CENTER FOR TAX AND ACCOUNTING RESEARCH

TAXATION, ACCOUNTING, AND FINANCE

TAF WORKING PAPER

No. 6 / January 2015

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forthcoming in Quarterly Review of Economics and Finance (2015)

University of Paderborn
www.taf-wps.cetar.org

Risk-taking incentives through excess variable compensation

Evidence from European banks

André Uhde*

Abstract: Employing compensation data provided by 63 banks from 16 European countries for the period from 2000 to 2010 this paper empirically investigates the impact of excess variable compensation on bank risk. As a main finding, we provide evidence for a risk-increasing impact of excess variable pay for both executive variable cash-based and variable equity-based compensation. This baseline finding holds under various robustness checks, in particular when controlling for likely reverse causality between bank risk and variable compensation by employing Granger-causality tests and instrumental variable regressions. In addition, results from a large number of sensitivity analyses including board and banking characteristics as well as the financial crisis period and the quality of a country's regulatory framework provide further important implications for banking regulators and politicians in Europe.

JEL classification: G21, G28, G32, J33

Keywords: Banking, Executive compensation, Risk-taking, Financial Stability

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1 Introduction

The global financial crisis from mid-2007 has sparked a new heated discussion among politicians, regulators and academics concerning compensation practices in banking. In particular, many critics demand a strict regulation of bank executives' remuneration since it is suggested that especially incentives from variable compensation packages in banks may have provoked a significant increase in managerial risk-taking and hence, may have been an additional cause of the financial crisis (Board of Governors, 2010; FSB, 2009; Bebchuk and Spamann, 2010).

The noisy debate on managerial compensation in banking is clearly fueled by theoretical predictions suggesting that risk-taking incentives from variable pay packages are expected to be much stronger at banks than at non-financial companies (e.g., Mehran et al., 2011). The reason is that banks are highly leveraged and, under limited liability, bank managers can shift risk to dispersed and unsophisticated debtholders. In the presence of deposit insurance schemes and implicit governmental bail-out guarantees under the "too-big-to-fail" doctrine, this risk shifting-mechanism becomes even more relevant and can additionally affect taxpayers.

Accordingly, in 2009 the Financial Stability Board (FSB) responded to the G20 Finance-Ministers' and Governors' call for detailed global standards on pay structures, greater disclosure and transparency in banking (FSB, 2009). In particular, *FSB Principles for Sound Compensation Practices* focus on (1) a deferral of variable compensation payments in order to reward long-term success rather than short-term risk-taking, (2) the implementation of claw-back provisions that allow recouping variable payments if management decisions fail later on, (3) the payment of bonuses by means of stock options rather than cash and (4) a cap of the proportion of total variable compensation.

As regards the latter principle, in 2013 the European Parliament and Council have decided that annual bonuses for European bank executives must not exceed their annual fixed salary in general. In exceptional cases, the bonus may reach a maximum of twice the salary, provided that 65% of shareholders owning half the shares represented, or 75% of votes if there is no quorum, agree to the increase. In addition, if variable payments exceed annual fixed salaries, then 25% of the entire bonus would be deferred for at least five years in order to encourage bank executives to take a long-term view during their management decisions. Respective regulations are included in the new *European Capital Requirements Directive (CRD IV, 2013)* transforming forthcoming *Basel III-regulations* into European banking law. Regulations apply to all bank executives working within the EU as well as employees of European bank subsidiaries abroad. As a consequence, several large European banks have simply increased annual fixed salaries for CEOs in order to bypass the cap of the current total amount of variable compensation. Moreover, it is feared that European banks will lose a competitive edge and that talented bank managers will be forced to move to more attractive financial centers outside Europe.

Against this background, the empirical study at hand sheds a brighter light on the relationship between variable compensation and managerial risk-taking in European banking. Our study complements and extends two previous studies for Europe (Vallascas and Hagendorff, 2013; Ayadi et al., 2011) in several aspects. First of all, a unique hand-collected data set is employed which includes compensation data provided by the largest 63 European banks from 16 European countries. This is, to best of our knowledge, the largest sample of compensation data from European banks so far. Second, stretching over the period from 2000 to 2010 the panel data set enables us to separately invest the impact of variable compensation on bank risk before and during the financial crisis period. Third, in contrast to previous related studies focusing on Europe (and the USA), the analysis at hand is extended to non-stock listed banks as well as savings banks and cooperative banks and hence, provides further important insights regarding the relationship between variable pay and managerial risk-taking incentives at these banking institutions. Fourth, in contrast to previous studies for Europe we employ a measure of *excess* variable compensation that is determined by other factors beyond bank size, namely managerial talents and quality. And fifth, likely reverse causality between managerial compensation and bank risk is addressed by Granger-causality tests and instrumental variable regressions.

As a core result, we provide empirical evidence of a risk-increasing impact of executive variable compensation with regard to both variable cash-based and variable equity-based payment arrangements. This baseline finding holds under various robustness checks while results from various sensitivity analyses offer further important insights into the compensation-risk nexus. Overall, the analysis at hand provides important implications for banking regulators and politicians, especially with regard to the FSB's principles on sound compensation practices and the European Parliament's decision to establish a regulatory cap of executive variable compensation in European banking.

The remainder of this paper is organized as follows. Section 2 provides a theoretical discussion of risk-taking incentives through executive variable compensation. Subsequently, Section 3 reviews previous related empirical studies for Europe. Section 4 presents the empirical methodology. While data and sources are described in Section 4.1, the empirical model is introduced in Section 4.2. Section 5 presents empirical results and finally, Section 6 summarizes and concludes.

2 Risk-taking incentives through executive variable compensation

Following the Merton framework (1973, 1974), bank shareholders hold an implicit contingent claim on the residual value of a bank's total assets. And much as in call options, shareholders' returns increase with the riskiness of the underlying assets since downside risks are borne by the bank's debtholders, regulators and taxpayers. Bank executives, in contrast, have personal wealth portfolios largely undiversified but concentrated in the bank they manage (Murphy, 1999). Therefore, executives are assumed to behave risk averse, protecting their personal wealth probably by passing up high-risk investments which, however, exhibit positive net present values. In order to solve this trade-off and to minimize agency costs, agency-based theories suggest that bank shareholders should design compensation contracts in ways that shareholders' and executives' interests are closely aligned (e.g., Smith and Watts, 1992). In particular, incentives through variable compensation packages could be set that encourage bank executives to adopt more risky but shareholder value-maximizing investment strategies.

Especially with regard to the banking industry the effectiveness of risk-taking incentives from executive variable compensation is expected to be high (Mehran et al., 2011; Bolton et al., 2011; Chesney at al., 2010). The reason is that banks are highly leveraged and, under limited liability, executives can shift bank risk to dispersed and unsophisticated debtholders who are not able to charge a sufficient risk premium and monitor the bank's activities perfectly due to greater opaqueness and complexity as compared to non-financial institutions (Bebchuk and Spamann, 2010; Caprio and Levine, 2002; John et al., 2000; Houston and James, 1995; Saunders et al., 1990). In addition, in the presence of deposit insurance schemes (not fully based on risk-adjusted premiums) and implicit governmental bail-out guarantees under the "too-big-to-fail" doctrine, the risk shifting-mechanism becomes even more relevant since an increase in bank risk raises the value of the put option granted to shareholders by the deposit insurance and government (Bolton et al., 2011; John et al., 2010; Jeitschko and Jeung, 2005; John and Qian, 2003; Crawford et al., 1995). Subsequently, as deposit insurance and bail-out guarantees may weaken market discipline, risk may additionally be shifted to regulators and taxpayers (Chaigneau, 2013; Beltratti and Stulz, 2012). Thus, provided that the agency conflict between shareholders and executives may effectively be externalized to third parties, compensation contracts in banks may not only include risk-taking incentives set by shareholders but may also reflect bank executives' intrinsic risk preferences resulting from variable payments (Bebchuk et al., 2010, Murphy, 1999, Houston and James, 1995).

Incentives for managerial risk-taking may generally be set by designing respective variable cash-based or variable equity-based compensation contracts. *Variable cash-based compensation* in banks is usually paid as a yearly cash bonus subject to reaching certain performance-based targets derived from accounting data of the past (Murphy, 2000). After having exceeded a specific threshold, bonus payments typically increase linear with bank performance but may be capped by a maximum payout (Smith and Stulz, 1985).

Basically, it is suggested that cash bonuses should be positively related to managerial risk-taking if executives indeed take high risks to meet short-term performance targets and hence, to gain short-term bonuses at the expense of a long-term productive effort (Hakenes and Schnabel, 2014; FSB, 2009; Holthausen et al., 1995). This so-called "*short-termism*" should become even more relevant for long-term investment projects when it is unclear if the anticipated performance will be realized, and when it is difficult to claw back overpaid cash bonuses from executives. Similarly, short termism may play an important role for financially distressed banks if it is assumed that short-term bonus payments may set an incentive to gamble for resurrection and to maximize the value of the financial safety net provided that risk-shifting opportunities exist and the bank's charter value is low (Freixas and Rochet, 2013; Hakenes and Schnabel, 2014; Houston and James, 1995; Keeley, 1990).

Nevertheless, due the bonus plan's specific payout structure, the incentive for greater risk-taking may only be effective as long as the performance-based target is not met. In this case the bonus plan may be described as a call option for bank executives on the performance-based threshold (Vallascas and Hagendorff, 2013). However, once the threshold (and bonus cap) is exceeded, further risk-taking will not be rewarded (Jenson and Murphy, 1990; Smith and Stulz, 1985). In addition, as cash bonuses are contingent on the financial solvency of the bank it is also suggested that they may mitigate excessive risk-taking for larger bonuses beyond the threshold (Acrey et al., 2011; John and John, 1993). Similarly, excessive risk-taking may be less likely under cash-based bonuses as the focus is on accounting measures, which more directly link to investment decisions taken by executives than stock price volatilities in the context of equity-based compensation (Barclay et al., 2005). And finally, it is also proposed that deferred cash compensation may distort greater risk-taking since deferred payments have debt-like characteristics, i.e. they are unsecured future claims (Bolton et al, 2011; Bebchuk and Spamann, 2010; Edmans and Liu, 2011). Against this background, we expect an ambiguous impact of cash-based pay on bank risk.

Turning to *equity-based pay*, this compensation component is typically provided as stock options or as restricted stocks from the bank the executive manages. Typically, both types of equity-based compensation are granted together with a vesting period where executives are not allowed to exercise options or sell stocks. Both in theoretical and empirical work it is commonly suggested that equity-based compensation may closely align executives' decisions with the value-maximizing objectives of shareholders, thus providing incentives for executives to greater risk-taking. Restricted stocks may implicitly induce risk-taking if they are conditional on certain performance targets that need to be reached during the vesting period. Stock options ("at the money") may increase the sensitivity of executives' wealth to stock return volatility (Guay, 1999), may set incentives for executives to overcome their risk aversion in order to raise the values of the options granted (Aggarwal and Samwick, 2003) and thus, may incentivize executives to engage in greater risk-taking in the long run if the stock market is efficient (Fahlenbrach and Stulz, 2011; Hagendorff and Vallascas, 2011; Chen et al., 2006; Coles et al., 2006; Murphy, 1999).

However, the effectiveness of risk-taking incentives inherent in option holdings may be mitigated by different aspects. If, ceteris paribus, option-based compensation increases, the executive's personal wealth portfolio becomes less diversified but more concentrated in the bank he manages. As a consequence, executive's risk aversion may rise with an increasing level of entrenchment so that he may not want to jeopardize his personal wealth portfolio with risky investment decisions (Ross, 2004; Chen et al., 1998; Smith and Stulz, 1985). Similarly, wealth portfolio effects from large equity holdings may reduce the executive's risk appetite since risk incentives through option-based compensation may be diluted in the executive's personal portfolio if he holds a large proportion of (restricted) shares from the bank he manages (Houston and James, 1995). Furthermore, if options get "into the money" over time, payoffs from stock options become concave resulting in an increase in risk aversion (Parrino et al., 2005). Related and one step further, the risk-reducing effect from concave payoffs may even outweigh the risk-taking incentives from stock option-based compensation if options are "deep in the money". Against this background, we expect an ambiguous relationship between equity-based compensation and executive risk-taking as well.

3 Previous related empirical studies for Europe

A large part of research so far has focused on the relationship between CEO compensation and bank performance while the risk-taking effect has been implicitly analyzed (e.g., Gregg et al., 2012). In contrast, a considerably smaller but fast-growing number of empirical studies investigate the direct impact of CEO pay on bank risk-taking (Mehran et al., 2011 provide a comprehensive survey) while a few analyses focus on the compensation-risk relationship with a special emphasis on the recent financial crises (Srivastav et al., 2014; Bhagat and Bolton, 2014; Bosma and Koetter, 2013; Beltratti and Stulz, 2012; Fahlenbrach and Stulz, 2011; Balachandran et al., 2010). In this context, however, the majority of studies investigate the compensation-risk linkage in the US context while primarily focusing on stock-option based compensation and its impact on aligning interests between bank shareholders and CEOs. In contrast, to the best of our knowledge, only two cross-country related empirical studies analyze the impact of variable compensation on managerial risk-taking using data from European banks.

