Risk Managers in Banks*

Matthias Efing†
(HEC Paris)

Patrick Kampkötter‡
(University of Tübingen)

June 4, 2021

ABSTRACT

How do banks remunerate risk managers? Studying 127 banks during the years 2003 to 2007, we show that the performance-linked pay of risk managers is positively aligned with the performance-linked pay of traders and loan officers. A risk manager receives a 13.6 to 33.5 Cents higher bonus when bonuses in front offices increase by one Euro. This finding is not fully explained by labor markets or by risk-sharing among employees. Risk managers whose remuneration is strongly aligned with performance pay in front offices tend to work for banks that did better in the crisis of 2008-2009. These findings are consistent with predictions we derive from a model of efficient risk manager compensation.

JEL classification: G20, G21, J3.

Keywords: risk management, governance, optimal contracts, pay-for-performance, risk-taking.

*We thank Bruno Biais, Jean-Edouard Colliard, Denis Gromb, Johan Hombert, Augustin Landier, and participants of the Junior European Finance Seminar for helpful comments and suggestions. We thank Harald Hau, Marcel Thum, and Johannes Steinbrecher for sharing data. Matthias Efing acknowledges financial support from Investissements d'Avenir (ANR-11-IDEX-0003 / Labex Ecodec / ANR-11-LABX-0047).

†HEC Paris, Rue de la Libération 1, FR-78350 Jouy-en-Josas, efing@hec.fr.

‡University of Tübingen, Nauklerstr. 47, DE-72074 Tübingen, patrick.kampkoetter@uni-tuebingen.de.

I. Introduction

The financial crisis of 2008-2009 has, in part, been attributed to risk management failures in banks (e.g., Hoenig, 2008; Kashyap, Rajan, and Stein, 2008; Stulz, 2008). Risk managers, it is argued, did not have the level of independence and authority that would have been necessary to prevent front offices (FOs) from taking excessive risk. In particular, concerns have been raised regarding the design of risk managers' remuneration:

> *A conflict of interest is created if the performance measures applied to them [risk managers], or the bonus pool from which awards are drawn, depend substantially on the financial results of the lines of business or business activities that such staff oversee [...] Thus, risk management and control personnel should be compensated in a way that makes their incentives independent of the lines of business whose risk taking and incentive compensation they monitor and control.*
>
> Federal Reserve Board (2011, p.22)

These concerns have motivated far-reaching reforms that regulate the contracts between banks and risk managers. For example, when Germany adapted the EU Capital Requiremnets Directive IV in 2013, it required that the variable incentive pay of risk managers and employees in FOs must not depend on the same performance parameters.[1]

In the first part of this paper, we take a step back and ask the following questions: How were risk managers compensated in the years leading up to the financial crisis? Is it true that banks aligned the variable performance pay of risk managers and front office employees? And, if yes, was such an alignment of employees' financial incentives really associated with weaker bank governance and weaker performance during the financial crisisi of 2008 and 2009? In the second part of this paper, we then compare our empirical findings against a theoretical model with mulitple agents that endogenizes the compensation of risk managers.

[1] In 2013, the European Parliament passed new regulations under the Capital Requirements Directive IV to strengthen banks' internal control units. The directive was implemented by the EU member states. In Germany, those regulations that target bank employee compensation were enacted in the Institutsvergütungsverordnung.

In our empirical analysis, we study a unique data set that was provided by a pay consultant. It offers three advantages. First, it shows the fixed and variable pay and the career paths of risk managers below the executive level and, in fact, of employees in all bank divisions including loan officers, traders, etc. Second, these data are available for 127 German banks and the period from 2003 to 2007, which is often associated with excessive risk-taking. Third, for each risk manager, we know the identity of the main front offices (FOs) that the risk manager is responsible for. Some risk managers only supervise credit risk and loan officers whereas others also supervise capital markets-oriented activities like trading.

Our empirical analysis starts with a simple test whether risk managers' incentive pay is indeed aligned with the incentive pay in FOs. Specifically, we regress a risk manager's short-term performance bonus on the average short-term performance bonus paid in the FOs that he or she supervises. Our baseline result shows that risk managers' bonus pay is not orthogonal but positively correlated with bonus pay in FOs. The average risk manager receives a 13.6 Cents higher bonus if bonuses in the FOs he supervises increase by, on average, one Euro. When we focus on senior risk managers in managerial positions (but still below the executive level), this bonus sensitivity increases to 33.5 Cents for each Euro that the average FO employee receives as a bonus. Equivalently, if performance pay in FOs increases by one standard deviation ($\approx$ Euro 19,575), a senior risk manager receives a Euro 6,558 higher bonus. This alignment of short-term incentive pay is FO-specific—i.e., the bonuses of risk managers that supervise mainly credit risk (respectively, market risk) are more aligned with the bonuses of loan officers (respectively, traders).

Having established a strong correlation between the incentive pay of risk managers and FO employees, we try to narrow down the set of possible explanations for this empirical finding—starting with labor markets as a determinant of bonus pay. Specifically, we consider the possibility that the reservation wages (outside options) of risk managers and FO employees are positively correlated and that banks pay them correlated retention bonuses. To rule out this explanation, we first estimate regressions that control for labor demand for

a given type of risk manager or FO employee. Our baseline finding remains robust. Second, we standardize an employee's bonus by the average bonus of similar employees in other banks—that is, we measure an employee's performance pay relative to other employees in the same labor market. We find that risk managers earn a 36% higher bonus than their peers in other banks when the FOs that they supervise earn a 100% higher bonus relative to comparable FOs in other banks. Overall, labor markets do not seem to explain the positive bonus correlation between risk management and FOs.

A second explanation could be risk-sharing between banks and employees. Thanassoulis (2012) and Efing, Hau, Kampkötter, and Rochet (2018) show that banks tend to cut bonuses of all their employees (in FOs as well as in back offices) when they need to preserve financial resources. In other words, the bonuses of risk managers and FO employees could both be correlated with banks' financial constraints. To control for this explanation, we include bank times year fixed effects and thereby hold overall bank performance and funding needs constant. Identification then only relies on bonus variation across risk managers that belong to the same bank-year but supervise different FOs (with different FO-level performance). Indeed, we find that the inclusion of bank-year fixed effects reduces risk managers' bonus sensitivity to FO pay from 13.6 to 3.8 Cents. However, this finding strongly depends on risk managers' seniority. Bank-year fixed effects do not explain a strong bonus correlation between FOs and *senior* risk managers in managerial positions. Even conditionally on bank-year fixed effects, the risk managers that truly matter (those with the power to approve or reject investments) still earn 22.3 Cents higher bonuses when bonus pay in the FOs they supervise increases by one Euro.

Third, we consider the regulatory hypothesis of the Federal Reserve Board (2011) that aligned financial incentives between risk management and FOs create a conflict of interest. Allegedly, risk managers are less likely to oppose excessive risk taking by traders and loan officers if performance-linked pay in risk management and FOs depends on similar performance metrics. According to this hypothesis, the observed correlation of short-term performance

pay between risk management and FOs is predicted to pose an inefficient governance failure.

We test two conjectures of this regulatory hypothesis. First, we ask whether the better governed banks in our sample provide their risk managers and FOs with less correlated incentives. The argument is the following: *If* the regulatory hypothesis is correct and efficient risk manager pay is necessarily independent from FOs, then at least the well-governed banks will design remuneration accordingly. Similar to Ellul and Yerramilli (2013), we construct an index that aggregates the competence of banks' supervisory boards and CROs into one measure of governance quality.[2] Then we test whether incentive pay is indeed less aligned between risk management and FOs in the better governed banks. This is not what we find. Depending on the controls we include in our regressions, either governance quality is irrelevant for risk manager pay or the incentive pay of risk managers in banks with better governance is slightly more and not less aligned with incentive pay in FOs.[3]

Finally, we test directly whether an alignment of incentive pay between risk management and FOs fosters risk-taking. As risk managers are probably not supposed to prevent all risk-taking but only extreme exposures to tail risk, we focus on bank performance during the recent financial crisis. We find no evidence that banks with higher bonus correlations between 2003 to 2007 perform worse during the crisis. In fact, the opposite appears to be true. Banks with more aligned incentive pay between risk management and FOs are more profitable (make smaller losses). This result is driven by capital markets-oriented activities like trading and by risk managers supervising market risk. Risk management that only supervises credit risk does not predict crisis performance.

Overall, we find no evidence for the regulatory hypothesis that aligned incentive pay between risk management and FOs constitutes a governance failure. If anything, our findings

[2]We thank Hau and Thum (2014) and Steinbrecher (2015) for sharing data about the professional experience and education of 761 directors on the supervisory boards of German banks.

