1.837	**	0.188		0.154		-0.039	**	0.0001		-0.002	
	(-2.51)		(1.52)		(1.30)		(-2.11)		(-0.52)		(-0.11)	
MTB	-17.473	***	1.687	***	1.675	***	-0.063		0.004		0.187	**
	(-3.97)		(2.65)		(2.95)		(-0.62)		(1.28)		(2.44)	
STAFF_INC	-3.392	***	0.251		0.347	*	-0.064	***	-0.001		-0.001	
	(-3.12)		(1.20)		(1.66)		(-2.60)		(-1.45)		(-0.06)	
LEVERAGE			0.028		0.021		0.012	**	0.001	***	0.006	
			(0.87)		(0.67)		(2.09)		(3.46)		(1.49)	
LOANS_TO_ASSETS	0.684	***										
	(4.79)											
TOTAL_RISK	2.061	***										
	(5.56)											
ROE	47.787											
	(0.79)											
TSR	-0.100											
	(-0.83)											
Industry-fixed effects	yes		yes		yes		yes		yes		yes	
No of observ.	297		297		297		302		265		248	
adj. R2	0.305		0.182		0.220		0.329		0.288		0.250	

Notes: The table reports coefficients of a OLS regression of risk measures on total incentives, bank regulation and firm-specific variables. t-statistics based on robust standard errors are reported in parentheses. All regression models are complemented by a set of industry dummies based on SIC industry code classification. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01

Table 7: Regression analysis of bank risk on compensation structure and bank regulation

Dep. variable	-TSR_07/08		TOTAL_RISK		FIRM_RISK		EDF		Z-SCORE		PRE_RISK_SCORE	
Model	(1)		(2)		(3)		(4)		(5)		(6)	
Compensation												
SBI_REL	0.356	***	0.004		0.022		-0.007	**	0.0001		-0.00001	
	(3.21)		(0.20)		(1.18)		(-2.10)		(1.10)		(-0.01)	
BONUS_REL	0.299	*	0.081	***	0.072	***	0.009	**	0.0001	**	0.010	***
	(1.92)		(3.59)		(3.49)		(2.53)		(2.49)		(3.40)	
FIX_EX	0.008	***	0.001	***	0.001	***	0.0001		0.0001		0.0001	
	(3.47)		(3.52)		(3.18)		(0.26)		(0.72)		(1.54)	
Regulation												
REG	-4.912	**	-0.945	**	-1.036	***	-0.026		-0.009	***	-0.145	**
	(-2.04)		(-2.41)		(-2.76)		(-0.38)		(-3.84)		(-2.56)	
ADRI_DLLS	6.754	**	-0.432		-0.630		-0.018		-0.005		-0.090	
	-2.020		(-0.77)		(-1.32)		(-0.16)		(-1.45)		(-1.21)	
MCAP_GDP	0.087	*	-0.007		-0.007		0.003		0.0001		-0.001	
	-1.730		(-0.67)		(-0.64)		-1.570		(-0.67)		(-0.41)	
Ownership												
OW_MANAGEMENT	0.241		0.110	***	0.110	***	0.0001		0.001	**	0.01	***
	(1.39)		(3.24)		(3.18)		(0.96)		(2.09)		(3.26)	
OW_OUTSIDE	-0.053		0.007		0.003		0.003		0.0001		0.002	
	(-0.38)		(0.27)		(0.11)		(0.75)		(0.77)		(0.49)	
Bank Characteristics												
MCAP_LN	2.408		-1.670	***	-1.753	***	-0.326	***	-0.003	**	-0.204	***
	(1.44)		(-5.86)		(-6.73)		(-7.56)		(-2.03)		(-6.70)	
TIER1	-1.848	**	0.189		0.155		-0.038	**	-0.0003		-0.002	
	(-2.49)		(1.60)		(1.34)		(-2.27)		(-0.54)		(-0.13)	
MTB	-17.592	***	1.596	**	1.614	***	-0.084		0.004		0.167	**
	(-4.01)		(2.51)		(2.83)		(-0.87)		(1.09)		(2.19)	
STAFF_INC	-3.369	***	0.192		0.308		-0.077	***	-0.001		-0.010	
	(-3.12)		(0.85)		(1.40)		(-3.22)		(-1.63)		(-0.46)	
LEVERAGE			0.018		0.014		0.009	*	0.001	***	0.005	
			(0.55)		(0.44)		(1.76)		(3.45)		(1.33)	
LOANS_TO_ASSETS	0.680	***										
	(4.67)											
TOTAL_RISK	2.083	***										
	(5.55)											
ROE	50.102											
	(0.81)											
TSR	-0.095											
	(-0.79)											
Industry-fixed effects	yes		yes		yes		yes		yes		yes	
No of observ.	297		297		297		302		265		248	
adj. R2	0.313		0.201		0.239		0.369		0.314		0.281	