To begin with, Vallascas and Hagendorff (2013) employ data on cash bonus compensation from a mixed sample of 117 stock-listed banks (thereof 41 European banks) for the period from 2000 to 2008. Their measure of cash compensation includes basic salary, cash bonuses and other forms of cash compensation while bank risk is proxied by the bank’s distance to default. The authors provide empirical evidence that an increase in CEO cash bonus payments generally reduces the default risk suggesting that bonus payments are contingent on the bank’s solvency and thus, mitigate managerial (excessive) risk-taking. However, further sensitivity analyses reveal that bonus pay induces managerial risk-taking if banks are financially distressed or operate under a weak regulatory framework indicating that banks seek to maximize the value of the financial safety net by shifting risk to weak regulators (and taxpayers).

Ayadi et al. (2011) use compensation data from 53 stock-listed and non-stock listed, systemically important European banks over the period from 1999 to 2009. Bank risk is proxied by the *z*-score and by different market-based risk measures (total, idiosyncratic, systematic and interest-rate risk) during further robustness checks. The compensation measure includes option plans and annual cash bonuses. The authors provide evidence that option plans and annual bonuses do not increase bank risk in general whereas long-term performance bonus plans deteriorate banking stability. Moreover, the analysis reveals a reverse relationship between bank risk and executive compensation, i.e. (i) long-term performance bonus plans are more likely under increasing systematic risk, and (ii) distressed banks substitute fixed basic salaries by annual bonus payments.

4 Empirical methodology

Table 1 (Statistical Appendix) reports the geographical distribution of the entire 63 European banks in our sample and indicates the time periods for which total variable compensation data is available. While Table 2 includes notes on variables and data sources, Table 3 presents descriptive statistics for the variables employed. The development of bank-averaged *z*-score values and averaged variable compensation volumes over the entire sample period is illustrated in Figure 1.

4.1 Data and sources

Variable compensation measures

In contrast to their US counterparts, the majority of banks in the EU-27 are far away from publishing compensation data on a large scale and in great detail. Furthermore, only the largest banking institutions provide information on managerial compensation in their balance sheets. Accordingly, we start our analysis by examining bank balance sheets from the 10 largest domestic banks (either stock-listed or non-stock listed) operating in each of the 27 European countries. We have to adjust the initial sample of 270 banks as follows. First of all, banks must provide data on executive compensation and specific board characteristics for at least three consecutive years to be included in our sample.[2] In addition, we do not include banks that only disclose the amount of executives' total compensation. Instead, we only collect data from banks whose total compensation can be at least sorted into fixed compensation and variable compensation regardless of other compensation packages such as contributions to pension funds, non-cash pay or benefits in kind. As a result, data on executive compensation and board characteristics is retrieved from 63 banking institutions located in 16 European countries for the period from 2000 to 2010. To the best of our knowledge, this is still the largest sample of compensation data from European banks. Banks in our sample and respective periods of total variable compensation are presented in Table 1 in the Appendix. The fraction of stock-listed (non-stock-listed) banks is at 63% (37%), while the sample includes private commercial banks (71%) as well as the group of government-owned banks, savings banks and cooperative banks (29%).

Executive compensation in European banking usually comprises of annual fixed salaries, variable cash-based pay (bonuses), variable equity-based pay (restricted shares and stock options) and other components. Our analysis focusses on *total variable compensation* (including cash- and equity-based pay) and its likely risk-taking incentives for bank executives. In this context, while it is an implicit standard in executive compensation literature to treat CEO compensation as representative for the entire firm, concerns are raised and evidence is provided that rather incentives from non-CEO compensation may induce greater managerial risk-taking (e.g., Kim et al., 2011). Thus, as CEOs alone might not be responsible for accumulating higher bank risk, we employ yearly-aggregated amounts of total variable compensation of the highest paid executives in

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[2] Due to a wave of mergers and acquisitions (M&A) within the European banking industry between 1997 and 2007 some banks in our sample no longer existed when compensation data were collected at the end of 2011. We have considered this problem by including both the acquirer and target until the final closing of the legal M&A transaction and keeping the acquirer or combined company in our sample from that point in time. Similarly, some banks went insolvent during the sample period. These banks are kept in the sample until the year their business was closed. We control for the viability of our baseline findings by excluding these banks from the sample as a robustness check. Since results do not remarkably differ from baseline findings, we do not comment them separately in this paper but provide results on request.

European banking, i.e. the members of the management board or the executive members of the board of directors including CEOs and CFOs.

Depending on the disclosure level and bank type, total variable compensation from our sample can further be separated into cash-based and equity-based compensation. *Cash-based compensation* in European banks is usually denoted as *bonus* in annual reports and is seen as a short-term incentive component based on accounting-based measures of performance. Unfortunately, however, most European banks do not provide much information on underlying performance measures, performance targets or caps concerning executive cash-based bonus pay. *Equity-based compensation* is considered as a long-term incentive component of compensation in annual reports while the largest fraction of equity-based compensation in our sample is made up of stock options measured by the value of stock options granted. However, only a few stock-listed banks in our sample provide further information, for example on grant dates, number of options granted, exercise prices, vesting periods or delta and vega of stock options.

On average, total variable pay in our sample covers 59 percent of the total amount of executive compensation. Cash-based pay accounts for 43 percent of total variable pay and consequently, the fraction of equity-based compensation is at 57 percent. As shown more precisely in Table 3, the mean value of total variable compensation is at €5,699,300 with a maximum value of €156,010,000.[3] A high standard deviation of €14,605,200 indicates a wide spread of total variable compensation in European banks in our sample. As further shown, equity-based compensation exceeds cash-based pay on average while the standard deviation of equity-based compensation is remarkably higher than it is for cash-based payments. Among our sample banks *UBS AG* exhibits the maximum value of aggregated total variable compensation of €156,010,000 in 2006 whereas *Länsförsäkringar AB* paid €100,000 as the lowest (apart from zero-values) amount of total variable compensation in 2010. The highest aggregated amount of variable cash-based compensation of €66,750,000 is provided by *UBS AG* in 2006 whereas the lowest amount of €130,000 is paid by

3 Some banks in our sample suspended variable pay to managers, in particular during the financial crisis period (2008-2010). As a consequence, variable compensation in our sample exhibits a minimum value of zero.

SNS Reaal NV in 2008. Finally, *Credit Suisse Group AG* exhibits the highest aggregated value of variable equity-based compensation of €89,260,000 in 2009 while *ABN Amro Holding NV* paid €30,000 as the lowest amount of equity-based compensation in 2009.

Figure 1 illustrates the development of the bank-averaged *z*-score and total variable compensation (cash-based and equity-based) over the entire sample period from 2000 to 2010. As shown, average total variable compensation decreases moderately during the dot-com crisis until 2003 and follows an increase in banking stability with a certain delay for the period between 2001 and 2003. Subsequently, a sharp increase in variable compensation is observed during the economic boom-phase in Europe between 2003 and 2007 while banking stability does not vary remarkably during this time period. With the beginning of the recent global financial crisis in mid-2007, *z*-score and compensation values drop sharply under their absolute values from the year 2000 clearly indicating that the recent financial crisis has induced a sharp decrease of both total variable compensation and bank soundness.

Due to the fact that only the largest banks in Europe report compensation data in detail, we do not employ absolute values of variable compensation but rather use measures of excess variable pay. The measure of *excess variable compensation* per bank *i* at time *t* is defined as the residuals of a regression of compensation on bank size proxied by the log of total assets while including country dummies and time dummies. Accordingly, the excess measure describes the level of executive variable pay that is determined by further factors beyond bank size, in particular by differences in managerial talents and quality (see also Gabaix and Landier, 2008).[4] The strategy to employ excess compensation is rational for the following reasons. First, we observe a strong correlation between "raw" compensation measures, bank size and size-related bank-specific control variables for our sample of banks. Thus, including bank size as a further control variable would lead to collinearity problems and would provoke biased estimation results. Second, a strong relationship between firm

[4] Banks exhibiting high excess variable compensation in our sample include *UBS AG, Credit Suisse Group AG* and *Deutsche Bank AG* whereas the lowest excess variable compensation is observed for *BNP Paribas, Royal Bank of Scotland Group Plc.* and *Credit Agricole S.A.*

(bank) size and compensation levels is commonly proposed by related research (e.g., Jensen and Murphy, 1990). However, as the study at hand does not focus on explaining different levels of executive compensation in banks but rather investigates risk-taking incentives through variable compensation, we propose a "size-corrected" compensation measure to be more expedient. Third, hand-collected data on executive compensation is primarily retrieved from the largest European banks since smaller European banks hardly disclose any information on their compensation structures. Hence, a self-selection bias could arise which, however, may be partly mitigated when employing a measure of excess compensation and hence, correcting for bank size.[5]

Z-score

Taking into account that our sample includes both stock-listed and non-stock listed banks, bank risk is proxied by the *z*-score as our main dependent variable.[6] Derived from the original measure as proposed by Altman (1968), the *z*-score is widely used to analyze the determinants of bank risk-taking (e.g., Schaeck and Čihák, 2012; Altunbas et al., 2011; Demirgüc-Kunt and Huizinga, 2010; Uhde and Heimeshoff, 2009; Foos et al., 2009; Boyd and De Nicoló, 2006; Beck et. al., 2006) and is also employed in recent CEO compensation literature (e.g., Bhagat and Bolton, 2014; Chemmanur et al., 2013; Laeven and Levine, 2009).

Using annual consolidated bank balance sheet data from *Fitch's BankScope database* the *z*-score per bank *i* in year *t* is defined as:

$$z\text{-}score_{i,t} \equiv \frac{ROAA_{i,t} + CAR_{i,t}}{\mathrm{SD}(ROAA)_{i,t}}, \tag{1}$$

5 As discussed in Section 4.2, a fixed-effects OLS model on panel data is employed during the empirical analysis. As regards baseline estimations, we additionally perform a standard two-step Heckman (1979) procedure to control for a potential selectivity bias. However, since estimations results do not remarkably differ from OLS results, we do not provide them in this paper but provide results on request.

6 Note, that the *z*-score measure is substituted by different market-based measures for a subsample of stock-listed banks during further sensitivity analyses in Section 5.3.2.

where *ROAA* is the bank's return on average assets, *CAR* is the bank's capital ratio defined as equity capital to total assets and *SD(ROAA)* is calculated as a three-year rolling window standard deviation of ROAA. Building the *z*-score this way, it is a measure of bank stability and indicates the distance from insolvency, combining accounting measures of profitability, leverage and volatility. Defining bank insolvency as a state where $ROAA + CAR \leq 0$, the *z*-score is designed to indicate the number of standard deviations a bank's asset return has to drop below its expected value before the bank's equity is depleted and it becomes insolvent. Accordingly, as the *z*-score is the inverse of the probability of bank insolvency a higher (lower) *z*-score indicates that a bank incurs fewer (more) risks and is more (less) stable.

Following Strobel (2014) the *z*-score measure may suffer from being upwardly biased, i.e. the *probability* of bank insolvency may be overestimated for lower *z*-score ratios, which becomes even more important for our sample of banks during the financial crisis period. Although the *z*-score may be described as a conservative measure from the regulators' point of view in this context, we correct for this potential bias by including the natural log of the *z*-score following Houston et al. (2010) and Laeven and Levine (2009). Since the distribution of the log of the *z*-score is heavily skewed for our sample of banks whereas the distribution of the traditional *z*-score is not, the log of the *z*-score may be more ideally interpreted as a risk measure that is negatively proportional to a bank's log *odds* of insolvency, which is a more meaningful interpretation when using the *z*-score as a dependent variable in standard regression analyses.

Further control variables

When investigating the impact of executive variable compensation on bank risk it is imperative to control for further macroeconomic, bank-specific and institutional factors that are likely to affect banking stability and hence, help mitigate omitted variable biases. While we employ a variety of further variables to control for different board and banking characteristics, the recent financial crisis as well as the regulatory framework during respective sensitivity analyses in Section 5.3, our baseline model includes "fixed" control variables as follows.

Macroeconomic control variables are retrieved from the *World Development Indicators (WDI)* provided by the *World Bank* and from *Thomson Reuter's Datastream*. We include the log of real GDP per country (*GDP*) to control for country differences as regards the state of the economy and the slope of the yield curve (*Slope*) as a leading indicator for future prospects of the economy. Consolidated bank-specific accounting data are obtained from *Fitch's BankScope database*. Variables are included to control for the banks' leverage (*Leverage*), the ratio of regulatory Tier1 capital to risk-weighted assets (*Tier1*) and the bank's liquidity ratio (*Liquidity*).[7]

4.2 Empirical model

The impact of executive variable compensation on bank risk is estimated by employing a linear model on panel data:

$$y_{it} = \alpha_{it} + \beta_1 c_{it-1} + \sum \beta_k x_{it,k} + \varepsilon_{it}, \tag{2}$$

where y_{it} represents the *z*-score of bank *i* in a respective year *t* and c_{it-1} is the one-period lagged excess variable compensation paid to executives at bank *i* in a respective year *t*. The vector $x_{it,k}$ includes macroeconomic and bank-specific control variables as described above. ε_{it} is an error term and α and the β's denote the parameters to be estimated. Excess variable compensation measures are lagged for one period in order to (i) basically address possible reverse causality between bank risk and compensation (see also Section 5.2.1) and (ii) appropriately allow time for potential risk-taking incentives inherent in variable compensation structures. Moreover, lagging for

[7] As shown in Table 9a, the correlation between both *Leverage* and *Tier1* and the *z*-score measure is low which justifies the inclusion of these control variables on the right hand side of the regression specification. In addition, baseline results from these control measures are reiterated even when substituting the *z*-score by market-based risk measures in further sensitivity analyses.

one period additionally mitigates simultaneity and collinearity as regards further employed unlagged (bank-specific) control variables.