[3]One could argue that good governance and well-designed risk manager remuneration are substitutes. For example, more competent directors on the supervisory boards of German banks could make independent risk management obsolete. However, in the German two-tier board setting, the supervisory board is not given sufficient resources (nor the mandate) to monitor each individual lending and trading decision itself. Competent directors are more likely to delegate this task to a well-designed risk management function.

point towards the opposite conclusion that aligned incentive pay is efficient. However, we are careful to acknowledge econometric challenges that our analysis shares with many other studies on governance and employee compensation.[4] In particular, risk manager compensation is likely endogenous. Although our findings remain robust when we use the incentive pay of accountants, IT support, and other bank employees with no direct influence on risk taking as an instrument, identification remains imperfect. Given the empirical challenges, we choose another approach in the second part of the paper and show theoretically that aligned incentive pay between risk management and FOs can, in fact, be efficient.

Our model features a risk-neutral FO employee who has two tasks. First, the FO employee must decide whether to invest into a project of good or bad type. Second, conditionally on investment, she must decide whether to exert effort to increase the return of the (good) project. Project types and private effort are unobservable. To incentivize the FO employee to spend effort on improving the return of the good project, the bank can pay her a bonus for high return realizations. However, in doing so, the bank also incentivizes the FO employee to implement the bad-type project, which does not require effort and offers a high return, albeit by exposing the bank to excessive risk. As a result, the bank is forced either to pay the FO employee a rent (to deter excessive risk taking) or to accept that the agent exerts too little effort on improving the good, safe project.

To solve this moral hazard problem, the bank can hire a second risk-neutral agent. This risk manager exerts unobservable effort to screen the investment chosen by the FO and has the power to reject it. In some sense, hiring the risk manager allows the bank to address a multitasking problem by assigning the task of selecting projects to one agent and the task of improving projects to another. The advantage of separating both tasks is that the bank does not need to pay the FO employee a rent anymore. The disadvantage is that the bank must incentivize the risk manager to exert effort on screening the project chosen by the FO.

A key insight of our theoretical analysis is that the risk manager has *two* incentive

[4]See, for example, the literature survey on executive compensation by Edmans, Gabaix, and Jenter (2017).

compatibility constraints, which reflect two ways in which the risk manager can shirk. First, a *No Excessive Approval* constraint limits the risk manager's compensation for high return realizations. If this constraint is violated, the risk manager stops screening and simply approves all projects. Hence, the *No Excessive Approval* constraint captures the regulatory concern that risk manager and FO collude if risk managers participate too much in the upside of FO performance. However, our model shows that risk manager pay must also satisfy a *No Excessive Rejection* constraint, which requires strictly positive participation of the risk manager in FO performance. If this second incentive compatibility constraint is violated, the risk manager stops exerting effort and simply rejects all projects, including the good type.

Overall, our model predicts that the risk manager's compensation in the case of a high investment return must be moderate but strictly larger than for a low return realization. As FO pay is positively sensitive to investment returns as well (to incentivize effort for improving the good project), incentive pay is, hence, positively aligned between risk management and FO—consistent with our empirical findings. Indeed, if the bank *underexposes* its risk manager to FO performance, then the FO *underinvests* in the good-type project, and, hence, the bank underperforms. This prediction is again consistent with our finding that banks with higher bonus correlations between risk management and FOs performed better in the crisis.

Finally, we study two extensions of our analysis. First, we analyze the effect on risk manager pay if part of bank losses are socialized, i.e. born by the taxpayer. We find that this extension can nest a case in which the bank deliberately violates the *No Excessive Approval* constraint because it wants the risk manager and the FO to collude and to take risk that is partly born by society. Second, we consider the possibility that the FO employee captures the risk manager through side payments, unnoticed by the bank. As an example of such side payments, we consider career promises. A risk manager might be reluctant to reject investments if he fears that this jeopardizes his relationship with FO employees and the likelihood to get a lucrative job as a trader or loan officer. Empirically, we find that job rotations between risk management and market-oriented FOs are indeed associated with

large salary increases and could, hence, have incentive effects. However, we also observe that these job rotations are quite rare and that the salary increase following job rotations is partly explained by the young age of the moving employees.

In 1972, Alchian and Demsetz posed the seminal question how monitors in firms should be remunerated. While the Great Financial Crisis sparked renewed theoretical interest in this question (e.g., Rahman, 2012), the empirical evidence remains scarce. To the best of our knowledge, our paper is the first to study the remuneration of risk managers. Only a few other papers also provide a systematic empirical analysis of the internal control mechanisms and risk oversight in banks. Based on data for CROs and risk committees, Ellul and Yerramilli (2013) construct an index that measures the quality of risk management in U.S. bank holding companies. Banks with a higher index value before the onset of the financial crisis of 2008-2009 have lower tail risk and perform better in the crisis. Based on detailed data from one German bank, Berg (2015) shows that the involvement of lower-level risk managers in individual lending decisions reduces default rates. Neither Ellul and Yerramilli (2013) nor Berg (2015) show how the incentive pay of risk managers depends on FO performance.

In the theoretical literature, especially papers that consider a setup with multiple agents are related to our own research. Holmstrom and Milgrom (1991) analyze a model in which the principal allocates the tasks in which performance is easier to measure to one agent and the more opaque tasks to another. This setup describes well the banking industry in which FO employees are remunerated based on observable metrics like trading income or loan volume, whereas risk managers assess banks' exposures to (tail) risks in a complex environment. Dewatripont and Tirole (1999) analyze a model that emphasizes the conditions under which it is optimal to allocate conflicting objectives to different advocates. Studying the role of dissent in further detail, Landier, Sraer, and Thesmar (2009b) add a two-agent hierarchy that endows one worker with higher authority.[5] In Landier, Sraer, and Thesmar

[5]Earlier contributions examine the conditions under which a hierarchical organization with supervisors and workers improves information production and efficiency and when flatter hierarchies and decentralized decision-making reduce costs (e.g., Aghion and Tirole, 1997; Stein, 2002; Falk and Kosfeld, 2006).

(2009a), the same authors provide an application of their two-agent hierarchy to the case of risk management. They predict that risk managers must not be subject to the same risk biases that are prevalent in banks' FOs. However, in their model, agents' risk preferences are exogenous and, unlike us, the authors do not endogenize compensation. A second paper that explicitly focuses on risk management is Bouvard and Lee (2019). Their model shows that banks face a trade-off between accurate and timely investment decisions. Conservative risk management can cause costly delays in trade execution thereby increasing the trader's risk to be preempted by a competitor. Again, the authors do not endogenize compensation.

Our paper also relates to the literature that considers labor markets as an alternative source of discipline that could counter moral hazard. Griffin, Kruger, and Maturana (2019) find that banks do not punish employees who are involved in fraudulent securitization and marketing of residential mortgage-backed securities, whereas Gao, Kleiner, and Pacelli (2020) show that corporate bankers face adverse career outcomes after negative credit events. For the employees of funds, Ellul, Pagano, and Scognamiglio (2019) show that labor markets discipline via the effects of fund liquidations on careers and Bonelli (2019) shows that labor markets are important for the allocation of capital across fund managers.

Finally, we believe that this is the first empirical paper that studies job transitions between banks' internal control functions and front offices. Other papers in the broader literature on revolving doors include, for example, Cornaggia, Cornaggia, and Xia (2016), who find that revolving doors between credit rating agencies and firms can create captured analysts. At the same time, career prospects outside the rating industry can also incentivize analysts to become more accurate (Kempf, 2020). Lucca, Seru, and Trebbi (2014) focus on revolving doors between regulators and the private sector. They find no evidence for regulatory capture but that regulators find it difficult to retain skilled labor during economic booms. Similarly, Shive and Forster (2016) show that private hiring of former regulators is more consistent with a "regulatory schooling" hypothesis than with regulatory capture.

In Section II, we review the regulatory view on risk manager pay. After describing our

data in Section III, we discuss our empirical findings about the compensation of risk managers in Section IV. In Section V, we study a model of risk manager pay, Section VI compares our theoretical predictions against our empirical findings, and Section VII concludes.