Notes: The table reports coefficients of a OLS regression of risk measures on compensation structure, bank regulation and firm-specific variables. t-statistics based on robust standard errors are reported in parentheses. All regression models are complemented by a set of industry dummies based on SIC industry code classification and country dummies. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01

Table 8: Regression analysis of bank risk on interaction between compensation structure and bank regulation

Dep. variable	-TSR_07/08		PRE_RISK_SCORE		-TSR_07/08		PRE_RISK_SCORE	
Model	(1)		(2)		(3)		(4)	
Compensation								
INC_REL	0.402	***	0.004	*				
	(3.84)		(1.87)					
SBI_REL					0.359	***	-0.0003	
					(3.33)		(-0.14)	
BONUS_REL					0.439	***	0.0102	***
					(2.68)		(3.75)	
FIX_EX	0.009	***	0.0001		0.009	***	0.0001	
	(3.80)		(0.98)		(3.40)		(1.39)	
Regulation								
REG	-5.333	**	-0.162	***	-4.801	**	-0.143	**
	(-2.26)		(-2.74)		(-2.07)		(-2.51)	
ADRI_DLLS	7.376	**	-0.100		7.693	**	-0.096	
	(2.18)		(-1.36)		(2.28)		(-1.29)	
MCAP_GDP	0.103	*	-0.001		0.099	*	-0.001	
	(1.91)		(-0.69)		(1.87)		(-0.50)	
Regulation x Compensation								
REG x INC_REL	0.148	***	-0.001					
	(2.61)		(-0.61)					
REG x SBI_REL					0.100		-0.010	
					(1.32)		(-0.62)	
REG x BONUS_REL					0.182	**	0.0007	
					(2.15)		(0.38)	
Ownership								
OW_MANAGEMENT	0.292		0.009	***	0.262		0.011	***
	(1.52)		(2.80)		(1.58)		(3.17)	
OW_OUTSIDE	-0.040		0.003		-0.067		0.002	
	(-0.29)		(0.87)		(-0.50)		(0.51)	
Bank Characteristics								
MCAP_LN	1.519		-0.220	***	2.503		-0.198	***
	(0.93)		(-6.81)		(1.54)		(-6.17)	
TIER1	-2.044	***	-0.006		-1.939	**	-0.001	
	(-2.64)		(-0.44)		(-2.56)		(-0.12)	
MTB	-18.209	***	0.146	*	-17.789	***	0.159	**
	(-4.26)		(1.92)		(-4.20)		(2.15)	
STAFF_INC	-3.702	***	0.001		-3.912	***	-0.012	
	(-3.79)		(0.07)		(-4.06)		(-0.54)	
LEVERAGE			0.006				0.005	
			(1.60)				(1.35)	
LOANS_TO_ASSETS	0.572	***			0.602	***		
	(3.68)				(3.99)			
TOTAL_RISK	1.817	***			2.013	***		
	(4.71)				(5.39)			
ROE	0.408				0.327			
	(0.68)				(0.53)			
TSR	-0.127				-0.100			
	(-1.02)				(-0.83)			
Industry-fixed effects	yes		yes		yes		yes	
No of observ.	290		243		297		248	
adj. R2	0.316		0.249		0.313		0.281	

Notes: The table reports coefficients of a OLS regression of risk measures on the interaction of compensation structure and bank regulation. t-statistics based on robust standard errors are reported in parentheses. All regression models are complemented by a set of industry dummies based on SIC industry code classification. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01

Table 9: Simultaneous Regression analysis (3SLS) of pre-crisis risk score and compensation