We utilize a bank-specific fixed effects model and set time dummies to control for time-specific effects (e.g., a change of supply or demand for managerial talents; trends in banking regulation; common shocks to the European banking market).[8] In addition, since the level and frequency of variable compensation remarkably differs between banks in our sample, we address heterogeneity in executive pay by clustering standard errors at the bank-level. We use the generalized Lagrange multiplier test based on White (1980) to determine whether controlling for bank-level heterogeneity improves the fit of our model. The null hypothesis of homoscedasticity is rejected at $\rho<0.000$, suggesting that the use of robust standard errors is appropriate.

Estimating the model with fixed effects is a consequent strategy for two reasons. First, as regards the panel data at hand, a high within-bank variation of the compensation measure is observed for European banks in our sample. Second, it is assumed that unobserved bank-specific and especially executive-specific characteristics (Graham et al., 2011) may affect the compensation measure so that employing a fixed effects model is more adequate than a random effects model (Wooldridge, 2002). Since we include cluster-robust standard errors at the bank-level and the Hausman test (1978) is inappropriate under heteroscedasticity we employ a generalization of the Hausman approach by Arellano (1993) to statistically test for the appropriateness of our model specification. Adopting this approach, the null hypothesis that the individual specific effect is uncorrelated with the independent variables is rejected at $\rho<0.004$, suggesting that employing the fixed effects model is rational.

8 As Table 2 reports, the number of observations in our panel varies. Thus, in addition to the fixed effects model, we employ the consistent estimator for the variance components by Baltagi and Chang (1994) as a robustness check to avoid possible biases resulting from our unbalanced panel. However, as results do not differ significantly from the ordinary random effects estimations, we do not comment them in this paper but provide them on request.

5 Empirical results

Table 4 presents results from baseline regressions assessing the impact of executive excess variable compensation structures on bank risk as measured by the *z*-score technique. Table 5 and Table 6 report empirical results from Granger-causality tests and 2SLS instrument variable regressions. Further robustness checks are presented in Table 7 while Tables 8a-8c show results from a variety of sensitivity analyses. Finally, respective correlation matrices are presented in Tables 9a and 9b. If signs and significances of control variables do not remarkably differ from baseline regressions during robustness checks (Section 5.2) and sensitivity analyses (Section 5.3), we do not comment them separately in this paper.

5.1 Baseline regressions

As shown in Table 4, *excess variable compensation* enters regression specification (1) significantly negative at the one-percent level indicating that higher executive excess total variable pay in European banks may have a risk-increasing effect. In addition, coefficients of both *excess cash-based and excess equity-based pay* turn out to be significantly negative at the one-percent level respectively in regressions (2) and (3) while a higher economic effect is observed for excess cash-based compensation.[9] Against this background, baseline findings at hand support theoretical arguments that cash bonuses may set incentives to greater managerial risk-taking (Freixas and Rochet, 2013; Hakenes and Schnabel, 2014; Houston and James, 1995). They additionally correspond to theoretical predictions that equity-based compensation may closely align executives' decisions with the value-maximizing objectives of shareholders, thus incentivizing executives to greater risk-taking (Mehran et al., 2011; Bolton et al., 2011; Chesney at al., 2010). As regards previous related empirical studies for Europe baseline findings at hand do not support main findings provided by Vallascas and Hagendorff (2013) for a mixed sample of European and US banks

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9 Note that this result has to be considered with caution since only 19 out of 63 banks in our sample provide data on equity-based compensation at all. Moreover, as shown in Table 3 excess cash-based compensation is much less volatile than excess equity-based compensation so that the *marginal* impact of excess equity-based pay is higher.

suggesting that CEO cash bonuses are not associated with greater risk-taking in general. In contrast, they correspond to results provided by Ayadi et al. (2011) indicating a risk-increasing impact of performance bonus plans for European banks.

Among the control variables, the *slope of the yield curve* measure enters regressions (1)-(3) significantly positive at the ten- and five-percent level respectively suggesting that economic growth may coincide with greater banking stability (Schaeck and Čihák, 2012). An increase in financial stability during economic upturns may be explained by the fact that (i) the bank's investment opportunities may be correlated with an economic upturn (Beck et al., 2006), (ii) borrowers' solvency should be higher under increasing economic performance which in turn raises the banks' asset quality (Demirgüç-Kunt and Detragiache, 2002) and (iii) banks may pro-cyclically widen their capital under economic booms to take precautionary measures in anticipation of forthcoming economic downturns (Borio et al., 2001). In addition, since banks typically transform short-term loanable funds (e.g., deposits) into longer-term loans, a steeper yield curve will increase interest rate spreads and thus the value of bank assets and future profits, which in turn will lessen moral hazard and reduce bank risk-taking (Altunbas et al., 2014; Albertazzi and Gambacorta, 2009).

Financial leverage enters regressions (1)-(3) significantly negative at the one- and five-percent level indicating a negative impact of a rise in the debt-to-equity ratio on banking stability. If the increase of the leverage ratio is the result of a rising proportion of debt, the risk-increasing effect may originate from the bank's larger exposure to interest rate risk and hence, more volatile earnings. In contrast, if the increase is due to a decline of the proportion of equity, the negative effect on bank stability may be explained by the fact that risk-taking incentives become stronger under decreasing opportunity costs (Keeley, 1990).

Finally, *Tier1* exhibits significantly positive coefficients throughout regressions (1)-(3) indicating a positive impact of an increase in risk-weighted regulatory capital on financial stability. Results at hand support the "capital at risk effect", i.e. higher regulatory equity capital implies higher downside risk and higher losses for bank shareholders in case of bank default, which may counter shareholders' intention to set risk-taking incentives through variable compensation (Boot and Thakor, 2008; Repullo, 2004; Hellmann et al., 2000).

5.2 Robustness checks

Baseline findings of a positive impact of excess variable compensation on bank risk may be biased by (i) reverse causality between risk and compensation, (ii) multicollinearity between compensation measures and (bank-specific) control measures and (iii) different aspects as regards the compensation measure employed (aggregation level, outlier bias). We control for these potential problems in the following.

5.2.1 Reverse causality

The causality between executive compensation and bank risk is not clear if the design of variable compensation packages depends on the bank's overall risk exposure. Hence, *reverse causality* may arise, if it is assumed that financially stronger banks may pay higher variable compensation and set stronger risk-taking incentives as compared to distressed banks. In contrast, however, one may also argue that even financially distressed banks may pay higher variable bonuses to executives if they opt to follow "gambling for resurrection" strategies. Despite this, bank risk is likely to affect managerial behavior in general due to its implications for the reputation and career paths of bank managers (Mehran and Rosenberg, 2007).

Although we employ one-period lagged compensation measures in our baseline regression model to generally address possible endogeneity problems, we control for reverse causality in a more sophisticated way by performing Granger-causality tests and instrumental variable regressions in the following (Tables 5 and 6). To begin with, a simple *Granger test* (Granger, 1969) is used as a standard econometric procedure to explore causal directions between bank risk and compensation. As a first step, testing for Granger causality requires that time series of the *z*-score and excess variable compensation measures are covariance stationary. We perform a Fisher-type test for unit roots that is suitable for finite panel datasets when individual series have gaps (Choi 2001). Hence, based on an Augmented-Dickey-Fuller (ADF; Dickey and Fuller, 1979; 1981) and Phillips-Perron test (Phillips and Perron, 1988) due to yearly data in our sample, unit-root tests are conducted for each panel individually, and p-values from these tests are combined to produce an overall test. As shown in Table 5, the null hypothesis that all the panels contain a unit root is rejected for both time series.

In a second step, both the Akaike (AIC) and Schwarz Information Criteria (SIC) are employed to find an appropriate number of lags for the *z*-score and compensation measure to be included in the autoregressive analysis. Both criteria suggest an optimal lag order of 1 for each of the series. However, since the Granger-causality test is very sensitive to the number of lags included in the regression, we additionally perform the analyses with three lags and then drop the third and then the second if they are not significant and if the significance level of the F-test does not decline. This procedure again suggests an optimal lag order of 1 for both time series.

As a final third step, Granger-causality tests are performed. The Granger test involves two separate autoregressive analyses. In a first regression, excess variable compensation is regressed on lags of itself and on lags of the *z*-score measure. In turn, the *z*-score is regressed on lags of itself and on lagged excess variable compensation in the second regression. As shown in Table 5, while control variables exhibit expected signs in both regressions, one-period lagged *z*-score enters regression (1) insignificantly positive whereas the coefficient of one-period lagged excess variable compensation is observed to be significantly negative at the five-percent level in regression (2). In addition, taking respective F-tests into account, results from Granger tests reveal that bank risk does not Granger-cause excess variable compensation whereas compensation Granger-causes a change in bank risk as already indicated by baseline findings from Table 4.

Next to Granger-causality tests possible reverse causality is further analyzed by employing a *two-stage least squares (2SLS) instrumental variable (IV) estimator* with fixed effects, time dummies and a robust-clustering at the bank-level. We propose the executive's consecutive years on board (tenure) standardized by the executive's respective age as an adequate instrumental variable for excess compensation and refer to this ratio as *executive's quality*. We initially hypothesize that the amount of excess pay is positively related to the length of tenure. The reason is that a long tenure may indicate entrenchment, provoke higher firm-specific human capital and a better reputation, which in turn should induce an increase in executive compensation (Harjato and Mullineaux, 2003). We additionally assume that risk-taking incentives from excess compensation may become less important for more experienced executives since these executives might already show an extensive track record of their value added to the firm. In this context, several empirical studies indeed provide evidence that intrinsic motivation for managerial risk-taking decreases with the tenure due to career and reputational considerations (e.g., Berger et al., 2014).

As shown in Table 6 and in line with findings from Granger-causality test, results from IV regressions indicate that baseline findings from Table 4 may not be biased by reverse causality. The instrumental variable enters the first stage regression (1) significantly positive at the one-percent level while control variables exhibit expected signs. Our baseline findings of a negative relationship between excess variable compensation and bank soundness are reiterated during the second stage regression (2). Moreover, control variables retain significances and signs while a significantly positive impact of the bank's liquidity position on financial stability is additionally observed.

Concerning the quality and strength of the instrumental variable employed, Table 9a illustrates that *executive's quality* is uncorrelated with the *z*-score but sufficiently high correlated with the excess variable compensation measure. Furthermore, Table 6 reports that the coefficient of the instrumented compensation measure only slightly increases during the IV estimation indicating that excluding the instrument from the second stage regression may not generate further endogeneity problems. Moreover, results from respective tests of underidentification and weak identification reveal that IV regression results are robust to issues of instrument-validity. We use the rank statistic proposed by Kleibergen and Paap (KP, 2006), which is robust under heteroscedasticity and robust-clustering in the case of one single endogenous regressor and one single instrument. Table 6 reveals that the KP rank LM statistic (underidentification test) is at 16.242 with p = 0.002 rejecting the null hypothesis that the equation is underidentified. The KP rank Wald F statistic (weak identification test) is at 14.921 and hence very close to the Stock and Yogo (2005) 10% critical value of 16.387. In addition, since the KP rk Wald F statistic satisfies the Staiger and Stock (1997) rule of thumb that the F-statistic should be at least at 10, we reject the null hypothesis of a weak correlation between our instrument and the endogenous regressor.

5.2.2 Compensation measure

We proceed and investigate the robustness of the compensation measure employed (Table 7). In this context it is initially controlled if baseline findings may be biased due to multicollinearity, i.e. included control variables may not only affect bank risk but may also have an impact on the compensation measure on the right hand side of the regression equation. Although (i) the compensation measure is lagged by one period while (bank-specific) control variables are not, (ii) bidirectional correlation between compensation and control measures is moderate (Table 9a) and (iii) variance inflation factors consistently exhibit values smaller than 10 as a rule of thumb, multicollinearity problems may not be generally ruled out. Thus, to control for a possible estimation bias we initially omit bank-specific measures and further exclude macroeconomic control variables from the regression model. As shown in Table 7, even though control variables are excluded from respective regressions (1a) and (1b), baseline findings from Table 4 are reconfirmed. As coefficients of the excess variable compensation measure exhibit slightly higher values compared to baseline regressions, we suggest that the risk-increasing effect might be slightly overestimated but rule out that main results are seriously biased due to multicollinearity.

Furthermore, taking into account that we employ the *aggregate* amount of excess variable compensation received by the entire number of executives on the management board per bank and year, one may argue that the risk-increasing effect may be driven by single executives (especially the CEO or CFO) receiving a comparably higher amount of variable compensation than other executives and thus, facing stronger incentives for greater risk-taking. To shed a brighter light on this aspect, we initially calculate *excess average variable compensation* defined as the residuals of a regression of average compensation (i.e. the ratio of the sum of total variable compensation divided by the number of executives in charge per bank and year) on bank size while including country dummies and time dummies. Table 7 reports that excess average variable compensation enters regression (2a) significantly negative while the coefficient value subsides as compared to baseline regressions. Hence, results suggest that the risk-increasing effect through variable compensation may be driven by “above-average” excess variable pay. Accordingly, we control for a potential outlier-bias due to extraordinarily high variable payments in our sample in a second step. On account of the small sample size *Winsorizing* rather than Trimming is employed. We use 1 percent Winsorizations converting the top one-percent values of variable compensation to the 99th percentile and subsequently compute excess variable compensation measures. Regression (2b) in Table 7 reports that baseline findings are reiterated even when employing winsorized excess variable compensation while the estimated coefficient becomes only slightly lower in value.