II. Regulatory View on Risk Manager Pay

The financial crisis of 2008-2009 exposed excessive risk taking by banks. Part of the excess was blamed on risk management failures and regulators passed different reforms intended to strengthen the internal control units of banks. Regulators were especially concerned that remuneration will create a conflict of interest in risk management if it depends on the *financial results of the lines of business or business activities that such staff [risk managers] oversee* (Federal Reserve Board, 2011, p.22). It was recommended that risk managers' financial incentives be *independent of the lines of business whose risk taking [...] they monitor.*

In Germany, which is the country studied in this paper, the Federal Financial Supervisory Authority BaFin passed specific regulations on the remuneration of risk managers when Germany enacted Directive 2013/36/EU of the European Parliament, also called the Capital Requirements Directive IV.[6] The regulations targeted at the compensation of risk managers were passed under the Institutsvergütungsverordnung (InstitutsVergV) and specify what the regulator understands by "appropriate" risk manager compensation: *Remuneration systems are appropriately designed if the remuneration systems do not conflict with the monitoring function of the control units [...]* (BaFin, 2019, p.8). In the view of the regulator, a conflict exists *in particular if the amounts of variable remuneration for the staff members of the control units and for the staff members of the organisational units monitored by them are largely determined by analogous remuneration parameters.* We summarize this regulatory view on "appropriate" risk manager compensation in the following hypothesis:

HYPOTHESIS 1: ***Regulatory view on risk manager pay***

[6]These regulations were passed in 2013. We study risk manager pay between 2003 and 2007.

To prevent a conflict of interest that causes risk management failure and excessive risk taking, banks must not base the performance-linked pay of risk managers and FO employees on similar performance metrics. The financial incentives in risk management and FOs must not be aligned.

The argument underlying this hypothesis appears to be the following: If performance-linked compensation of traders and loan officers biases these employees towards taking excessive risk, then the bank should install appropriate counter powers that balance or restrain these risk biases again. However, according to Hypothesis 1, risk managers will fail as a counter power if their variable compensation is based on the same performance metrics that also determine FO compensation—that is, on those metrics that allegedly cause the risk biases in FOs in the first place. We note that this narrative is consistent with Landier et al. (2009a). In that paper, the authors are not studying risk manager compensation in particular. However, they do predict that, in general, risk management will fail if there is not a sufficient level of "dissent" about risk taking between risk managers and traders.

Finally, the validity of Hypothesis 1 largely depends on the assumption that the design of performance-linked pay in FOs is indeed causally responsible for excessive risk taking by traders and loan officers. Testing the validity of this assumption is important but we believe that the scope of this task would justify a separate study. In this paper, we simply point to existing evidence in this regard. For example, Agarwal and Ben-David (2013) show empirically that volume-based pay of loan officers increases loan default rates.[7] Berg, Puri, and Rocholl (2019) show that loan officers with volume-based incentives manipulate hard information and make loans with higher default rates. Heider and Inderst (2012) show theoretically that competition can cause banks to provide loan officers with steep volume-based compensation that induces excessive lending. Efing, Hau, Kampkötter, and Steinbrecher (2015) show for a data set that partly overlaps with the one used in this paper

[7] In a field experiment, Cole, Kanz, and Klapper (2015) confirm this result but further show that penalizing loan officers for bad lending decisions can improve screening effort.

that the ratio of short-term performance pay to total compensation is associated with a higher volatility of trading income.

III. Data

A. Data Sources

This paper uses granular remuneration data for German bank employees. The data were collected by an international pay consulting firm, which carries out industry and peer group analyses for German banks. The pay consultant uses the remuneration data to inform clients whether they are over- or underpaying a given employee relative to employees that work for other banks but in comparable job positions. To guarantee the quality of such salary benchmarking, the pay consultant exerts significant efforts in terms of data collection and processing. The payroll data are directly extracted from the banks' electronic personnel records along with detailed information on job descriptions, employee seniority, tenure, and age. Banks that wish to compare their remuneration practices against those of their peers are asked to report at least 80% of their own payroll below the executive level. To make the reported information comparable across the participating banks, the consultant defines a set of specific job positions and banks must classify their employees accordingly when they report their payrolls. Similarly, the consultant defines explicit criteria to sort employees into six different seniority levels in the employment hierarchy. This standardization guarantees that job descriptions and hierarchy levels are comparable across different banks.

The pay consultant collects remuneration data for front offices (FOs) as well as back offices (BOs). Each FO job is uniquely assigned to one of six different FO areas—i.e., either to one of the three mainly capital markets-oriented FO areas *treasury/capital markets*, *investment banking*, and *asset management* or to one of the three more credit-oriented FO areas *retail banking*, *corporate banking*, and *private banking*. BO jobs are sorted either into the BO area *logistical support* (e.g., IT support, customer service, etc.) or into the BO area *headquarter*

support (e.g., accounting, human resources, risk management, etc.).

The pay consultant distinguishes between two groups of employees that satisfy the definition of a risk manager: both groups are responsible for the identification, approval, and management of risk exposures. However, the two groups of risk managers differ with regard to the types of risk that they supervise. Risk managers in the first group only manage credit risk and (dis-)approve the lending decisions of the banks' credit-oriented FOs. They do not evaluate the banks' other FO activities and ignore exposures to market risk.[8] By contrast, the second group of risk managers provides a holistic risk assessment that comprises all of the banks' different FO activities. To this end, risk managers in this second group evaluate credit as well as market risk exposures. In particular, only risk managers in the second group also identify (and close) excessively risky positions in the capital markets-oriented FOs of banks. For simplicity, we refer to these two groups of risk managers as *credit-oriented risk managers* and, respectively, *capital markets-oriented risk managers*. The pay consultant assigns both groups of risk managers to the same BO area *headquarter support*. Neither group is directly involved in the generation of investment opportunities by the banks' FOs.

The full database of the pay consultant covers 1.26 million employee-years, 324 banks, and the years 2003 to 2010. A description of this database can be found in Efing et al. (2015) and Efing et al. (2018). However, the full database has two limitations, which are critical for this paper. First, employees cannot be tracked over time because a majority of the 324 banks does not report a unique employee ID. Second, some of the detailed job descriptions and, in particular, those of risk managers are not available to us in the full database. Therefore, for the purpose of this study, we focus on a subsample of 127 banks and the pre-crisis years 2003 to 2007. This smaller data set with employee IDs and with information on different types of risk managers was first described by Kampkötter and Sliwka (2018).

We combine the payroll data with information about banks' balance sheets and profit

[8]This first group of credit-oriented risk managers in Germany resembles the loan review functions that were created in U.S. banks in the 1980s. Udell (1989) provides survey evidence that these loan review functions had the primary purpose to monitor loan officers.

and loss statements from the database Bureau Van Dijk Bankscope (now called Bank Focus). Finally, we use data about the composition and quality of German banks' supervisory boards, which were handcollected by Hau and Thum (2014) and Steinbrecher (2015).

B. Sample Description

Our payroll data include 351,989 employees of 127 German banks during the economically stable period from 2003 to 2007 before the outbreak of the financial crisis in Germany. The employee panel is unbalanced because some banks do not report their payrolls in all sample years, because some employees retire and because employees cannot be tracked across banks as they are reassigned a new identifier each time they switch employers.

Panel A of Table I provides an overview over the different FO and BO areas in the data set. Risk managers account for 51,795 employee-years, which can be broken down into 43,457 and 8,338 observations for credit-oriented and capital markets-oriented risk managers, respectively.[9] The areas *headquarter support (excluding risk management)* and *logistical support* account for another 90,503 and 128,354 observations in banks' BOs, respectively. Capital markets-oriented and credit-oriented FOs account for 30,033 and 234,628 observations, respectively. Hence, credit-oriented risk managers and FO employees dominate their capital markets-oriented colleagues in terms of numbers.

Panel A of Table I further shows how the level and design of employee remuneration vary across the different BO and FO areas. Total employee compensation, defined as fixed base salary plus variable cash bonus, is highest in capital markets-oriented FOs and especially high in the area *treasury / capital markets* (on average, Euro 145,554). Among the more credit-oriented FOs, employees in corporate lending tend to earn the most (on average, Euro 84,185) and significantly more than their colleagues in retail banking (on average, Euro 51,372). The level of total compensation in risk management and in other jobs of the BO area *headquarter support* amounts to, on average, Euro 66,511 and 73,094, respectively.

[9]The break-down into credit- and capital markets-oriented risk managers is not shown in Table I.

Employees in *logistical support* earn relatively little (on average, only Euro 47,846).

Comparing the composition of employee remuneration, we find that variable (cash) bonuses are significantly larger among the capital markets-oriented FOs than in other functional areas. The average employee in the area *treasury / capital markets* earns a bonus of Euro 64,420, which amounts to about 61% (=bonus share) of his fixed base salary. But also employees in other FOs and even in BOs earn economically significant bonuses even though their bonuses remain much smaller than in capital-markets oriented FOs. For example, the bonus paid to the average risk manager still amounts to 13% of his fixed base salary. In unreported multivariate regressions, we find that the differences in the level and composition of employee remuneration across the different FOs and BOs are not fully explained by variation in age, tenure, or seniority (hierarchy level) nor by bank or year fixed effects.