Dep. variable	PRE_RISK_SCORE		SBI_REL		BONUS_REL	
Compensation						
SBI_REL	0.012					
	(0.92)					
BONUS_REL	0.034	***				
	(3.12)					
FIX_EX	0.000					
	(0.55)					
Risk						
PRE_RISK_SCORE			-6.83		13.02	
			(-0.80)		(1.51)	
Regulation						
REG	-0.213	**	4.008	***	4.334	***
	(-2.39)		(2.99)		(3.24)	
ADRI_DLLS	-0.121		1.907		1.543	
	(-1.50)		(0.97)		(0.78)	
MCAP_GDP	0.002		0.054	*	-0.077	***
	(1.11)		(1.91)		(-2.72)	
Bank Characteristics						
LEVERAGE	0.005					
	(1.29)					
MTB	0.003					
	(0.06)					
TIER1	0.015					
	(0.94)					
STAFF_INC	-0.017					
	(-0.57)					
MCAP	-0.333	***	5.136	***	4.838	***
	(-3.64)		(3.64)		(3.41)	
TSR_LAG			0.078		0.033	
			(1.30)		(0.61)	
TSR			-0.117	*	0.057	
			(-1.68)		(0.90)	
ROE_LAG			-0.282		0.195	
			(-0.88)		(0.76)	
ROE			0.088		0.243	
			(0.27)		(0.91)	
BOD_NEXEC			-0.647	**	0.240	
			(-2.11)		(0.89)	
Industry-fixed effects	yes		yes		yes	
No of observ.	277		277		277	

Notes: The table reports coefficients of a three-stage least square regression (3sls) estimating simultaneously the relation between pre-crisis risk score and compensation in 2006. t-statistics based on robust standard errors are reported in parentheses. All regression models are complemented by a set of industry dummies based on SIC industry code classification. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01

Table 10: Regression analysis of alternative tail risk measures

Dep. variable	-TSR_07/08		-TSR_08		-TSR_LEHMAN	
Panel A: Full sample						
Model	(1)		(2)		(3)	
Compensation						
SBI_REL	35.952	***	33.111	***	29.599	***
	(3.33)		(2.85)		(2.89)	
BONUS_REL	43.989	***	39.811	**	39.213	***
	(2.68)		(2.36)		(3.16)	
FIX_EX	0.009	***	0.009	***	0.007	***
	(3.40)		(3.56)		(3.21)	
Regulation						
REG	-4.801	**	-5.426	**	1.647	
	(-2.07)		(-2.37)		(0.73)	
ADRI_DLLS	7.693	**	7.259	**	8.368	***
	(2.28)		(2.07)		(2.62)	
MCAP_GDP	0.099	*	0.078		0.128	**
	(1.87)		(1.41)		(2.35)	
Regulation x Compensation						
REG x SBI_REL	10.019		16.671	**	1.476	
	(1.32)		(2.02)		(0.18)	
REG x BONUS_REL	18.255	**	18.521	**	7.417	
	(2.15)		(2.20)		(0.98)	
Ownership						
OW_MANAGEMENT	0.262		0.223		0.268	**
	(1.58)		(1.23)		(2.13)	
OW_OUTSIDE	-0.067		-0.024		-0.140	
	(-0.50)		(-0.19)		(-1.02)	
Bank Characteristics						
MCAP_LN	2.503		2.134		1.094	
	(1.54)		(1.26)		(0.72)	
TIER1	-1.939	**	-1.681	**	-1.801	***
	(-2.56)		(-2.31)		(-2.72)	
MTB	-17.789	***	-17.094	***	-14.362	***
	(-4.20)		(-3.93)		(-3.85)	
STAFF_INC	-3.912	***	-3.680	***	-3.991	***
	(-4.06)		(-3.57)		(-4.58)	
LOANS_TO_ASSETS	0.602	***	0.414	**	0.746	***
	(3.99)		(2.52)		(5.04)	
TOTAL_RISK	2.013	***	1.896	***	1.582	***
	(5.39)		(4.52)		(4.58)	
ROE	32.654		47.238		29.811	
	(0.53)		(0.75)		(0.54)	
TSR	-0.100		-0.109		0.080	
	(-0.83)		(-0.81)		(0.73)	
Industry-fixed effects	yes		yes		yes	
No of observ.	297		297		297	
adj. R2	0.313		0.283		0.294	