Finally, variable compensation is substituted by the ratio of variable to fixed compensation. Like excess variable compensation, excess fixed pay is computed as the residuals from regressions of executives’ fixed salaries on bank size while including country dummies and time dummies. Subsequently, the ratio of *excess variable to fixed compensation* is built. As reported by Table 7, the ratio enters regression (3a) significantly negative. Taking into account that fixed compensation in our sample hardly varies over time, results additionally suggest that an increase in the gap between excess variable and fixed compensation negatively affects bank soundness. Referring to the European Parliament’s decision to limit an executive’s variable compensation to the maximum of his annual fixed salaries, we employ a further measure that exceptionally includes ratios of variable to fixed compensation being larger than 1, which is observed for 49 banks in our sample. As shown, this excess ratio enters regression (3b) significantly negative while the coefficient remarkably increases in value as compared to baseline regressions from Table 4. Accordingly, as results suggest that the negative impact of excess variable compensation may become stronger if executive variable pay exceeds fixed salaries, the European Parliament's decision to set a regulatory cap of variable pay seems to be appropriate.

5.3 Sensitivity analyses

One may argue that especially larger banks may also have some characteristics regarding their business model, e.g. are more strongly engaged in fee-based business, are internationally operating banks and are also often stock-listed. In addition, larger banks with good governance may also report more detailed on their compensation structure. Taking this into account we perform various sensitivity analyses controlling for different board structure and bank characteristics in the following.

5.3.1 Board characteristics

Among sensitivity analyses focusing on board characteristics we initially control for differences in board structures by building two subsamples. One subsample includes 42 European banks, which have adopted a *one-tier board system* whereas the other subsample includes 21 banks with a *two-tier board structure*. While monitoring executives' activities is delegated to a separate supervisory board in a two-tier system, it is an additional task of the board itself within a one-tier system. Accordingly, one may argue that the disciplinary power of two-tier boards may be greater due to the separation of execution and control and hence, due to the limited scope for CEOs or CFOs to capture the rest of the board. However, one may also hypothesize that information asymmetry and moral hazard problems may be stronger under a dual board structure, making monitoring more difficult for single members of the supervisory board. As reported in Table 8a, the compensation measures enter both regressions (1a) and (1b) significantly negative while the negative impact is remarkably weaker for the subsample of banks having adopted a two-tier board structure. Results suggest that risk-taking incentives may be less effective under a two-tier board structure supporting previous findings provided by Gillette et al. (2008) that two-tiered boards are more conservative in their investment decisions.

We control for the *board size* (total number of executives) and *board independence* (proxied by the ratio of non-executives to board size) in a next step. While the impact of board size and board independence on firm (bank) performance is well documented in literature, only a few studies explicitly focus on the effect on managerial risk-taking in this context. Most of these studies argue that smaller boards may act more consistently with the shareholders' interests and hence, provide evidence for a negative relationship between board size and managerial risk-taking (e.g., Pathan, 2009; Hermalin and Weisbach, 2003). Similarly, it is generally suggested that greater board independence tends to decrease bank risk since non-executives may have stronger monitoring incentives than bank insiders and may take a more determined stand in the interests of the bank's stakeholders (e.g., Mehran et al., 2011). As shown by regression (2) and (3), Table 8a, we do not find a significant effect of board size and board independence on bank risk. While the risk-increasing impact of excess variable compensation is retained in each regression, coefficients of board size and board independence exhibit expected signs but turn out to be statistically insignificant.

Related, it is further analyzed if the risk-increasing impact of excess variable compensation changes with an increasing fraction of *female executives* on board. Although gender studies generally suggest that women may exhibit a stronger risk aversion during financial decisions than men (e.g., Schubert et al., 1999), empirical evidence on the risk-taking behavior of female executives is ambiguous. Kahn and Vieito (2013), for example, find a stronger risk aversion of female CEOs in US firms compared to male CEOs. They additionally provide evidence that shareholders may not consider this difference in risk aversion when designing equity-based compensation packages. In contrast, Berger et al. (2014) provide evidence that female executives may self-select into stable and well-capitalized banks. However, after three years of female board representation managerial risk-taking tends to increase which may be due to the fact that female executives have less experience than their male counterparts. As reported by regression (4a) in Table 8a, greater managerial risk-taking is observed for those banks with male-only executive boards. In contrast, regression (4b) reveals a distinctly weaker negative impact of variable compensation on bank risk if the fraction of female executives on boards becomes larger. Results, however, have to be taken with caution since the number of female executives on bank boards in our sample is generally low (the maximum is at 4). Moreover, we do not observe any female executive on board for more than 60 percent of the entire number of banks.

Finally, it is analyzed if executive risk-taking through excess variable compensation is affected by the strength of bank shareholder rights. Accordingly, based on the shareholder rights index from La Porta et al. (1997) we employ the updated and corrected *Anti-Director Rights Index (ADRI)* provided by Spamann (2010) to measure the level of investor protection. It is suggested that under poor investor protection bank executives may invest in a more risk averse manner than outside shareholders would desire (Kose et al., 2008). In contrast, if shareholder rights are strong, bank shareholders should be able to more effectively monitor executives and thus, may stronger press for greater risk-taking to increase their returns on investment. As shown in regression (5), Table 8a, we find a negative impact of the ADRI measure on bank stability and, more important, a stronger negative impact of the interaction variable as compared to our baseline findings from Table 4. Thus, results correspond to previous findings provided by Pathan (2009) suggesting that stronger shareholder rights may spur managerial risk-taking in banking.

5.3.2 Bank characteristics

Taking into account that our sample comprises of 40 stock-listed financial institutions, we build two subsamples of *stock-listed and non-stock-listed banks* and analyze if the risk-increasing effect from excess variable compensation differs depending on the bank type. Moreover, only stock-listed banks report data on both variable cash-based and equity-based compensation. Regressions (1a) and (1b) in Table 8b indicate a significantly negative impact of compensation measures on bank soundness for both subsamples while coefficient values are remarkably lower in value for the subsample of non-stock-listed banks. On the one side, results at hand support theoretical predictions that managerial risk-taking may evolve due to the alignment of shareholders' and executives' interests by setting risk-taking incentives in compensation contracts. On the other side, however, results may further indicate that managerial risk-taking may also stem from intrinsic risk-taking preferences of executives (at non-stock-listed banks) beyond shareholder pressure.

Although we are convinced that the *z*-score is an adequate measure of bank risk, we substitute this ratio by *market-based risk measures* (distance-to-default, systematic risk and idiosyncratic risk) for the subsample of stock-listed banks in order to reach a higher comparability with previous related studies.[10] As correlations between market-based risk measures and control variables from the baseline model are moderate (Table 9b), we do not re-specify the regression model but simply change single risk measures. Table 8b reports that excess variable compensation enters regression (2a) significantly negative at the five-percent level indicating a decrease in the banks' distance-to-default due to executive variable pay. Similarly, coefficients of the compensation measure turn out to be significantly positive at the five- and ten-percent level respectively in regressions (2b) and (2c) suggesting an increase in the banks' systematic and idiosyncratic risk due to higher variable compensation. Thus, as macroeconomic and bank-specific control variables exhibit expected signs and retain significances for the most part, baseline findings of a risk-increasing effect of excess variable compensation are reconfirmed even when employing market-based risk measures instead of the book-based *z*-score ratio.

The recent trend towards non-traditional, non-interest rate based banking activities due to the wave of banking market deregulation and liberalization around the globe has provoked a strong heterogeneity in European banks' revenue structures (e.g., Lepetit et al., 2008; Goddard et al., 2007). Accordingly, in a next step it is investigated if baseline findings differ depending on the banks' *business model* proxied by the ratio of a bank's non-interest income to total operating income. As shown in Table 8b, the business model measure enters regression (3) significantly

10 The calculation of the market-based risk measures is described in detail in the *Technical Appendix*.

negative suggesting a decrease in financial soundness for those European banks which stronger engage in fee-based business activities (e.g., Brunnermeier et al., 2011). In contrast, results at hand do not support theoretical predictions that a higher degree of revenue diversification may benefit financial stability. In addition, it is also shown that the interaction term turns out to be significantly negative while its coefficient turns out to be distinctly larger in value as compared to baseline findings from Table 4. This result was expected since variable compensation might be primarily based on the financial success of proprietary trading from the fee-based investment banking business.

Furthermore, it is controlled if the risk-increasing effect of excess variable compensation is driven by the degree of a bank's overall risk exposure. Therefore, dividing the entire series of the *z*-score ratio into four quartiles we build two subsamples of high-risk and low-risk banks. A bank is defined as a high-risk institution if respective *z*-score values are located in the first quartile of the distribution. This subsample includes 19 banks. In contrast, a bank is characterized as low-risk institution if respective *z*-score values fall into the fourth quartile, which is the case for 21 banks in the second subsample. Regressions (4a) and (4b) in Table 8b report a significantly negative impact of excess variable compensation on bank soundness for the subsample of high-risk banks whereas we do not provide any statistical evidence for this effect as regards low-risk banks. Results for high-risk banks correspond to findings provided by Vallascas and Hagendorff (2013) for a mixed sample of US and European financial institutions. Moreover, as the coefficient from regression (3b) increases in value as compared to baseline findings from Table 4, we suggest that banks moving closer towards insolvency may opt to follow a "gambling for resurrection strategy", i.e. executives may more strongly carry out high-risk but high-return investments and seek to maximize the value of the safety net.

5.3.3 Financial crisis and regulatory framework

As illustrated by Figure 1, bank-average variable compensation in European banks has sharply decreased from the beginning of the financial crisis in mid-2007 until the end of our sample period while the same is true for averaged *z*-score values. Accordingly, risk-taking incentives through excess variable compensation are further analyzed with a special emphasis on the financial crisis period in the following.

To begin with, based on results from a CUSUM test (Brown et al., 1975) for structural breaks in our time series of *z*-score and compensation data we build two subsamples with the *pre-crisis subsample* covering the time period between 2000 and 2006 and the *crisis subsample* stretching from 2007 to 2010. As shown by regressions (1a) in Table 8c, baseline findings are reconfirmed for the pre-crisis period. Hence, results indicate that the risk-increasing effect through variable compensation over the whole sample period is not driven by the sharp decrease of *z*-score values during the crisis period. On the contrary, as we do not observe any statistical impact of excess variable pay on bank risk during the crisis period, results indirectly correspond to findings provided by Fahlenbrach and Stulz (2011) for US banks suggesting that neither cash bonuses nor stock options had an adverse impact on bank performance during the crisis. Results from our analysis may initially be explained by the fact that the financial crisis itself has prevented bank executives from greater risk-taking even at financially sounder banks during this period (Raviv and Sisli-Ciamarra, 2013). In addition, it may also be true that risk-taking incentives may have become less effective considering the sharp decrease in the amount of variable compensation being paid to executives during the crisis period. In particular, the risk-taking effect may have faded with an increase in fixed compensation and rising long-term variable payments as being observed in the aftermath of the crisis in Europe.

We proceed and analyze the *short- and long-term effect of risk-taking incentives* through excess variable compensation with a special emphasis on the financial crisis period. However, since most European banks are silent on term structures of cash-based and equity-based compensation packages, we propose the following procedure to approximately measure a short-term and long-term effect. In a first step, we exclude compensation data observed during the crisis period (2007-2010) from the sample. In a second step, *z*-score data from the crisis period (2007-2010) is panel-regressed on compensation data from the pre-crisis period (2000-2006) in specification (2a) whereas *z*-score data from the crisis-period is pooled-regressed on compensation data from the last year before the crisis started (2006) in specification (2b). Table 8c reports that baseline findings are reiterated for both specifications. In addition, results from regression (2a) may indicate a *long-term impact* on bank risk through variable compensation supporting the widely believe that compensation practices in the banking industry may have played an important role in causing the recent financial crisis (e.g., Bebchuk and Spamann, 2010). Moreover, results indirectly correspond to findings provided by Beltratti and Stulz (2012) suggesting that (European) banks with more shareholder-friendly boards before the crisis performed worse during the crisis. As regards regression specification (2b), findings at hand may further reveal a stronger *short-term impact* of excess variable pay on bank risk as indicated by a significantly higher coefficient value of the compensation measure as compared to regression (2b). Taking this into account, one may argue that bank executives may have anticipated the crisis and sharply decreased their personal wealth portfolios at the banks they manage shortly before the crisis, so that they did not bear the losses from their risky investments ex post. In contrast, however, one may also hypothesize that the crisis came fully unexpected for bank executives. If this is true, findings at hand underline the “short termism” effect of variable compensation schemes.

We proceed and control for the effect of *governmental capital assistance* towards distressed banks since it is assumed that risk-incentives through variable compensation may be different for this subset of banks. As a focus on the crisis period only would result in an insufficient number of observations, two subsamples are built over the entire sample period. The first subsample includes 18 banks from our sample, which explicitly retrieved governmental guarantees or capital assistance during the financial crisis period whereas the second subsample comprises of 45 banks without governmental help. The mean values of variable compensation do not remarkably differ between both subsamples so that we can rule out that capital assistance was first and foremost provided due to higher risk-taking induced by higher amounts of variable compensation paid at supported banks. Regressions (3a) and (3b) in Table 8c reveal that excess variable compensation turns out to be significantly negative for both subsamples. However, as compared to our baseline findings from Table 4, the negative impact of excess variable compensation on bank risk is weaker for the subsample of supported banks. Our findings correspond to empirical evidence provided by Fahlenbrach and Stulz (2011) for a sample of TARP-supported US banks. Moreover, results at hand do not support theoretical arguments that (anticipated) governmental guarantees or bail-outs may have led to steeper bonus schemes and hence, induced even more managerial risk-taking at European banks (Hakenes and Schnabel, 2014). They also contradict assumptions that bank profits may have been boosted by favorable refinancing conditions due to public capital aid, thus further increasing the source for higher variable pay and stronger risk-taking incentives. In contrast, taking into account that governmental capital assistance typically comes along with specific constraints (such as replacing executives or the suspension of executives' fees and bonuses) results at hand rather suggest that these interventions may be effective instruments to mitigate managerial risk-taking incentives.