We note that our data do not report equity-based remuneration. The majority of German banks are not listed, which prevents the use of stock options for compensation purposes. In general, granting stock options to employees below the executive level is not widely practiced in Germany, which may differ from the U.S. in this regard. According to the pay consultant, less than 1% of German bank employees are entitled to equity-based compensation. Similarly, we note that our data do not report any long-term performance pay, deferred compensation, bonus claw-backs, etc. In 2003-07, compensation tied to long-term performance was negligible for German non-executive bank employees and was debated by regulators and policymakers only much later.[10] In our data, the annual cash bonus is paid only for short-term performance.

Panel B of Table I shows summary statistics for the main regression sample used in Section IV. This subsample is limited to risk manager-years and ignores all observations from other functional areas. The 75-percentile of the variable $RM\ bonus_{i,t}$ shows that at least 25% of risk manager observations receive a variable bonus of at least Euro 10,000. We will discuss the other variables of Panel B later in Section IV when we specify our multivariate

[10]The Capital Requirements Directive of the European Union stipulates that 25% of variable remuneration should be deferred. It was applied, for the first time, to bonuses paid in 2015 for performance in 2014.

regression analysis. An overview of variable definitions can also be found in Appendix A.

IV. Empirical Analysis

In this section, we study the short-term performance pay of risk managers and estimate its sensitivity to performance pay in the front offices (FOs) they supervise. Second, we examine how risk manager independence in terms of pay relates to the quality of bank governance and to bank performance during the financial crisis 2008-2009.

A. Remuneration and Independence of Risk Managers

Hypothesis 1 states that banks should not base the performance-linked pay in risk management and FOs on similar performance metrics. The financial incentives of risk managers and FO employees should not be aligned. To test this prediction, we estimate the following regression specification:

$$RM\ bonus_{i,t} \;=\; \beta\ Avg.\ FO\ bonus_{i,t} \;+\; Controls \;+\; \epsilon_{i,t}\ , \tag{1}$$

where the dependent variable is the bonus paid to risk manager i for (short-term) performance in year t. As discussed in Section III.A, our data allow us to distinguish between risk managers that only supervise credit risk and other risk managers that mainly supervise market risk. The regressor $Avg.\ FO\ bonus_{i,t}$ is defined accordingly and identifies the average (short-term) performance pay in the main FO area supervised by risk manager i—i.e., the average bonus either in credit-oriented or in capital markets-oriented FOs.[11]

Column (1) of Table II estimates the regression specified in equation (1) without any controls. The coefficient of 0.136 suggests that risk managers receive a 13.6 Cents higher bonus if average performance pay in the FOs they supervise increases by one Euro. Equivalently,

[11] To the extent that the distinction between credit-oriented and capital markets-oriented FOs and risk managers may not be perfect, measurement error should attenuate the coefficient β towards zero. Hence, we consider the $\hat{\beta}$ as a conservative estimate.

if performance pay in front offices increases by one standard deviation (≈ Euro 19,575), the risk managers receive a Euro 2,662 higher bonus. This effect corresponds to an economically sizable increase by 32% relative to the sample mean of *RM bonus*$_{i,t}$ (see Panel B of Table I).

Labor markets could provide a first explanation for why the bonuses of risk managers are sensitive to bonus pay in FOs: in general, a bank might tie its employee's variable compensation to his reservation wage to avoid slack in the participation constraint when the employee's outside employment options are weak (Oyer, 2004). Conversely, when labor demand is strong and the bank risks loosing the employee to a competitor, it would pay a sufficiently high *retention bonus* such that the employee again earned his reservation wage. For this theory to explain the positive bonus sensitivity of risk managers to FOs, we would need the reservation wages (and, hence, the retention bonuses) of risk managers and FO employees to be positively correlated. This condition would be met if risk managers that supervise traders were qualified to work as traders themselves and, equivalently, if risk managers that supervise loan officers were qualified to work as loan officers.

We include two labor market variables that proxy for a risk manager's outside employment options in column (2) of Table II. The regressor *Avg. FO bonus other banks*$_{i,t}$ controls for the market level of variable pay in the type of FOs that risk manager i is supervising in his own bank. For example, if risk manager i supervises credit-oriented FOs (loan officers) in his bank, *Avg. FO bonus other banks*$_{i,t}$ will equal the average bonus paid in the credit-oriented FOs of all the other German banks in the regression sample. The second control *Avg. RM bonus other banks*$_{i,t}$ measures the variable pay received by risk managers that supervise the same FOs as risk manager i but work in competing banks. In other words, the two controls *Avg. FO bonus other banks*$_{i,t}$ and *Avg. RM bonus other banks*$_{i,t}$ approximate the variable compensation that risk manager i would, on average, earn either as a FO employee or again as a risk manager in a competing bank. We find that these two controls for risk managers' outside employment options are both statistically insignificant in column (2), whereas the variable of interest *Avg. FO bonus*$_{i,t}$ remains significant. This result suggests that the labor

market does not (fully) explain the positive bonus sensitivity of risk managers to FOs.

Employee compensation likely depends on individual characteristics like skill and productivity or on observable traits like the employee's age, tenure, and seniority in the employment hierarchy. To control for such characteristics, we include risk manager, age, tenure, and hierarchy fixed effects in column (3). Due to the unbalanced nature of the panel, the risk manager fixed effects decrease sample size to 22,461 observations. Finally, we include year fixed effects and further control for risk managers' fixed base salary and for a binary dummy variable that equals one if the risk manager is employed in a managerial position with decision-making power and formal authority. Column (3) shows that risk managers' bonuses are positively correlated with their base salaries. The variable of interest $Avg.\ FO\ bonus_{i,t}$ decreases but remains positive and significant.

One possible explanation for the alignment of bonus pay between risk management and FOs could be provided by a theory of risk sharing between a bank's employees and shareholders. Thanassoulis (2012) and Efing et al. (2018) show theoretically and empirically that bonus pay in banks responds to bank-wide performance. In times of need when overall bank earnings are low and financial frictions prevent external recapitalization, banks cut bonuses of all their employees, regardless of individual performance, to preserve cash. Such risk-sharing on the payroll could explain part of the observed correlation between the bonuses of risk managers and FO employees. In column (4), we test whether this risk-sharing hypothesis explains our baseline result. To this end, we include bank times year fixed effects, which control for variation in bank-wide earnings and external financing conditions. Hence, we are only comparing a risk manager's bonus to performance pay in those FOs that he supervises (credit-oriented versus capital markets-oriented FOs), while holding overall bank performance constant. We find that the bonus pay correlation between risk managers and FOs remains positive and significant after the inclusion of bank-year fixed effects but decreases to 0.038.

In columns (5) to (7), we revisit the labor market explanation. However, instead of

controlling for the labor market variables *Avg. FO bonus other banks*$_{i,t}$ and *Avg. RM bonus other banks*$_{i,t}$ directly (as in columns (2) to (4)), we analyze *relative* performance pay of risk managers and FOs and use both labor market variables to standardize the bonuses of risk manager i and the FOs he supervises:

$$\begin{aligned} \textit{Relative RM bonus}_{i,t} \;=\; & \beta\ \textit{Relative FO bonus}_{i,t} \;+\; \textit{Controls} \;+\; \epsilon_{i,t}\ , \\ \text{where} \qquad \textit{Relative RM bonus}_{i,t} \;=\; & \frac{\textit{RM bonus}_{i,t}}{\textit{Avg. RM bonus other banks}_{i,t}}\ , \\ \textit{Relative FO bonus}_{i,t} \;=\; & \frac{\textit{Avg. FO bonus}_{i,t}}{\textit{Avg. FO bonus other banks}_{i,t}}\ . \end{aligned} \tag{2}$$

As we regress *relative* performance pay of risk managers on *relative* performance pay in FOs, the specification without any controls in column (5) suggests that a risk manager earns a 36% higher bonus relative to his peers in other banks if the FOs that he supervises earn a 100% higher bonus ($\approx$ one standard deviation) relative to the FOs of competing banks. This result remains qualitatively unchanged when we control for risk manager heterogeneity and year fixed effects in column (6). In the full specification with bank-year fixed effects in column (7), risk managers earn 8% higher bonuses than their peers when the FOs that they supervise double their performance pay relative to the FOs of other banks.

Overall, we make two observations in Table II. First, the *unconditional* bonus sensitivity of risk management to FOs is large—whether we study absolute bonus pay in column (1) or relative bonus pay in column (5). This may raise concerns regarding a possible lack of independence of risk managers and, hence, a possible collusion between risk managers and FOs. Second, *conditional* bonus sensitivities remain significant but are smaller than the unconditional ones. Especially the bank-year fixed effects in columns (4) and (7), which shut down the risk sharing channel, decrease risk managers' bonus sensitivity to FOs. However, we believe that this second finding does not necessarily alleviate concerns regarding a possible lack of risk manager independence. Even if the financial incentives of risk managers and FOs were aligned because of risk sharing considerations, collusion could still be triggered as an

unintended side effect. More importantly, as we will show next, risk sharing (bank-year fixed effects) fails as an explanation in the case of *senior* risk managers—i.e. precisely for those risk managers that have the authority to approve or reject risky investments.