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Panel B: Large banks						
Model	(1)		(2)		(3)	
Compensation						
SBI_REL	32.377	**	29.406	**	25.316	*
	(2.30)		(2.17)		(1.77)	
BONUS_REL	28.815		30.257		38.665	**
	(1.36)		(1.50)		(2.21)	
FIX_EX	0.0077	**	0.0080	***	0.0076	**
	(2.47)		(2.64)		(2.25)	
Regulation						
REG	-3.098		-3.068		1.192	
	(-0.88)		(-0.95)		(0.34)	
ADRI_DLLS	5.581		5.580		8.674	**
	(1.52)		(1.50)		(2.34)	
MCAP_GDP	0.042		0.005		0.092	
	(0.66)		(0.09)		(1.35)	
Regulation x Compensation						
REG x SBI_REL	10.473		17.926	*	2.697	
	(1.06)		(1.70)		(0.25)	
REG x BONUS_REL	18.975		22.662	**	19.296	*
	(1.65)		(2.04)		(1.89)	
Ownership						
OW_MANAGEMENT	0.071		-0.076		0.024	
	(0.33)		(-0.31)		(0.12)	
OW_OUTSIDE	-0.008		0.121		-0.122	
	(-0.04)		(0.67)		(-0.56)	
Bank characteristics						
MCAP_LN	5.419	**	6.825	***	0.363	
	(2.11)		(2.95)		(0.13)	
TIER1	-1.722		-1.221		-1.962	*
	(-1.44)		(-1.31)		(-1.84)	
MTB	-21.475	***	-18.473	***	-19.666	***
	(-3.62)		(-3.22)		(-3.37)	
STAFF_INC	-16.201	*	-18.124	**	-15.652	**
	(-1.92)		(-2.22)		(-2.08)	
LOANS_TO_ASSETS	0.516	**	0.320		0.544	**
	(2.50)		(1.49)		(2.48)	
TOTAL_RISK	2.096	***	2.297	***	1.919	***
	(3.60)		(4.38)		(3.22)	
ROE	1.638	*	1.500	*	1.123	
	(1.90)		(1.90)		(1.35)	
TSR 2006	0.059		0.042		0.129	
	(0.34)		(0.24)		(0.75)	
Industry-fixed effects	yes		yes		yes	
No of observ.	145		145		145	
adj. R2	0.342		0.388		0.266	

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Panel C: European banks						
Model	(1)		(2)		(3)	
Compensation						
SBI_REL	120.267		107.386		173.914	*
	(1.46)		(1.14)		(1.95)	
BONUS_REL	60.065		70.912	*	77.086	**
	(1.59)		(1.78)		(2.14)	
FIX_EX	0.0044		0.0050		0.0022	
	(1.16)		(1.28)		(0.57)	
Regulation						
REG	-4.341		-6.447		-3.295	
	(-0.59)		(-0.84)		(-0.42)	
ADRI_DLLS	4.417		4.630		3.251	
	(1.42)		(1.40)		(1.03)	
MCAP_GDP	-0.045		-0.060		0.028	
	(-0.60)		(-0.79)		(0.37)	
Regulation x Compensation						
REG x SBI_REL	48.391		52.187		67.917	
	(1.19)		(1.22)		(1.52)	
REG x BONUS_REL	34.885	*	42.814	**	36.085	
	(1.72)		(2.11)		(1.65)	
Ownership						
OW_MANAGEMENT	0.244		0.209		0.223	
	(1.33)		(1.00)		(1.18)	
OW_OUTSIDE	-0.170		-0.049		-0.242	
	(-0.79)		(-0.26)		(-0.94)	
Bank Characteristics						
MCAP_LN	-0.850		-0.001		-0.499	
	(-0.28)		(-0.00)		(-0.14)	
TIER1	-1.274		-1.237		-2.262	
	(-0.86)		(-0.89)		(-1.32)	
MTB	4.861		8.181		0.184	
	(0.56)		(0.94)		(0.02)	
STAFF_INC	-1.657		0.056		-7.241	
	(-0.19)		(0.01)		(-0.77)	
LOANS_TO_ASSETS	-0.275		-0.475		0.073	
	(-0.99)		(-1.57)		(0.26)	
TOTAL_RISK	0.333		0.606		0.055	
	(0.45)		(0.85)		(0.08)	
ROE	87.207		64.392		79.201	
	(0.98)		(0.76)		(0.89)	
TSR	0.128		0.000		0.331	*
	(0.69)		(-0.00)		(1.82)	
Industry-fixed effects	yes		yes		yes	
No of observ.	79		79		79	
adj. R2	0.139		0.154		0.162	

Notes: The table reports coefficients of OLS regressions of alternative risk tail measures on the interaction of compensation and regulation. Panel A reports results for all banks (Europe & US). Panel B reports regression results only for large banks. Large banks are banks located above the median of the sample distribution of market capitalization. Panel C reports regression results only for European banks. t-statistics based on robust standard errors are reported in parentheses. All regression models are complemented by a set of industry dummies based on SIC industry code classification. All variables are described in table A. * if p<0.1, ** if p<0.05, *** if p<0.01