Turning to the regulatory framework it is initially investigated if baseline findings differ due to a country's *deposit insurance system*. Following the methodology provided by Demirgüç-Kunt and Detragiache (2002) we employ data from chronological World Bank surveys (2001, 2003, 2007 and 2012) provided by Barth et al. (2012) to construct an index that measures the generosity of the deposit insurance system. In this context, higher index values indicate greater generosity and hence, a higher probability of managerial moral hazard and risk-taking. Table 8c reports that the deposit insurance measure enters regression (4) insignificantly negative. In contrast, the coefficient of the interaction term turns out to be significantly negative while coefficient values slightly increase as compared to baseline findings from Table 4. Accordingly, results at hand reveal an increase in managerial risk-taking through variable compensation under the financial safety net, which might be due to the fact that risks may be additionally shifted to regulators (and taxpayers) as discussed in detail in Section 2.

Finally, it is analyzed if the risk-increasing effect of excess variable compensation is mitigated by strong supervisory oversight. We include the *supervisory power index*, which is computed from the first principal component of answers to queries focusing on official supervisory power, the strength of external audits and private monitoring as employed in different World Bank surveys (2001, 2003, 2007 and 2012) provided by Barth et al. (2012). Higher values of this index indicate greater supervisory power. Regression (5) in Table 8c reports that the supervisory index turns out to be a significant determinant of bank soundness in general. Referring to the interaction term, results additionally reveal that greater supervisory power substantially mitigates the negative impact of excess variable pay on bank soundness. These findings are in line with previous empirical results provided by Vallascas and Hagendorff (2013) suggesting a risk-reducing effect of cash bonus plans if banks operate under a strong regulatory framework.

6 Summary and conclusion

Employing compensation data provided by 63 banks from 16 European countries for the period from 2000 to 2010 this paper provides empirical evidence that excess variable compensation (either cash-based or equity based) is positively related to bank risk. Our baseline finding is retained during a variety of robustness checks, especially when employing Granger-causality tests and instrumental variable regressions to address likely reverse causality. Most important results from a large number of sensitivity analyses reveal that (i) risk-taking incentives may not only be set by bank shareholders by committing respective compensation contracts but may also evolve from bank executives' intrinsic risk-preferences, (ii) the compensation-risk linkage may be stronger in financially distressed banks suggesting "gambling for resurrection strategies", (iii) the risk-increasing impact of excess variable pay describes a long term effect indicating that pre-crisis executive compensation may have contributed to an increase in bank risk during the crisis, (iv) more generous deposit insurance schemes may spur managerial-risk taking whereas governmental capital assistance during the crisis may mitigate it and (v) greater supervisory power may substantially diminish the negative impact of compensation on bank soundness in Europe.

Taking empirical findings from this study into account, we suggest that the FSB's principles on sound compensation practices as discussed in Section 1 are indispensable. As we provide evidence for a long-term risk-increasing effect of variable compensation at European banks, a deferral of executive variable pay and an implementation of claw-back provisions, that allow recouping variable payments if management decisions fail later on, should be suitable for maintaining financial stability. In addition, as we find that negative impact of excess variable compensation on bank soundness turns out to be stronger if variable pay exceeds fixed salaries, the European Parliament's decision to establish a regulatory cap of executive variable payments is appropriate.

References

Acrey, J.C., McCumber, W.R., Nguyen, T.H.T., 2011. CEO incentives and bank risk. Journal of Banking and Finance 63, 465-471.

Aggarwal, N.K., Samwick, A.A., 2003. Performance incentives within firms: the effect of managerial responsibility. Journal of Finance 58(4), 1630-1650.

Albertazzi U., Gambacorta L., 2009. Bank profitability and the business cycle. Journal of Financial Stability 5, 393-409.

Altman, E.I., 1968. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. Journal of Finance 23:4, 589-610.

Altunbas, Y., Manganelli, S., Marques-Ibanez, D., 2011. Bank risk during the financial crisis – Do business models matter? ECB Working Paper Series, No. 1394, European Central Bank, Frankfurt.

Altunbas, Y., Gambacorta, L., Marques-Ibanez, D., 2014. Does monetary policy affect bank risk-taking? International Journal of Central Banking 10(1), 95-135.

Arellano, M., 1993. On the testing of correlated effects with panel data. Journal of Econometrics 59, 87-97.

Ayadi, R., Arbak, E., DeGroen, W.P., 2011. Executive Compensation and Risk Taking in European Banking, in: Barth, J. R., Lin, C., Wihlborg, C. (eds.): Research Handbook on International Banking and Governance, 23-45, Edward Elgar Publishing.

Bhagat, S., Bolton, B., 2012. Bank executive compensation and capital requirements reform. Unpublished working paper, University of Colorado at Boulder and Portland State University.

Balachandran, S., Kogut, B., Harnal, H., 2010. The probability of default, excessive risk, and executive compensation: A study of financial services firms from 1995-2008. Unpublished working paper, Columbia Business School.

Baltagi, B.H., Chang, Y.J., 1994. Incomplete panels: a comparative study of alternative estimators for the unbalanced one-way error component regression model. Journal of Econometrics 62, 67-89.

Barclay, M., Gode, D., Kothari, S.P., 2005. Matching delivered performance. Journal of Contemporary Accounting Research 1, 1-25.

Barth, J.R., Caprio, G., Levine, L., 2012. The Evolution and Impact of Bank Regulations, World Bank Policy Research Working Paper 6288.

Bebchuk, L.A., Cohen, A., Spamann, H., 2010. The wages of failure: Executive compensation at Bear Stearns and Lehman 2000-2008. Yale Journal on Regulation 27, 257-282.

Bebchuk, L.A., Spamann, H., 2010. Regulating bankers' pay. Georgetown Law Journal 98, 247-287.

Beck, T., Demirgüç-Kunt, A., Levine, R., 2006. Bank concentration, competition, and crises: First results. Journal of Banking and Finance 30, 1581-1603.

Beltratti, A., Stulz, R., 2012. The credit crisis around the globe: Why did some banks perform better? Journal of Financial Economics 105(1), 1-17.

Berger, A.N., Kick, T., Schaeck, K., 2014. Executive board composition and bank risk taking. 2014: Journal of Corporate Finance 28, 48-65.

Bhagat, S., Bolton, B., 2014. Financial crisis and bank executive incentive compensation. Journal of Corporate Finance 25, 313-341.

Black, F., Scholes, M., 1973. The pricing of options and corporate liabilities. Journal of Political Economy 81, 637-654.

Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, Office of the Comptroller of the Currency, Treasury,and Office of Thrift Supervision, 2010. Guidance on Sound Incentive Compensation Policies. June 25 2010 .

Bolton, P., Mehran, H., Shapiro, J., 2011. Executive compensation and risk taking. Federal Reserve Bank of New York, Staff Report No. 456.

Boot, A., Thakor, A., 2008. Handbook of financial intermediation and banking, Elsevier.

Borio, C., Furfine, C., Lowe, P., 2001. Procyclicality of the financial system and financial stability: Issues and policy options, Bank for International Settlement Working Paper No. 1, Basel.

Bosma, J.J., Koetter, M., 2013. Bank executive compensation and systemic risk. Unpublished working paper, University of Groningen, and Frankfurt School of Finance and Management.

Boyd, J.H., De Nicoló, G., 2006. The theory of bank risk-taking and competition revisited. Journal of Finance 60, 1329-1343.

Brown, R.L., Durbin, J., Evans, J.M., 1975. Techniques for testing the constancy of regression relationships over time. Journal of the Royal Statistical Society B 37, 149-163.

Brunnermeier, M.K., Dong, G., Palia, D., 2011. Banks’ non-interest income and systemic risk. Working Paper, Princeton University.

Caprio, G., Levine, R., 2002. Corporate governance of banks: Concepts and international observations, in: Litan, R.E., Pomerleano, M., Sundararajan, V., (eds): Financial Sector Governance: The Roles of Private and Public Sectors, 17-50, Washington D.C.

Chaigneau, P., 2013. Risk-shifting and the regulation of bank CEOs’ compensation. Journal of Financial Stability 9, 778-789.

Chemmanur, T.J., Cheng, Y., Zhang, T., 2013. Human Capital, Capital Structure, and Employee Pay: An Empirical Analysis. Journal of Financial Economics 110 (2), 478-502.

Chen, C.R., Steiner, T.L., Whyte, A.M., 1998. Risk-taking behavior and management ownership in depository institutions. Journal of Financial Research 21(1), 1-16.

Chen, C.R., Steiner, T.L., Whyte, A.M., 2006. Does stock option-based executive compensation induce risk-taking? An analysis of the banking industry. Journal of Banking and Finance 30, 915-945.

Chesney, M., Stromberg, J., Wagner, A., 2010. Risk-taking incentives, governance, and losses in the financial crisis. Research Paper 10-18, Swiss Finance Institute.

Choi, I., 2001. Unit root tests for panel data. Journal of International Money and Finance 20, 249-272.

Coles, J.L., Daniel, N.D., Naveen, L., 2006. Executive incentives and risk-taking. Journal of Financial Economics 79, 431-468.

Crawford, A.J., Ezzell, J.R., Miles, J.A., 1995. Bank CEO pay-performance relations and the effects of deregulation. Journal of Business 68, 231-256.

Demirgüç-Kunt, A., Detragiache, E., 2002. Does deposit insurance increase banking system stability? An empirical investigation. Journal of Monetary Economics 49, 1373-1406.

Demirgüc-Kunt, A., Huizinga, H., 2010. Bank activity and funding strategies: The impact on risk and returns. Journal of Financial Economics 98, 626-650.

Edmans, A., Liu, Q., 2011. Inside debt. Review of Finance 15, 75-102.

Dickey, D.A., Fuller, W.A., 1979. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association 74, 427-431.

Dickey, D.A., Fuller, W.A., 1981. Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica 49, 1057-1072.

European Commission, 2010a. State aid scoreboard (spring 2010). Brussels.

European Commission, 2010b. Competition's review of guarantee and recapitalization schemes in the financial sector in the current crisis. Brussels.

Fahlenbrach, R., 2009. Shareholder rights, boards, and executive compensation. Review of Finance 13, 81-113.

Fahlenbrach, R., Stulz, R. M., 2011. Bank CEO incentives and the credit crisis, Journal of Financial Economics 99, 11-26.

Financial Stability Board, 2009. FSB Principles for Sound Compensation Practices – Implementation Standards (25 September 2009). Basel.

Foos, D., Norden L., Weber, M., 2010. Loan growth and riskiness of banks. Journal of Banking and Finance 34(12), 2929-2940.

Freixas, X., Rochet, J.C., 2013. Taming Systemically Important Financial Institutions. Journal of Money, Credit and Banking 45 (SUPPL 1), 37-58.

Gabaix, X., Landier, A., 2008. Why has CEO pay increased so much? Quarterly Journal of Economics 123(1), 49-100.

Gillette, A.B., Noe, T.H., Rebello, M.J., 2008. Board structures around the world: An experimental investigation. Review of Finance 12(1), 93-140.

Goddard, J., Molyneux, P., Wilson, J.O.S., Tavakoli, M., 2007. European Banking: An overview. Journal of Banking and Finance 31, 1911-1935.

Graham, J.R., Li, S., Qiu, J., 2011. Managerial attributes and executive compensation. Review of Financial Studies 24, 1944-1979.

Granger, C.W.J., 1969. Investigating causal relations by econometric models and cross-spectral methods. Econometrica 37, 424-436.

Gregg, P., Jewell, S., Tonks, I., 2011. Executive pay and performance: Did bankers' bonuses cause the crisis? International Review of Finance 12(1), 89-122.

Guay, W., 1999. Compensation, convexity, and the incentives to manage risk: An empirical analysis. Journal of Financial Economics 53, 43-71.

Hagendorff, J., Vallascas, F., 2011. CEO pay incentives and risk-taking: Evidence from bank acquisitions. Journal of Corporate Finance 17(4), 1078-1095.

Hakenes, H., Schnabel, I., 2014. Bank bonuses and bail-outs. Journal of Money, Credit and Banking 46(1), 259-288.

Heckman. J.J., 1979. Sample selection bias as a specification error. Econometrica 47(1), 153-162.

Hellmann, T.F., Murdock, K.C., Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? American Economic Review 90(1), 147-165.

Hermalin, B.E., Weisbach, M.S., 2003. Boards of directors as an endogenously determined institution: A survey of the economic literature. Economic Policy Review, 7-26.

Holthausen, R.W., Larcker, D.F., Sloan, R.G., 1995. Annual bonus schemes and the manipulation of earnings. Journal of Accounting and Economics 19, 29-74.

Houston, J.F., James, C., 1995. CEO compensation and bank risk: Is compensation in banking structured to promote risk taking? Journal of Monetary Economics 36(2), 405-431.

Houston, J., Lin, C., Lin, P., Ma, Y., 2010. Creditor rights, information sharing, and bank risk taking. Journal of Financial Economics 96, 485-512.