A.1. Bonus Pay Sensitivities of Senior Risk Managers

A risk manager's power to veto a loan or trade depends on his authority. Typically, junior risk managers only collect and process information but leave the approval or rejection of large investments to their seniors. Hence, to avoid collusion between the risk management function and FOs, it seems especially important that the senior risk managers with decision-making power and authority are sufficiently independent and have no incentives to collude with traders and loan officers. In Table III, we test whether bonus sensitivities to FOs are indeed weaker for senior risk managers. To this end, we interact the main regressor *Avg. FO bonus*$_{i,t}$ with the binary variable $\mathbb{1}\left(\textit{Managerial position}\right)_{i,t}$, which identifies risk managers in managerial positions (but still below the executive level). At the same time, we control for the effect of young age through and interaction with $\mathbb{1}\left(RM\ age_{i,t} \leq 35\right)$.

We find that the performance pay of senior risk managers in managerial positions is, in fact, *more* sensitive to FOs than the one of junior risk managers. According to column (1), the bonus of a risk manager who does not occupy a managerial position increases by only 7.1 Cents when average performance pay in FOs increases by one Euro. Risk managers in managerial positions receive another 26.4 Cents or, in total, 33.5 Cents for each additional Euro of performance pay in FOs. This result remains qualitatively unchanged when we focus on relative (standardized) bonus pay. Column (3) suggests that risk managers in managerial positions earn a 67% $(= (0.385 + 0.281) \cdot 100\%)$ higher bonus relative to risk managers in other banks when "their" FOs perform twice as well as comparable FOs of competitors.

Importantly, the bonus sensitivities of senior risk managers remain high even when we shut down the risk-sharing channel. In column (2), we again include bank-year fixed effects to control for bank-wide performance. Risk managers in managerial positions receive an

economically sizable 22.3 Cents (= 0.208 + 0.015) when average performance pay in FOs increases by one Euro. In relative terms, after including bank-year fixed effects, we still find that senior risk managers earn a 32.2% (= 0.301 + 0.021) higher bonus than their peers in other institutions when "their" FOs double their performance relative to comparable FOs in competing banks (column (4)).

Overall, the incentive pay of senior risk managers and FOs is aligned to an extent that cannot be explained by theories of risk-sharing or by bank-year fixed effects more broadly.

A.2. Bonus Pay Sensitivities by Risk Management Activity

In this section, we compare in more detail the short-term performance pay of the two types of risk managers distinguishable in our data: those that mainly supervise capital markets-oriented FOs and those that only monitor loan business. We show directly that each type of risk managers earns a higher bonus when the *specific* FOs that he is monitoring perform better. To this end, we estimate the following regression specification:

$$\begin{aligned} \textit{RM bonus}_{i,t} \;=\; & \beta_1 \; \textit{Avg. FO-credit bonus}_{b(i),t} \;+\; \beta_2 \; \textit{Avg. FO-markets bonus}_{b(i),t} \\ & +\; \beta_3 \; \mathbb{1}\left(\textit{RM for markets}\right)_{i,t} \times \textit{Avg. FO-credit bonus}_{b(i),t} \\ & +\; \beta_4 \; \mathbb{1}\left(\textit{RM for markets}\right)_{i,t} \times \textit{Avg. FO-markets bonus}_{b(i),t} \\ & +\; \beta_5 \; \mathbb{1}\left(\textit{RM for markets}\right)_{i,t} \;+\; \textit{Controls} \;+\; \epsilon_{i,t} \;, \end{aligned} \tag{3}$$

where $\mathbb{1}\left(\textit{RM for markets}\right)_{i,t}$ equals one if risk manager i mainly supervises market risk and zero if he only supervises credit risk. The regressors $\textit{Avg. FO-credit bonus}_{b(i),t}$ and $\textit{Avg. FO-markets bonus}_{b(i),t}$ are defined as the average performance pay in the credit-oriented and capital markets-oriented FOs of bank $b(i)$. The coefficients β_1 to β_2 show how bonuses of credit-oriented risk managers respond to average performance pay in credit-oriented and in capital markets-oriented FOs, respectively. Similarly, the sums $\beta_1 + \beta_3$ and $\beta_2 + \beta_4$ show the respective bonus sensitivities of capital markets-oriented risk managers to performance pay in the different FOs. Finally, β_3 and β_4 alone are the incremental effects for capital

markets-oriented relative to credit-oriented risk managers.

Column (1) of Table IV shows the coefficient estimates for equation (3) without any fixed effects. We find that each type of risk manager (credit-oriented vs. capital markets-oriented) is more sensitive to the performance in the specific FOs that he is responsible for. When *Avg. FO-credit bonus*$_{b(i),t}$ increases by one standard deviation (= Euro 8,136), the bonus of a credit-oriented risk manager increases by Euro 2,262 (= 0.278 × Euro 8,136). The bonus of a capital markets-oriented risk manager increases only by Euro 960 (= (0.278-0.160) × Euro 8,136). By contrast, when *Avg. FO-markets bonus*$_{b(i),t}$ increases by one standard deviation (= Euro 35,812), the bonus of a capital markets-oriented risk manager increases by Euro 2,614 (= (0.045+0.028) × Euro 35,812) whereas the bonus of a credit-oriented risk manager increases only by (a statistically insignificant) Euro 1,612 (= 0.045 × Euro 35,812).

We caution not to over-interpret the exact magnitudes of these estimates. However, we note that a theory of risk sharing cannot explain why a given risk manager exhibits different sensitivities to the performance of different FOs. According to risk sharing, any employee's variable compensation is a function of *bank-wide* performance, regardless of whether performance originates in credit-oriented or capital markets-oriented FOs (Efing et al., 2018).

Column (2) of Table IV shows that our results are qualitatively robust when we include different fixed effects and control for base salaries and managerial positions. Column (3) shows that our findings remain unchanged if we study relative instead of absolute bonus pay. For example, when credit-oriented FOs in bank b double their performance pay relative to competing FOs in other banks, then the credit-oriented risk managers of bank b see their relative bonuses increase by 38.1% relative to their peers in other banks. By contrast, the capital markets-oriented risk managers in bank b receive only a 9.5% (= $0.381 - 0.286$) higher bonus. Similarly, when relative bonus pay in the capital markets-oriented FOs doubles, then the capital markets-oriented risk managers see their bonuses increase by 11.9% (= $0.033 + 0.086$) whereas the credit-oriented risk managers of the same bank receive only a (statistically insignificant) 3.3% higher bonus. In column (4), we check the robustness of our

finding when we study relative bonus pay and also include further controls and fixed effects. Several coefficients become statistically insignificant in column (4). However, the signs of the coefficients are still broadly consistent with the findings in columns (1) to (3).

Overall, Table IV suggests that the financial incentives of a given risk manager are not aligned with just any FO. Instead, it seems that a risk manager's incentive pay is more sensitive to the *specific* FOs that he is supervising. Again, this observation raises concerns regarding a possible collusion between risk managers and those they are supposed to monitor.

B. Risk Manager Independence, Governance, and Risk-Taking

Labor market and risk sharing theories do not fully explain why the performance pay of risk managers, especially of those in managerial positions with decision-making power, is aligned with performance pay in the FOs they supervise. In this section, we study the possibility that these correlated financial incentives constitute a governance failure that undermines the independence of risk management and fosters collusion and excessive risk-taking. In Section IV.B.1, we ask how correlated incentive pay between risk managers and FOs relates to the general governance quality of banks. We test whether better governed banks pay their risk managers and FOs more or less correlated bonuses. In Section IV.B.2, we test how bonus correlations in 2003-2007 are related to bank performance during the financial crisis.