Jeitschko, T.D., Jeung, S.D., 2005. Incentives for risk-taking in banking - A unified approach. Journal of Banking and Finance 29(3), 759-777.

Jensen, M.C., Murphy, K.J., 1990. Performance pay and top-management incentives. Journal of Political Economy 98(2), 225-264.

John, T.A., John, K., 1993. Top-management compensation and capital structure. Journal of Finance 48(3), 949-74.

John, K., Saunders, A., Senbet, L.W., 2000. A theory of bank regulation and management compensation. Review of Financial Studies 13(1), 95-125.

John, K., Qian, Y., 2003. Incentive features in CEO compensation in the banking industry. Federal Reserve Bank of New York Economic Policy Review 9, 109-121.

Khan, W.A., Vieito, J.P., 2013. CEO gender and firm performance. Journal of Economics and Business 67, 55-66.

Keeley, M., 1990. Deposit insurance, risk and market power in banking. American Economic Review 80, 1183-1200.

Kim, J.-B., Li, Y., Zhang, L., 2011. CFOs versus CEOs: Equity incentives and crashes. Journal of Financial Economics 101, 713-730.

Kose, J., Litov, L., Yeung, B., 2008. Corporate governance and risk-taking. The Journal of Finance 63(4), 1679-1728.

Kleibergen, F., Paap, R., 2006. Generalized reduced rank tests using the singular value decomposition. Journal of Econometrics 127, 97-126.

Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. Journal of Financial Economics 93, 259-275.

La Porta, R., Lopez-de Silanes, F., Shleifer, A., Vishny, R.W., 1997. Legal determinants of external finance. Journal of Finance 52(3), 1131-1150.

Lepetit, L., Nys, E., Rous, P., Tarazi, A., 2008. Bank income structure and risk: An empirical analysis for European banks. Journal of Banking and Finance 32, 1452-1467.

Mehran, H., Rosenberg, J.V., 2007. The effect of employee stock options on bank investment choice, borrowing, and capital. Staff Report No. 305, Federal Reserve Bank of New York.

Mehran, H., Morrison, A., Shapiro, J., 2011. Corporate Governance and Banks: What Have We Learned From the Financial Crisis? mimeo, Federal Reserve Bank of New York.

Merton, R.C., 1973. Theory of rational option pricing. Bell Journal of Economics and Management Science 4, 141-183.

Merton, R.C., 1974. On the pricing of corporate debt: The risk structure of interest rates. Journal of Finance 29, 449-470.

Murphy, K., 1999. Executive Compensation, in: Ashenfelter, O., Card, D. (eds.): Handbook of Labor Economics, Vol. 3b. New York and Oxford, 2485-2563.

Murphy, K., 2000. Performance standards in incentive contracts. Journal of Accounting and Economics 30, 245-278.

Parrino, R., Poteshman, A.M., Weisbach, M.S., 2005. Measuring investment distortions when risk-averse managers decide whether to undertake risky projects. Financial Management 12, 21-60.

Pathan, S., 2009. Strong boards, CEO power and bank risk-taking. Journal of Banking and Finance 33(7), 1340-1350.

Phillips, P.C.B., Perron, P., 1988. Testing for an unit root in time series regression. Biometrika 75, 335-346.

Raviv, A., Sisli-Ciamarra, E., 2013. Executive compensation, risk taking and the state of the economy. Journal of Financial Stability 9(1), 55-68.

Repullo, R., 2004. Capital requirements, market power and risk-taking in banking. Journal of Financial Intermediation 13(2), 156-182.

Ross, S.A., 2004. Compensation, incentives, and the duality of risk aversion and riskiness. Journal of Finance 59, 207-225.

Saunders, A., Strock, E., Travlos, N.G., 1990. Ownership structure, deregulation, and bank risk taking. Journal of Finance 45(2), 643-654.

Schaeck, K., Čihák, M. 2012. Banking Competition and Capital Ratios. European Financial Management 18(5), 836-866.

Schubert, R., Brown, M., Gysler, M., Brachinger, H.W., 1999. Financial decision-making: Are women really more risk-averse? The American Economic Review 89(2), 381-385.

Smith, C.W., Stulz, R.M., 1985. The determinants of firms' hedging policies. Journal of Financial and Quantitative Analysis 20(4), 391-405.

Smith, C.W., Watts, R.L., 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. Journal of Financial Economics 32, 263-292.

Spamann, H., 2010. The “Antidirector Rights Index” revisited. Review of Financial Studies 23, 467-486.

Srivastav, A., Armitage, S., Hagendorff, J., 2014. CEO inside debt holdings and risk-shifting: Evidence from bank payout policies. Journal of Banking and Finance 47, 41-53.

Staiger, D., Stock, J.H., 1997. Instrumental variables regression with weak instruments. Econometrica 65, 557-86.

Stock, J. H., Yogo, M., 2005. Testing for weak instruments in linear IV regression. In: Andrews, D.W., Stock, J.H. (Eds.), Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, 80-108.

Strobel, F., 2014. Bank insolvency risk and z-score measures: A refinement. Working Paper, University of Birmingham.

Uhde, A., Heimeshoff, U., 2009. Consolidation in banking and financial stability in Europe: Empirical evidence. Journal of Banking and Finance 33, 1299-1311.

Vallascas, F., Hagendorff, J., 2013. CEO bonus remuneration and bank default risk: Evidence from the U.S. and Europe. Financial Markets, Institutions & Instruments, 47-89.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48, 817-830.

Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data. MIT Press, Cambridge.

Statistical Appendix

Table 1
Geographical distribution of banks and availability of total variable compensation data

Country	Bank name	Total variable compensation
Austria	Erste Group Bank	2000-2010
	Hypo Alpe Adria	2003-2008
	Kommunalkredit Austria	2003-2007
	Raiffeisen Zentralbank Oesterreich	2005-2010
Belgium	Dexia	2004-2007
	Fortis (state-owned in 2008)	2001-2008
Czech Republic	Česká spořitelna	2004-2010
	Komercni Banka	2004-2010
Denmark	Danske Bank	2001-2010
France	Banque Populaire Group	2003-2008
	BNP Paribas	2000-2010
	Crédit Agricole	2005-2010
	Dexia Crédit Local	2005-2010
	Natexis / Natixis (since 2006)	2003-2010
	Société Générale	2000-2010
Germany	Bayerische Hypo- und Vereinsbank	2001-2003
	Bayerische Landesbank	2001-2007
	Commerzbank	2000-2010
	Deutsche Bank	2000-2010
	Deutsche Postbank	2004-2010
	Hypo Real Estate Holding	2003-2008
	KFW Bankengruppe	2004-2010
	Landwirtschaftliche Rentenbank	2004-2010
	West LB	2004-2008
Ireland	Allied Irish Banks	2000-2008
	Anglo Irish Bank	2000-2008
	Bank of Ireland	2000-2010
	Irish Life & Permanent	2000-2010
Italy	UniCredit Group	2002-2010
Netherlands	ABN Amro Holding	2000-2010
	Delta Lloyd Group	2001-2010
	Friesland Bank	2003-2010
	ING Groep	2000-2010
	NIBC Bank (NIBC Holding since 2003)	2002-2010
	Rabobank Nederland-Rabobank Group	2004-2010
	SNS Reaal	2002-2010
	Van Lanschot	2002-2010

Table 1 (continued)

Country	Bank name	Total variable compensation
Norway	SpareBank 1 SR-Bank	2004-2010
Poland	BRE Bank	2004-2010
	Kredyt Bank	2004-2009
Portugal	Banco BPI	2000-2010
	Banco Comercial Português	2002-2009
	Banco Espirito Santo	2003-2010
Spain	Banco Bilbao Vizcaya Argentaria	2000-2010
	Banco Espanol de Crédito	2004-2010
	Banco Popular Espanol	2005-2010
	Banco Santander	2002-2010
Sweden	AB Svensk Exportkredit	2003-2007
	Kommuninvest i Sverige	2004-2010
	Länsförsäkringar	2004-2009
	Nordea Bank	2000-2010
	Skandinaviska Enskilda Banken	2002-2010
	Svenska Handelsbanken	2002-2010
Switzerland	Banque Cantonale Vaudoise	2003-2010
	Credit Suisse Group	2002-2010
	UBS	2002-2010
United Kingdom	Barclays	2000-2010
	HBOS	2000-2007
	HSBC Holdings	2000-2010
	Lloyds Banking Group	2000-2010
	Northern Rock	2000-2008
	Royal Bank of Scotland Group	2000-2010
	Standard Chartered	2000-2010

Table 2
Description of variables and data sources

Variable	Description	Data sources
z-score	Natural log of the ratio of the sum of equity capital to total assets and the return on average assets before taxes (ROAA) to the standard deviation of ROAA. The standard deviation of ROAA is calculated employing a five-year rolling window.	BankScope, own calc.
Variable compensation	Sum of executive total variable compensation in million EUR per bank and year. If indicated by bank, sum of cash-based and equity-based (non-cash) performance-related compensation.	Banks' annual reports, SEC Form 20-F filings
Excess variable compensation	The residuals of a regression of variable compensation on bank size, country- and time-dummies.	Own calc.
Variable cash-based compensation	Sum of executive variable cash-based compensation in million EUR per bank and year.	Banks' annual reports, SEC Form 20-F filings
Excess variable cash-based compensation	The residuals of a regression of variable cash-based compensation on bank size, country- and time-dummies.	Own calc.
Variable equity-based compensation	Sum of executive variable equity-based compensation in million EUR per bank and year.	Banks' annual reports, SEC Form 20-F filings
Excess variable equity-based compensation	The residuals of a regression of variable equity-based compensation on bank size, country- and time-dummies.	Own calc.
Years	An executive's consecutive number of years on a bank board.	Banks' annual reports
Age	An executive's age in consecutive years on a bank board.	Banks' annual reports
Executive's quality	The ratio of an executive's consecutive years on board to an executive's age.	Own calc.
Average variable compensation	The sum of total variable compensation divided by the number of executives in charge per bank and year in million EUR.	Own calc.
Excess average variable compensation	The residuals of a regression of average variable compensation on bank size, country- and time-dummies.	Own calc.
Variable to fixed compensation	The ratio of the sum of executive total variable compensation to the sum of executive fixed compensation per bank and year.	Own calc.
Excess variable to fixed compensation	The residuals of a regression of the ratio of variable to fixed compensation on bank size, country- and time-dummies.	Own calc.
One-tier system	Dummy that takes on the value of 1 if a one-tier board structure is installed, and zero otherwise.	Banks' annual reports

Table 2 (continued)

Variable	Description	Data sources
Two-tier system	Dummy that takes on the value of 1 if a bank exhibits a two-tier board structure, and zero otherwise.	Banks' annual reports
Board size	The total number of executives on a bank board per bank and year.	Banks' annual reports
Non-executives to board size	The ratio of the number of non-executives to board size per bank and year serving as a proxy for board independence.	Banks' annual reports
Male executives	The total number of male executives on a bank board per bank and year.	Banks' annual reports
Female executives	The total number of female executives on a bank board per bank and year.	Banks' annual reports
ADRI	The corrected Anti-Director Rights Index (ADRI) per country and year. Originally from La Porta et al., 1998) and updated by Spamann (2010). The index ranges from 0 to 5 with higher index values indicating stronger shareholder rights.	Spamann (2010)
Stock-listed bank	Dummy that takes on the value of 1 if a bank is stock-listed, and zero otherwise.	
Non-stock-listed bank	Dummy that takes on the value of 1 if a bank is not stock-listed, and zero otherwise.	
Distance to default	A stock-listed bank's distance to default per year. The distance to default is calculated following the Merton framework (1973, 1974).	Datastream, own calc.
Systematic risk	A stock-listed bank's systematic risk (beta factor) per year. The beta factor is estimated from the standard CAPM (market model).	Datastream, own calc.
Idiosyncratic risk	A stock-listed bank's idiosyncratic risk per year. The idiosyncratic risk is estimated following the methodology proposed by Altunbas et al. (2014).	Datastream, Altunbas et al. (2014), own calc.
Business model	A bank's ratio of non-interest income to total operating income per year.	BankScope
High-risk bank	Dummy that takes on the value of 1 if a *z*-score-value is located in the first quartile of the distribution, and zero otherwise.	Own calc.
Low-risk bank	Dummy that takes on the value of 1 if a *z*-score-value is located in the fourth quartile of the distribution, and zero otherwise.	Own calc.
Pre-crisis	Dummy that takes on the value of 1 for the years 2000-2006, and zero otherwise.	Own calc.
Crisis	Dummy that takes on the value of 1 for the years 2007-2010, and zero otherwise.	Own calc.

Table 2 (continued)

Variable	Description	Data sources
Aid	Dummy that takes on the value of 1 in years when a bank has retrieved governmental guarantees of capital assistance, and zero otherwise.	European Commission (2010a, 2010b)
No aid	Dummy that takes on the value of 1 in years when a bank has not been supported by government, and zero otherwise.	European Commission (2010a, 2010b)
Deposit insurance	Index that measures the generosity of the deposit insurance regime. The index is built from the following deposit insurance design features: coinsurance, coverage of foreign currency and interbank deposits, type of funding, source of funding, management, membership, and the level of explicit coverage. Higher index values indicate greater generosity.	Demirgüç-Kunt and Detragiache (2002), World Bank surveys, own calc.
Supervisory power	The principal component of the following queries as employed in World Bank surveys (2001, 2003, 2007 and 2012) provided by Barth et al. (2012): (a) Can supervisors take legal action against bank directors and officers?, (b) Can supervisors suspend CEO's fees and bonuses?, (c) Can supervisors supersede shareholder rights and remove/replace CEOs?, (d) Are at least 100 percent of the largest 10 banks be rated by international rating agencies?, (e) Are bank directors and officials legally liable for the accuracy of information disclosed to the public?, (f) Are external auditors licensed or certified?, (g) Do supervisors receive a copy of the auditor's report?, (h) Are auditors legally required to report bank misconduct to supervisors?, and (i) Can supervisors take legal action against external auditors? Higher index values indicate greater supervisory power.	World Bank surveys
GDP	The natural log of a country's GDP in constant EUR per year.	World Bank's WDI
Slope	Slope of the yield curve. Calculated as 10-year minus 2-year government bond yields per country and year.	Datastream
Leverage	A bank's leverage ratio calculated as debt to equity per year.	BankScope
Tier1	A bank's ratio of Tier 1 capital to risk-weighted assets per year.	BankScope
Liquidity	A bank's liquidity ratio. Calculated as 1 minus the ratio of net loans to total assets per year.	BankScope

Table 3
Descriptive statistics (absolute values in million EUR)

Variable	N	Mean	SD	Min	Max
z-score	693	1.1729	0.423	–1.4861	2.2558
Variable compensation	489	5.6993	14.6052	0	156.01
Excess variable compensation	489	0.0015	0.137	–0.2354	1.2288
Variable cash-based compensation	335	4.3122	8.2344	0	66.75
Excess variable cash-based compensation	335	0.0017	0.0737	–0.1155	0.5246
Variable equity-based compensation	154	7.9444	16.8493	0	89.26
Excess variable equity-based compensation	154	0.0055	0.1576	–0.2114	0.7924
Years	585	12.9362	5.9925	2	18
Age	585	49.5704	7.0139	32	72
Executive's quality	585	0.2571	0.1028	0.0417	0.6667
Average variable compensation	489	0.8727	1.5063	0	11.0525
Excess average variable compensation	489	0.0032	0.0133	–0.0322	0.092
Variable to fixed compensation	489	1.4554	2.3938	0	17.8913
Excess variable to fixed compensation	489	0.0052	0.0224	–0.0394	0.1650
One-tier system	585	0.3333	0.4718	0	1
Two-tier system	585	0.6667	0.4718	0	1
Board size	585	8.1145	3.4016	4	25
Non-executives to board size	585	0.6806	0.1281	0.2857	0.6565
Male executives	585	5.7778	3.1675	4	21
Female executives	585	0.3368	0.7006	0	4
ADRI	638	3.1505	1.0991	0	5
Stock-listed bank	693	0.6349	0.4814	0	1
Non-stock-listed bank	693	0.3651	0.4814	0	1
Distance to default	440	4.47	2.4333	0.0016	16.9722
Systematic risk	440	0.8429	0.4525	1.0106	2.3248
Idiosyncratic risk	440	0.0503	0.0901	0.0028	0.9399
Business model	652	0.4109	1.1339	–17.2857	17.7039
High-risk bank	693	0.2294	0.4208	0	1
Low-risk bank	693	0.3117	0.4635	0	1
Pre-crisis	693	0.6364	0.4814	0	1
Crisis	693	0.3636	0.4814	0	1
Aid	693	0.2857	0.4521	0	1
No aid	693	0.7143	0.4521	0	1
Deposit insurance	638	2.8950	1.4186	0	6
Supervisory power	636	0.2111	1.0032	–5.8359	2.3498
GDP	693	27.0972	1.0071	24.8601	28.5078
Slope	693	0.9925	0.6532	–0.0014	2.781
Leverage	635	0.3124	0.6181	0.0745	12.49
Tier1	634	0.0772	0.0399	0.004	0.347
Liquidity	652	0.4996	0.1815	0.0856	0.9921

Figure 1
Development of *z*-score and variable compensation averaged by the number of banks per year

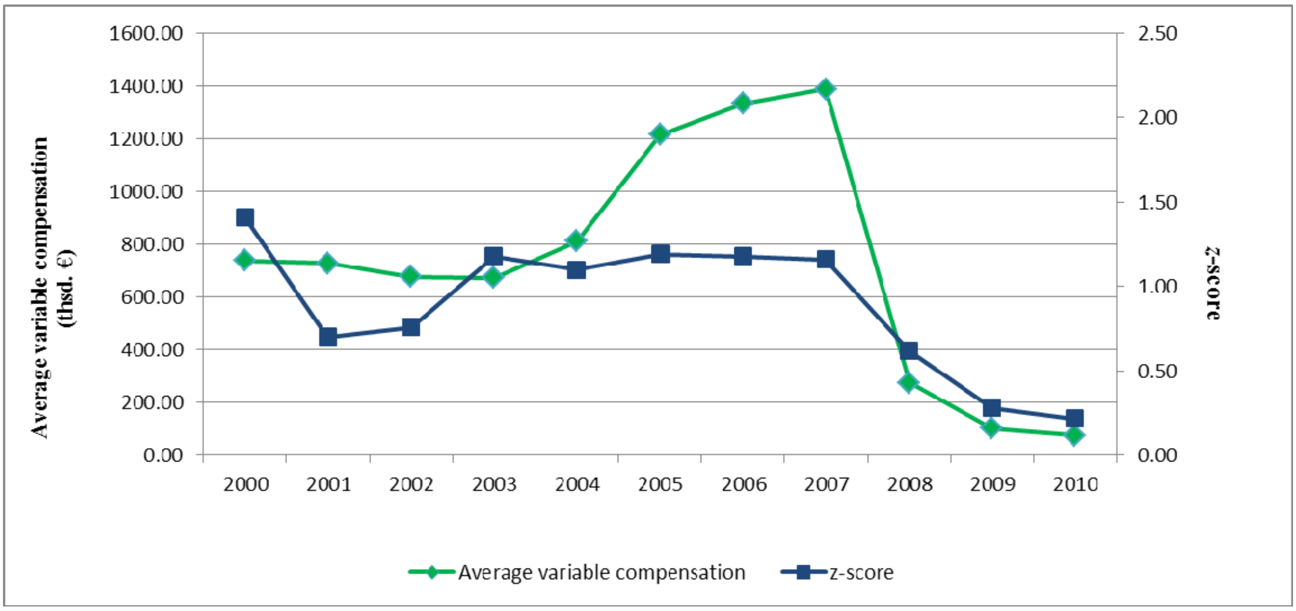

Table 4
Baseline regressions

	(1)	(2)	(3)
Excess variable compensation $_{(t–1)}$	–0.2542***		
	(0.0000)		
Excess variable cash-based compensation $_{(t–1)}$		–0.3565***	
		(0.0043)	
Excess variable equity-based compensation $_{(t–1)}$			–0.2271***
			(0.0077)
GDP	0.0550	0.0524	0.0472
	(0.5882)	(0.3755)	(0.4340)
Slope	0.0420*	0.0316**	0.0371**
	(0.0757)	(0.0253)	(0.0391)
Leverage	–0.0635**	–0.0517***	–0.0518***
	(0.0131)	(0.0000)	(0.0008)
Tier1	1.0982**	0.9550*	0.9058**
	(0.0236)	(0.0766)	(0.0117)
Liquidity	0.2207	0.1669	0.1319
	(0.1084)	(0.5113)	(0.4204)
Cluster at bank-level	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
No. of obs.	459	325	134
No. of groups	63	44	19
Adj. R^2	0.32	0.24	0.22

The fixed-effects panel model estimated is *z*-score $_{(i=\text{bank},\ j=\text{time})}$ = $\alpha + \beta_1$ Compensation$_{i,t-1}$ + β_2 GDP$_{i,t}$ + β_3 Slope$_{i,t}$ + β_4 Leverage$_{i,t}$ + β_5 Tier1$_{i,t}$ + β_6 Liquidity$_{i,t}$ + μ_t + $\varepsilon_{i,t}$. Constant term included but not reported. Heteroscedasticity consistent p-values are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively. Excess variable compensation is substituted by excess variable cash-based and excess variable equity-based compensation in regressions (2) and (3).

Table 5
Granger-causality tests

	(1) *z*-score → compensation	(2) Compensation → *z*-score
Excess variable compensation $_{(t-1)}$	0.4032***	–0.1999**
	(0.0000)	(0.0360)
z-score $_{(t-1)}$	0.0209	0.3353***
	(0.4980)	(0.0001)
GDP	0.0237	0.0650
	(0.8057)	(0.4083)
Slope	0.0172	0.0200*
	(0.1251)	(0.0912)
Leverage	0.0013*	–0.0451***
	(0.0643)	(0.0005)
Tier1	0.3528	0.7004***
	(0.1227)	(0.0076)
Liquidity	0.0877***	0.1224
	(0.0063)	(0.4172)
Cluster at bank-level	Yes	Yes
Time dummies	Yes	Yes
No. of obs.	459	459
No. of groups	63	63
Adj. R^2	0.18	0.46
Fisher-type unit root test (z-score)		
ADF (inverse χ^2, p-value)	114.01 (0.0045)	
Phillips-Perron (inverse χ^2, p-value)	225.91 (0.0089)	
Fisher-type unit root test (compensation)		
ADF (inverse χ^2, p-value)	260.96 (0.0000)	
Phillips-Perron (inverse χ^2, p-value)	252.96 (0.0000)	
Granger-causality (lag order of 1, based on AIC & SIC)		
H0: *z*-score does not GC compensation (F-test, p-value)	0.46 (0.4980)	
H0: compensation does not GC *z*-score (F-test, p-value)		4.59 (0.0360)

The empirical model and estimation parameters are defined in Table 4. In regression (1) excess variable compensation is regressed on a one-period lag of itself and on the one-period lagged *z*-score. In regression (2) *z*-score is regressed on a one-period lag of itself and on the one-period lagged excess variable compensation.

Table 6
2SLS IV regression

	(1) 1st stage regression	(2)
Excess variable compensation $_{(t-1)}$		–0.2616***
		(0.0043)
Executive's quality $_{(t-1)}$	3.4144***	
	(0.0000)	
GDP	0.0793	0.0553
	(0.2134)	(0.5771)
Slope	0.0023**	0.0221*
	(0.0415)	(0.0611)
Leverage	0.0084*	–0.0415***
	(0.0633)	(0.0093)
Tier1	0.0573	1.0621**
	(0.3814)	(0.0172)
Liquidity	0.4344**	0.2147*
	(0.0113)	(0.0954)
Cluster at bank-level	Yes	Yes
Time dummies	Yes	Yes
No. of obs.	459	459
No. of groups	63	63
Adj. R^2		0.34
Centered R^2	0.48	
F-test	13.26	
Stock-Yogo critical value (10 %)	16.38	
KP rK LM Statistic	16.242***	
KP rK Wald F Statistic	14.921	
Hansen J statistic (p-value)	0.000	

Regressions are estimated by means of a 2SLS instrumental variable regression. Excess variable compensation is instrumented by the one-period lagged ratio of an executive's years on board to an executive's age serving as a proxy for an executive's quality. Results from the 1st stage regression are shown in specification (1).

Table 7
Robustness checks

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Excess variable compensation $_{(t–1)}$	–0.2675***	–0.2744***				
	(0.0000)	(0.0000)				
Excess average variable compensation $_{(t–1)}$			–0.1984***			
			(0.0000)			
Excess variable compensation (winsorized) $_{(t–1)}$				–0.2277***		
				(0.0003)		
Excess variable to fixed compensation $_{(t–1)}$					–0.1238***	
					(0.0049)	
Excess variable to fixed compensation > $1_{(t–1)}$						–0.3231***
						(0.0000)
GDP	0.0656		0.0476	0.0516	0.0769	0.0750
	(0.3598)		(0.6569)	(0.1682)	(0.4632)	(0.5108)
Slope	0.0479*		0.0250*	0.0209*	0.0263*	0.0319
	(0.0822)		(0.0890)	(0.0691)	(0.0963)	(0.1139)
Leverage			–0.0741**	–0.0827**	–0.0631**	–0.0420***
			(0.0150)	(0.0148)	(0.0135)	(0.0000)
Tier1			1.1197**	1.1414**	1.1032**	1.1542*
			(0.0141)	(0.0265)	(0.0211)	(0.0747)
Liquidity			0.2438	0.2447	0.2441	0.2764
			(0.2635)	(0.1743)	(0.1699)	(0.2893)
Cluster at bank–level	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	489	489	459	459	459	213
No. of groups	63	63	63	63	63	49
Adj. R^2	0.22	0.14	0.30	0.33	0.32	0.19

The empirical model and estimation parameters are defined in Table 4.