B.1. Risk Manager Independence and Bank Governance

Bank governance is organized differently in Germany than in many other countries. German law mandates a two-tier board structure, i.e., a clear distinction between management and control. The directors on the supervisory board are supposed to monitor the actions of the executive board on behalf of shareholders and employees. Their task is to mitigate agency conflicts and to prevent value-destroying activities like excessive risk-taking. However, supervisory boards rarely have the capacity (or mandate) to check each individual

lending or trading decision in the banks' FOs.[12] Instead, directors are supposed to install appropriate risk controls like, for example, a functioning risk management division that acts as a counter-power against potential risk biases in the banks' FOs. We conjecture that, if it is true that risk managers need to be compensated in a way that makes their incentives independent of FOs, then better-governed banks with competent directors will ensure that performance pay of risk managers and FOs is not aligned. The coefficient β_1 of the interaction term in the following regression should be negative:

$$\begin{aligned} \textit{RM bonus}_{i,t} \;=\; & \beta_1 \; \textit{Avg. FO bonus}_{i,t} \times \textit{Governance quality}_{b(i),t} \;+\; \beta_2 \; \textit{Avg. FO bonus}_{i,t} \\ & +\; \beta_3 \; \textit{Governance quality}_{b(i),t} \;+\; \textit{Controls} \;+\; \epsilon_{i,t} \end{aligned} \tag{4}$$

The regressor $\textit{Governance quality}_{b(i),t}$ measures the quality of risk oversight provided by the supervisory board and the CRO of bank $b(i)$. The variable is constructed based on handcollected data about the composition of German banks' supervisory boards.[13] For each board member, these data report total and financial work experience as well as work experience as corporate executives. Further, we know whether a board member has gained work experience abroad and whether he holds a Ph.D. in economics or in closely related studies like finance. Finally, the data tell us whether a bank reports the existence of a CRO and whether this CRO also occupies other executive positions in the bank.[14] In total, we aggregate seven handcollected variables into the proxy $\textit{Governance quality}_{b(i),t}$. To avoid subjective judgments regarding the relative importance of the seven competence variables, we

[12] German law requires supervisory boards of listed (private) banks to meet twice (once) per semester. As boards have little time to supervise individual loans and trades themselves, they delegate this task to risk management. In recent years (but not during our sample period), risk oversight is also performed by risk committees. Effective from January 1, 2014, the German Banking Act (Gesetz über das Kreditwesen) mandates the appointment of risk committees, which shall advise the supervisory board on the current and future risk strategy and ensure that business activities are in line with the business model of the company.

[13] The data were handcollected by Hau and Thum (2014) and Steinbrecher (2015) and cover the 30 largest German banks with assets of at least Euro 25bn (761 supervisory board members).

[14] Ellul and Yerramilli (2013) also construct proxies for the centrality and influence of CROs based on the relative remuneration of CROs and CEOs. Unfortunately, during the time period we analyze, this information is not available for most (private) banks in our sample neither publicly nor in our own database, which only comprises employees below the board level.

follow Tetlock (2007) and Ellul and Yerramilli (2013) and construct *Governance quality*$_{b(i),t}$ as the first principal component (on a year-by-year basis). Table IA.1 in the Internet Appendix describes the data and the principal component analysis in more detail.

Table V shows the coefficient estimates for equation (4). Again, we estimate specifications for absolute and for relative bonus pay and for specifications without and with fixed effects. The interaction term *Avg. FO bonus*$_{i,t}$ $\times$ *Governance quality*$_{b(i),t}$ is either statistically insignificant or significantly positive (only at the 10%-level). It is never negative. Possibly, we do not observe lower bonus correlations between risk management and FOs in better governed banks because correlated financial incentives are, in fact, efficient and not the result of a governance failure, as was predicted by the regulator (Hypothesis 1).[15] Alternatively, our analysis could be blurred by omitted variables. In the absence of a credible instrument for governance quality, it is difficult to refute this possibility empirically. In Section V, we will, therefore, resort to theory and study a model of efficient risk manager compensation.

B.2. Risk Manager Independence and Crisis Performance

Before we turn to theory, we test directly whether high bonus correlations (aligned financial incentives) between risk management and FOs lead to more risk taking. We study the financial crisis 2008-2009 as a large realization of tail risk, which had the potential to push individual banks into bankruptcy. Arguably, large exposures to tail risk provide a good example for excessive risk taking that risk managers are supposed to prevent. Ideally, we would like to follow Ellul and Yerramilli (2013) and evaluate banks' crisis performance based on their stock returns. Unfortunately, our German sample contains only nine listed banks with stock price information. Therefore, we focus on operating performance instead and rely

[15] Another explanation could be that independent risk managers (with financial incentives orthogonal to those in FOs) are not needed in banks that have competent supervisory boards. However, as we pointed out above, supervisory boards typically lack the capacity and mandate to monitor each individual lending and trading decision taken in FOs and are more likely to delegate this task. Competent supervisory boards and a well-designed risk management function are unlikely to be substitutes.

on accounting data about bank earnings during the crisis:

$$\textit{Crisis ROA}_b \;=\; \alpha \;+\; \beta\; \rho\textit{(all FO, all RM)}_b \;+\; \textit{Controls} \;+\; \epsilon_b \;, \tag{5}$$

where ρ*(all FO, all RM)*$_b$ is the correlation between *Avg. RM bonus*$_{b,t}$ and *Avg. FO bonus*$_{b,t}$ measured over the years 2003 through 2007; i.e. the correlation between the average bonuses bank b pays its risk managers and FO employees before the crisis. A higher value of ρ*(all FO, all RM)*$_b$ means that risk managers' financial incentives before the crisis are more aligned with those in FOs. The dependent variable *Crisis ROA*$_b$ is calculated as the sum of interest and non-interest income less additions to loan loss provisions and standardized by total assets. In keeping with the regulatory hypothesis, we expect a negative coefficient $\hat{\beta}$.

Column (1) of Table VI shows the coefficient estimates for equation (5). The point estimate $\hat{\beta}$ is positive but statistically insignificant in column (1). In columns (2) and (3), we refine the analysis and distinguish between the bonus correlations for credit-oriented and market-oriented risk managers before the crisis. ρ*(FO-credit, RM-credit)*$_b$ measures how strongly the bonuses of credit-oriented risk managers are aligned with performance pay in credit-oriented FOs between 2003 and 2007. Similarly, ρ*(FO-markets, RM-markets)*$_b$ denotes the bonus correlation between capital markets-oriented FOs and risk managers. We find that ρ*(FO-credit, RM-credit)*$_b$ in 2003-2007 does not explain bank income during the crisis (column (2)). However, we find a positive coefficient of 2.009 for ρ*(FO-markets, RM-markets)*$_b$ in column (3), which is statistically significant at the 1% level.

In columns (4) to (6) of Table VI, we break out earnings that mostly originate in capital markets-oriented FOs and use only non-interest income (= trading and fee & commission income) as dependent variable. This focus is interesting because Brunnermeier, Dong, and Palia (2020) show it to be the largest source of systemic risk and tail risk in banks. In column (4), we regress *Non-interest income on assets*$_b$ on the bonus correlation between all of a bank's risk managers and all its (credit- and market-oriented) FOs. The coefficient is

positive but insignificant. In column (5), we find that, unsurprisingly, the bonus correlation of credit-oriented risk managers has no significant effect on the non-interest income from capital markets-oriented FOs. In column (6), we link non-interest income in the crisis to the independence of those risk managers that supervise capital markets-oriented FOs. The coefficient of ρ*(FO-markets, RM-markets)*$_b$ is positive and significant. Capital markets-oriented FOs tend to perform better in the crisis if the risk managers that supervised them in 2003-2007 were less independent in terms of pay.

The regression sample in Table VI is relatively small as only the largest of the 127 banks that report remuneration data to the pay consultant are also found in Bankscope.[16] This could raise concerns (i) that the sample is not representative of the German banking industry and (ii) that the coefficient estimates could be driven by only one or two outliers. However, the banks in Table VI account for an economically meaningful 70% of total German bank assets.[17] To examine the possible influence of outliers, we re-estimate the regressions in columns (3) and (6) several times, while each time eliminating one single bank from the sample. As reducing the small sample further necessarily affects the power of inference, we are not so much interested in any changes in statistical significance. Instead, the goal of this analysis is to examine the robustness of the coefficient estimates in terms of magnitude.

Panel A of Figure 1 shows the influence of outliers in column (3) of Table VI. The red vertical line represents the original point estimate of 2.009. After we drop different banks from the regression sample, the new point estimates for ρ*(FO-markets, RM-markets)*$_b$ range from 1.703 to 2.174 and, hence, stay close to the original estimate in the full sample. The 95% confidence intervals are relatively narrow except in the fourth iteration from the top. But even this estimate of 1.703 has a p-value of only 0.058. Panel B repeats the same analysis for column (6) of Table VI. Again, the new point estimates stay reasonably close to the

[16] In particular, Bankscope is missing small cooperative and (state-owned) savings banks, which, together with the privately-owned banks constitute the three pillars of the German banking sector. The cooperative and savings banks are geographically constrained by their by-laws and follow conservative business models.

[17] According to the Deutsche Bundesbank, total German bank assets in December 2008 equal Euro 7,956,390bn. See https://www.bundesbank.de/de/statistiken/zeitreihen-datenbanken.

original point estimate, ranging from 0.746 to 1.314. There exists one bank (fourth iteration from the top) whose elimination reduces statistical significance but still does not change the magnitude of the coefficient (1.113 compared to 1.093 in the full sample). Overall, outliers do not seem to drive the magnitude of the point estimates in Table VI.

Another econometric concern relates to the possible endogeneity of the main regressor ρ*(FO-markets, RM-markets)*$_b$. In Table VII, we estimate two-stage least squares (2SLS) regressions and instrument ρ*(FO-markets, RM-markets)*$_b$ with the variable ρ*(FO-markets, Support ex RM)*$_b$ — defined as the bonus correlation between the capital markets-oriented FOs of a bank and its employees in logistical and headquarter support like accounting, IT, etc. In the first stage, the Kleibergen-Paap F-statistic of the excluded instrument equals 16.98 or 9.40 (columns (1) and (2)), depending on whether we add control variables or not. Columns (3) and (4) show the corresponding second stages of the 2SLS regressions without and with bank controls. We find that the coefficient of the (instrumented) ρ*(FO-markets, RM-markets)*$_b$ is close to the one in column (3) of Table VI, which is reassuring.

To satisfy the exclusion restriction, the instrument ρ*(FO-markets, Support ex RM)*$_b$ must meet two conditions. First, it must not have any direct effect on bank risk-taking and crisis performance. Second, it must also not have any indirect effect through variables other than ρ*(FO-markets, RM-markets)*$_b$ itself. The first of these two conditions is easier to defend. We argue that employees in support functions like accounting, human resources, or IT rarely define the risk appetite of their banks as they typically do not interfere with lending or trading choices in FOs. In this regard, we believe that the instrument takes us closer to identifying the causal effect of risk manager independence on bank performance.

The second condition of the exclusion restriction is more critical. We cannot rule out the possibility that some omitted variable determines the instrument and also banks' crisis performance simultaneously. One candidate for such an omitted variable could be persistent differences in bank culture (Fahlenbrach, Prilmeier, and Stulz, 2012; Cheng, Hong, and Scheinkman, 2015). For example, Ellul and Yerramilli (2013) hypothesize that some banks

"may have a conservative risk culture and choose to take lower risks and put in place stronger risk management systems, whereas others may have an aggressive risk culture and may choose to take higher risks and also have weaker risk management functions (p. 1763)."[18]

Acknowledging this remaining endogeneity concern, we are careful not to overinterpret Tables VI and VII. However, we believe that our findings are novel and intriguing enough to justify a closer look at theory. The fact that positive bonus correlations between risk management and FOs are pervasive and associated with *better* crisis performance should at least cast doubts on the regulatory hypothesis that aligned financial incentives constitute an inefficient governance failure. In the next section, we will show theoretically that correlated financial incentives can, in fact, be the outcome of efficient contracting.

V. A Model of Risk Manager Compensation

We solve a model in which a FO employee (e.g., a trader or a loan officer) performs two tasks. First, the FO employee decides whether to invest into a project of good or bad type. Second, she decides whether to exert costly effort to increase the return of the (good) project. Project type and private effort are unobservable to the bank and potential sources of moral hazard. The bank can hire a second employee, a risk manager, who monitors the FO's investment decisions and has the power to reject them.

A. Case without a Risk Manager

To begin, we first study a bank that only hires a FO employee but no risk manager. The FO employee is endowed with exactly one investment project, which has one of two possible types $\theta \in \{I; II\}$. The return of type I only depends on the level of effort e exerted by

[18] We note that, according to Table VI, the banks that took less tail risk and performed better during the crisis had less and not more independent risk managers. Hence, taking the statement quoted above literally, we would have to posit that some banks with a conservative risk culture choose to take lower risks and put in place stronger *albeit less independent* risk management systems. I.e., in this reading, a stronger risk management function would be one with *more* correlated financial incentives with FOs.

the FO employee. It is equal to $\overline{R}$ for $e \geq \overline{e}$ but equal to $\underline{R}$ for $e < \overline{e}$. The return of type II does not depend on effort. However, it is risky and equal to $\overline{R}$ only with probability π. With probability $1-\pi$, type II generates a loss L. Investment costs are normalized to zero. The employee's private cost of effort is strictly increasing in e. To save notation, we assume, without loss of generality, that the effort cost is equal to $\overline{e}$ for an effort level of $e = \overline{e}$. Spending effort $\overline{e}$ on a project of type I is efficient. Only type I has a positive NPV whereas the type-II project is excessively risky offering a negative NPV:

$$\overline{R} - \overline{e} \; > \; \underline{R} \; \geq \; 0 \; > \; \pi\overline{R} - (1-\pi)L \tag{6}$$

Figure 2 shows the timing of the model. At time $t = 0$, nature endows the FO employee with a project of type $\theta = I$ with probability λ and with a project of $\theta = II$ with probability $1-\lambda$. The FO employee perfectly observes θ, decides whether to invest and, if yes, how much effort e she wants to exert. The bank observes whether the FO employee invests, but it does not observe θ or e. At time $t = 1$, returns realize. The bank pays the FO employee α when a return of $\overline{R}$ realizes, β for $\underline{R}$, γ if the employee does not invest and, hence, earns no return, and 0 in the case of a large loss L. The FO employee is risk-neutral, enjoys limited liability ($\alpha, \beta, \gamma \geq 0$), and maximizes her expected compensation less her cost of effort.

The bank maximizes its expected profit defined as expected financial return less expected compensation. We begin the analysis with a few direct observations. First, we note that it is never optimal for the FO employee to choose an effort level outside the set $\{0; \overline{e}\}$. Second, to incentivize the employee to spend effort $\overline{e}$ on a type-I project, the bank needs to pay $\alpha - \beta \geq \overline{e}$. Third, to ensure that the FO employee does *not* invest into a type-II project, the bank needs to pay the FO employee a rent of at least $\gamma \geq \pi\alpha$. Fourth, profit maximization implies that the bank optimally sets $\beta = 0$. If the bank chooses to satisfy the incentive

compatibility constraints, it will optimally set $(\alpha, \beta, \gamma) = (\overline{e}, 0, \pi\overline{e})$:

$$(\alpha, \beta, \gamma) = (\overline{e}, 0, \pi\overline{e}) : \ \mathrm{E}\left[Profit_i^{Bank}\right] = \lambda(\overline{R} - \overline{e}) - (1-\lambda)\pi\overline{e} \tag{7}$$

Fifth, if the bank decides not to pay a rent of $\gamma = \pi\overline{e}$, then the FO employee potentially invests into a type-II project with a negative NPV, which lowers expected bank profit:

$$\begin{aligned}(\alpha, \beta, \gamma) = (\overline{e}, 0, 0) : \ \mathrm{E}\left[Profit_{ii}^{Bank}\right] &= \lambda(\overline{R} - \overline{e}) + (1-\lambda) \cdot \left[\pi \cdot (\overline{R} - \overline{e}) - (1-\pi)L\right] \\ &< \mathrm{E}\left[Profit_i^{Bank}\right]\end{aligned} \tag{8}$$

Finally, the only contract that avoids paying a positive rent γ and also avoids investment into a type-II project is a contract that fails to incentivize effort for the type-I project:

$$(\alpha, \beta, \gamma) = (0, 0, 0) : \ \mathrm{E}\left[Profit_{iii}^{Bank}\right] = \lambda \cdot \underline{R} \tag{9}$$

The optimal choice between (7) and (9) is summarized in Proposition 1:

PROPOSITION 1: ***FO compensation in the case without a risk manager***

The contract $(\alpha, \beta, \gamma) = (\overline{e}, 0, \pi\overline{e})$ *incentivizes effort in the type-I project but pays the FO employee an expected rent of* $(1-\lambda)\pi\overline{e}$ *to avoid investment into the type-II project. The contract* $(0, 0, 0)$ *does not pay the FO employee any rent but foregoes expected efficiency gains of* $\lambda(\overline{R} - \overline{e} - \underline{R})$ *from effort on the type-I project. The bank optimally chooses the contract* $(0, 0, 0)$ *and not* $(\overline{e}, 0, \pi\overline{e})$ *if the expected rent exceeds the efficiency gains from exerting effort:*

$$(1-\lambda)\pi\overline{e} > \lambda(\overline{R} - \overline{e} - \underline{R}) \tag{10}$$

Proposition 1 describes an excessive risk-taking problem when the bank observes neither private effort nor project types. As a result, the bank either needs to pay a rent or to accept that the agent exerts insufficient effort. Both outcomes are costly.

B. *Case with a Risk Manager*

Next, we study the case with a risk manager who has the authority to approve or reject the project proposed by the FO employee. In some sense, we allow the bank to solve the multitasking problem in Section V.A by assigning the task of selecting projects to one agent and the task of improving projects to another.