Table 8a
Sensitivity analyses: Board characteristics

	(1a)	(1b)	(2)	(3)	(4a)	(4b)	(5)
Excess variable compensation $_{(t-1)}$	-0.2628^{***}	-0.0986^{*}	-0.2402^{***}	-0.2474^{***}	-0.3416^{***}	-0.1659^{*}	-0.2179^{***}
	(0.0000)	(0.0773)	(0.0002)	(0.0000)	(0.0000)	(0.0862)	(0.0000)
Board size			0.0673				
			(0.3703)				
Non-executives to board size				0.0564			
				(0.6932)			
ADRI							-0.1295^{**}
							(0.0251)
Excess variable compensation * ADRI $_{(t-1)}$							-0.4550^{***}
							(0.0094)
GDP	0.0913	0.0768	0.0368	0.0646	0.0870	0.0538	0.0336
	(0.5451)	(0.4213)	(0.7856)	(0.5667)	(0.5766)	(0.2419)	(0.7910)
Slope	0.0514^{**}	0.0702	0.0292^{**}	0.0255^{**}	0.0470^{**}	0.0852	0.0484^{*}
	(0.0388)	(0.1437)	(0.0461)	(0.0222)	(0.0461)	(0.1262)	(0.0779)
Leverage	-0.0579^{***}	-0.0974^{***}	-0.0629^{**}	-0.0649^{**}	-0.0645^{**}	-0.0725^{*}	-0.0551^{***}
	(0.0081)	(0.0000)	(0.0122)	(0.0140)	(0.0112)	(0.0950)	(0.0007)
Tier1	1.0125^{*}	0.9467^{*}	1.2827^{**}	0.9327^{**}	0.9738^{**}	1.0383^{*}	1.0598^{**}
	(0.0810)	(0.0589)	(0.0156)	(0.0145)	(0.0429)	(0.0792)	(0.0375)
Liquidity	0.2939	0.2197	0.1836	0.2822	0.2868	0.2522	0.2135
	(0.1977)	(0.4867)	(0.2331)	(0.4868)	(0.5555)	(0.1731)	(0.1532)
Cluster at bank–level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	278	181	459	459	343	116	459
No. of groups	42	21	63	63	39	24	63
Adj. R^2	0.21	0.22	0.34	0.30	0.30	0.10	0.35

The empirical model and estimation parameters are defined in Table 4. Regression (1a) includes banks with a one-tier board structure whereas regression (1b) comprises of banks with a two-tier system. Regression (2) controls for a bank's board size while regression (3) further controls for board independence. Regression (4a) includes banks with exceptionally male executives on board whereas regression (4b) comprises of banks with at least one female executive among the board's executives. The effect of anti-directors rights is investigated in regression (5).

Table 8b
Sensitivity analyses: Bank characteristics

	(1a)	(1b)	(2a)	(2b)	(2c)	(3)	(4a)	(4b)
Excess variable compensation $_{(t-1)}$	–0.3273***	–0.1618**	–0.7402**	0.3355**	0.3531*	–0.2112***	–0.3642*	–0.1401
	(0.0001)	(0.0124)	(0.0483)	(0.0174)	(0.0821)	(0.0000)	(0.0759)	(0.3780)
Business model						–0.0158**		
						(0.0149)		
Excess variable compensation * Business model $_{(t-1)}$						–0.3564***		
						(0.0065)		
GDP	0.0624*	0.0825	0.0467**	–0.0561	–0.0260	0.0651	0.0697	0.0893
	(0.0702)	(0.2943)	(0.0298)	(0.2345)	(0.8052)	(0.5811)	(0.3897)	(0.2075)
Slope	0.0800	0.0278**	0.0436*	–0.0508	–0.0342*	0.0134*	0.0977*	0.0144
	(0.4024)	(0.0266)	(0.0826)	(0.1091)	(0.0875)	(0.0636)	(0.0987)	(0.1722)
Leverage	–0.0466**	–0.0895***	–0.1855	0.1660**	0.1362	–0.0591***	–0.1583**	–0.0974**
	(0.0134)	(0.0001)	(0.7991)	(0.0341)	(0.6348)	(0.0004)	(0.0294)	(0.0106)
Tier1	1.1049**	0.9574	1.2863	–1.1694*	–1.4576	1.0368**	1.7552*	1.0749
	(0.0302)	(0.5394)	(0.4063)	(0.0981)	(0.7990)	(0.0199)	(0.0512)	(0.1914)
Liquidity	0.2495***	0.1652	0.2516	–0.2910	–0.3522	0.1981	0.4223***	0.2433
	(0.0003)	(0.6961)	(0.7272)	(0.7820)	(0.6874)	(0.1320)	(0.0030)	(0.3038)
Cluster at bank–level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	324	135	324	324	324	459	109	119
No. of groups	40	23	40	40	40	63	19	21
Adj. R^2	0.51	0.38	0.16	0.15	0.17	0.36	0.48	0.47

The empirical model and estimation parameters are defined in Table 4. Regression (1a) includes stock-listed banks whereas regression (1b) comprises of non-stock-listed banks from the sample. The *z*-score measure is substituted by a bank’s distance-to-default, systematic risk and idiosyncratic risk in regressions (2a)-(2c) respectively. The effect of a bank’s business model is investigated by regression (3). Regression (4a) includes high-risk banks (*z*-score values located in the first quartile of distribution) whereas regression (4b) comprises of low-risk banks (*z*-score values located in the fourth quartile).

Table 8c
Sensitivity analyses: Financial crisis and regulatory framework

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4)	(5)
Excess variable compensation $_{(t-1)}$	–0.2979***	–0.0436			–0.1858***	–0.2420**	–0.1832**	–0.1716***
	(0.0004)	(0.6294)			(0.0051)	(0.0483)	(0.0374)	(0.0023)
Excess variable compensation $_{(2000\text{-}2006)}$			–0.2625***					
			(0.0000)					
Excess variable compensation $_{(2006)}$				–0.4159***				
				(0.0006)				
Deposit insurance							–0.0150	
							(0.3341)	
Excess variable compensation * Deposit insurance $_{(t-1)}$							–0.2830**	
							(0.0462)	
Supervisory power								0.3825***
								(0.0000)
Excess variable compensation * Supervisory power $_{(t-1)}$								–0.0386**
								(0.0356)
GDP	0.1114	0.1318*	0.0175	0.0435	0.0327	0.0949	0.1046	0.0606
	(0.4222)	(0.0939)	(0.8964)	(0.1491)	(0.8584)	(0.3419)	(0.4432)	(0.2457)
Slope	0.0176	0.0799**	0.0173	0.0374	0.0452	0.0472**	0.0456	0.0284***
	(0.1628)	(0.0351)	(0.7116)	(0.8044)	(0.9615)	(0.0293)	(0.1081)	(0.0034)
Leverage	–0.1118***	–0.0594**	–0.0487**	–0.0646***	–0.1691**	–0.1571*	–0.0428***	–0.0137***
	(0.0000)	(0.0257)	(0.0412)	(0.0000)	(0.0125)	(0.0805)	(0.0000)	(0.0043)
Tier1	0.3663*	1.8253***	0.9485	0.9711***	1.3707***	0.7319***	0.9947**	0.9965
	(0.0660)	(0.0005)	(0.1322)	(0.0099)	(0.0054)	(0.0067)	(0.0264)	(0.1076)
Liquidity	0.0531	0.3287**	0.2055	0.2252	0.4243*	0.2597*	0.2296	0.2451*
	(0.6498)	(0.0453)	(0.6313)	(0.6195)	(0.0538)	(0.0562)	(0.1928)	(0.0530)
Cluster at bank–level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	No	No	No	No	Yes	Yes	Yes	Yes
No. of obs.	241	218	459	459	129	330	454	452
No. of groups	63	63	63	63	18	45	63	63
Adj. R^2	0.28	0.31	0.28	0.32	0.13	0.21	0.37	0.32

The empirical model and estimation parameters are defined in Table 4. Regression (1a) refers to the pre-crisis period (2000-2006) whereas regression (1b) is based on the crisis period (2007-2010). In specification (2a) *z*-score values from 2007 to 2010 are panel-regressed on excess variable compensation values from 2000 to 2006. Similarly, *z*-score values from 2007 to 2010 are pooled- regressed on excess variable compensation values from 2006 in specification (2b). Regression (3a) includes banks which retrieved governmental capital aid and guarantees during the crisis whereas regression (3b) comprises of banks which were not supported during the crisis period. The effect of the deposit insurance system is analyzed in regression (4) while the impact of supervisory power is investigated in regression (5).

Table 9a
Correlation matrix: Baseline regression and robustness checks

	z-score	Excess variable compensation	Excess variable cash-based compensation	Excess variable equity-based compensation	Executive's quality	Excess average variable compensation	Excess variable to fixed compensation	GDP	Slope	Leverage	Tier1	Liquidity
z-score	1.00											
Excess variable compensation	–0.05*	1.00										
Excess variable cash-based compensation	–0.14*	0.88***	1.00									
Excess variable equity-based compensation	–0.07*	0.94***	0.72***	1.00								
Executive's quality	–0.06	0.57***	0.61***	0.58***	1.00							
Excess average variable compensation	–0.04*	0.86***	0.82***	0.82***	0.84***	1.00						
Excess variable to fixed compensation	–0.04*	0.74***	0.76***	0.88***	0.70***	0.90***	1.00					
GDP	0.22***	0.19***	0.18**	0.17**	0.02*	0.11*	0.09*	1.00				
Slope	0.02	0.01	0.02	0.04	0.01**	0.05	0.03	0.09**	1.00			
Leverage	–0.11***	0.01*	–0.03	–0.01	–0.01	–0.04*	–0.03*	0.07	0.05	1.00		
Tier1	0.10*	0.19***	0.23***	0.26***	0.08**	0.14**	0.18***	0.06*	0.07	–0.04**	1.00	
Liquidity	0.13**	0.13**	0.23***	0.11*	0.14*	0.08*	0.10*	0.28***	0.02**	–0.03	0.10*	1.00

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

Table 9b
Correlation matrix: Sensitivity analyses

	z-score	Excess variable compensation	Board size	Non-executives to board size	Male executives	Female executives	ADRI	Distance to default	Systematic risk	Idiosyncratic risk	Business model	Deposit insurance	Supervisory power	GDP	Slope	Leverage	Tier1	Liquidity
z-score	1.00																	
Excess variable compensation	–0.05*	1.00																
Board size	0.05	0.09*	1.00															
Non-executives to board size	0.03	–0.34***	0.13**	1.00														
Male executives	–0.01	0.35***	0.43***	–0.71***	1.00													
Female executives	0.02	0.05*	0.14***	–0.73***	0.04***	1.00												
ADRI	–0.22***	0.05*	0.16***	–0.01	0.09**	–0.04	1.00											
Distance to default	0.17***	–0.17*	0.01	0.03	–0.04*	0.08	–0.11**	1.00										
Systematic risk	–0.15**	0.14*	–0.02	–0.06	0.05*	–0.06	0.07*	–0.34***	1.00									
Idiosyncratic risk	–0.19***	0.15*	–0.03	–0.01	0.04*	–0.02	0.06*	–0.32***	0.35***	1.00								
Business model	–0.03	0.09*	0.06*	0.06	0.12*	–0.02	0.16*	–0.10*	0.05**	0.02***	1.00							
Deposit insurance	–0.11*	0.13***	0.03*	–0.44***	0.14***	0.07***	0.08**	–0.10**	0.04	0.02	0.06*	1.00						
Supervisory power	0.28***	–0.01	0.07	0.01	0.06	0.01	–0.11**	0.20***	–0.09*	–0.06*	0.02	–0.07*	1.00					
GDP	0.22***	0.19***	0.13**	0.35***	0.20***	0.19***	0.08	0.05	–0.37***	–0.12*	0.05	–0.22***	–0.25***	1.00				
Slope	0.02	0.01	0.05*	0.12**	0.10*	0.02	–0.08*	0.39***	–0.05	–0.03	0.03	–0.06	0.01	–0.06	1.00			
Leverage	–0.21***	0.01*	0.06*	0.03	0.09*	0.12**	–0.05	–0.12*	0.31***	0.11*	–0.06	0.02	–0.33***	0.07	0.09**	1.00		
Tier1	0.10*	0.19***	–0.01	–0.09*	–0.07*	–0.07*	0.11**	0.23***	–0.14**	–0.11*	–0.05	–0.17***	0.10*	–0.06	0.07	0.05	1.00	
Liquidity	0.13**	0.13**	0.27***	0.23***	0.18*	0.14***	–0.28***	0.11*	–0.40***	–0.07	0.11**	–0.25***	–0.14***	0.28***	0.06*	0.07	–0.04**	1.00

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

Technical Appendix

1. Calculation of the distance-to-default

According to the Merton framework (1973, 1974) and standard option-pricing models provided by Black and Scholes (1973) the bank's d*istance-to-default* (DtD) is calculated as

$$DtD \equiv \frac{ln\left(\frac{V_A}{DB}\right)+\left(\mu-\frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}}, \tag{1}$$

where V_A denotes the bank's asset value (share price), μ is the drift rate of assets, σ_A is the standard deviation of assets, *DB* represents the distress barrier defined as the face value of short term liabilities (maturity ≤ 1 year) plus half of the amount of long term liabilities (maturity > 1 year) and *T* is the maturity of bank debt. Designed in this way, the DtD is associated with the probability that the market value of a bank's assets falls below the value of its debt within a given time horizon (one year). Accordingly, a higher (lower) DtD implies lower (higher) bank risk. Data to calculate the DtD for each stock-listed bank are retrieved from Thomson Reuter's Datastream database. We include the change in the DtD per bank and year.

2. Calculation of systematic and idiosyncratic risk

As regards the bank's *systematic risk*, beta coefficients are estimated from the standard CAPM (market model) as follows:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{it}, \tag{2}$$

where $R_{i,t}$ is the stock return on bank *i* in year *t*, $R_{m,t}$ is the market return (national blue chip indices) in year *t*, α_i is the intercept, β_i is the beta factor for bank *i* and $\varepsilon_{i,t}$ is the error term. Following Altunbas et. al. (2014) the *idiosyncratic component* is then simply given by the unexplained regression for bank *i* over each year *t*. We calculate the systematic and idiosyncratic risk for each stock-listed bank in our sample and for each specific year, using daily data on bank stock returns and national index returns retrieved from Thomson Reuter's Datastream database.