We assume that, unlike the FO employee, the risk manager does not directly observe project types I and II. Instead, the risk manager must exert privately costly effort to screen the project. In the case of lending, a possible justification for such asymmetric information could be that the personal contact with the borrower provides the loan officer (FO employee) with information that is not available to the risk manager. In the model, this assumption ensures that the bank cannot use the risk manager for free but must compensate him.

Figure 3 shows the role of the risk manager in the model. After nature has endowed the FO employee with a project, the risk manager spends effort m on searching the project for evidence that it is of the bad type II. If the project drawn by nature is good ($\theta = I$), no such evidence exists and the risk manager approves the project. However, if the project is bad, then the risk manager uncovers the incriminating evidence that $\theta = II$ only with probability m. With probability $1 - m$, he does not find the evidence and approves the project. We assume quadratic cost of effort $m^2/2$ and that m is not observed by the bank.

We first derive the optimal compensation of the FO employee. To this end, we note that it can only be optimal for the bank to hire and pay for a risk manager if this allows the bank to incentivize the FO employee to spend effort $\overline{e}$ on the type-I project *without* paying her a rent. It is not optimal for the bank to hire a costly risk manager just to offer the FO employee one of the two contracts $(\alpha, \beta, \gamma) = (\overline{e}, 0, \pi\overline{e})$ and $(0, 0, 0)$ in Proposition 1.

LEMMA 1: ***FO compensation in the case with a risk manager***

If it is optimal for the bank to hire a risk manager, then the bank optimally pays the FO employee $(\alpha, \beta, \gamma) = (\overline{e}, 0, 0)$*, incentivizing effort* $\overline{e}$ *on project* I *without paying a rent.*

We now turn to the compensation of the risk manager himself. The bank pays him A if $R = \overline{R}$, C if he rejects the project ($R = 0$), and 0 in the case of a loss L (see Figure 3). B denotes his pay if $R = \underline{R}$ but can be ignored as Lemma 1 implies that a return of $\underline{R}$ never realizes. The risk manager maximizes his expected compensation less his cost of effort:

$$\max_m \mathrm{E}[Profit^{RM}] = \lambda \cdot A + (1-\lambda)m \cdot C + (1-\lambda) \cdot (1-m)\pi A - \frac{m^2}{2} \tag{11}$$

$$\text{FOC:} \quad m^* = (1-\lambda) \cdot (C - \pi A) \tag{12}$$

The first-order condition in (12) implies that the risk manager only chooses a strictly positive screening intensity (effort) m^* if $C > \pi A$. Otherwise, the risk manager colludes with the FO employee and simply approves all projects without inspection ($m^* = 0$). Besides approving all projects, the risk manager can also shirk in a second way and simply reject all projects without screening. To avoid this outcome, the risk manager's compensation C if he rejects needs to be smaller than his expected profit if he chooses $m^* = (1-\lambda) \cdot (C - \pi A) > 0$:

$$\lambda \cdot A + (1-\lambda)m^* \cdot C + (1-\lambda)(1-m^*)\pi A - \frac{m^{*2}}{2} \geq C \ , \tag{13}$$

which simplifies to inequality (15) in Lemma 2:

LEMMA 2: ***Incentive compatibility constraints of the risk manager***

To incentivize the risk manager to spend positive effort $m^* = (1-\lambda) \cdot (C - \pi A)$ *on the inspection of the investment project, the risk manager's contract* (A, B, C) *must satisfy:*

$$\textit{No Excessive Approval}: \quad C \geq \pi A \tag{14}$$

$$\textit{No Excessive Rejection}: \quad A \geq C + \frac{m^*}{\lambda}\left(1 - \frac{m^*}{2}\right) \tag{15}$$

Otherwise, the risk manager chooses $m = 0$ *and either approves or rejects all projects.*

To prevent collusion between risk manager and FO employee, the *No Excessive Approval*

constraint limits the risk manager's compensation A for high financial returns $\overline{R}$. At the same time, the risk manager's participation in the upside of FO performance must remain sufficiently large to satisfy the *No Excessive Rejection* constraint: A must be larger than C.

Finally, the bank chooses A and C in a way that maximizes its expected profit:

$$\max_{A,C} \mathrm{E}\left[Profit^{Bank}\right] \;=\; \lambda\left[\overline{R}-\overline{e}\right] - \Psi(A,C) \tag{16}$$

$$\text{subject to } A, C \geq 0,\ (14),\ \&\ (15),\ \text{where:}$$

$$\Psi(A,C) \;\equiv\; \lambda A + (1-\lambda) m^*(A,C)\, C - (1-\lambda)\left(1-m^*(A,C)\right)\left[\pi\left(\overline{R}-\overline{e}-A\right) - (1-\pi)L\right]$$

$m^*(A,C)$ is the effort chosen by the risk manager as a function of A and C (see (12)). $\Psi(A,C)$ is the expected cost that arises because the bank must compensate the risk manager and because the risk manager fails to detect the type-II project with probability $(1-m^*(A,C))$.

PROPOSITION 2: ***Optimal risk manager compensation***

Let (A^*, C^*) solve the bank's maximization problem in (16).

- *(a) If $m(A^*, C^*)$ is strictly positive, the No Excessive Approval constraint in (14) holds as a strict inequality whereas the No Excessive Rejection constraint in (15) is binding.*
- *(b) If (A^*, C^*) is an interior solution, then A^*, C^*, $A^* - C^*$, and the screening intensity $m(A^*, C^*)$ are strictly increasing in L and $\overline{e}$ and strictly decreasing in $\overline{R}$.*
- *(c) For sufficiently large L and $\overline{e}$ or sufficiently low $\overline{R}$, risk manager pay (A^*, C^*) is maximal and the risk manager screens with monitoring intensity $m(A^*, C^*) = 1$. For sufficiently low L and $\overline{e}$ or sufficiently large $\overline{R}$, risk manager pay is zero, i.e., the bank does not hire a risk manager.*

Proof: See Appendix Appendix B.

Part (a) of Proposition 2 implies that risk manager compensation strictly increases in FO performance whenever it is optimal for the bank to incentivize the risk manager to spend strictly positive effort on screening ($m(A^*, C^*) > 0$).[19] As shown in Figure 4, risk manager

[19] m^* is strictly positive whenever the *No Excessive Approval* condition in (14) holds as a strict inequality.

pay increases from 0 to C to A as the financial return in the FO increases from $-L$ to 0 to $\overline{R}$. As a result, the compensation of the risk manager and the FO employee are correlated.

Part (b) states that the bank wants the risk manager to screen with a higher intensity $m(A^*, C^*)$ and, hence, is willing to pay the risk manager higher compensation A^* and C^* if the (negative) NPV of the bad type-II project ($\pi\overline{R} - (1-\pi)L$) is very low or when the incentive problem in the FO is very large (high unobservable $\overline{e}$). The difference $A-C$, which is the additional compensation that the risk manager receives if he approves the project and a high return $\overline{R}$ realizes, is also increasing in L and $\overline{e}$. In other words, the larger the excessive risk-taking problem in the FO, the *larger* the risk manager's bonus for high realized returns.

Part (c) describes the corner solutions. The bank pays at most the compensation necessary to incentivize a screening intensity of $m = 1$ or decides not to hire the risk manager and to offer the FO employee one of the two contracts in Proposition 1.

VI. Discussion and Extensions

How should firms design the financial incentives of internal monitors? After the crisis of 2008 to 2010, the regulatory debate of this question has mainly focused on risk managers in banks and on preventing collusion with FOs, i.e. on preventing an excessive approval of risky investments. A frequent policy recommendation states that *risk management and control personnel should be compensated in a way that makes their incentives independent of the lines of business whose risk taking [...] they control* (Federal Reserve Board, 2011, p.22).

This recommendation is consistent with the *No Excessive Approval* constraint in our model in the sense that risk managers' compensation must not be too sensitive to the upside of FO performance. However, we also show that complete *independence* of FO performance is too strong as a requirement because it violates the *No Excessive Rejection* constraint. Optimal risk manager compensation is moderately sensitive to FO performance and, hence,

This is indeed the case provided it is optimal to hire a risk manager. Paying a risk manager strictly positive values $A, C > 0$ just to set $C = \pi A$, implying $m^* = 0$, is inefficient.

correlated with the compensation of FO employees. Possibly, the bonus correlations observed in Tables II to IV are not the result of a governance failure but could, in fact, be efficient.

According to our model, banks that *underexpose* their risk managers to FO performance and violate the *No Excessive Rejection* constraint underinvest in positive-NPV projects and, hence, underperform. The better crisis performance of banks that aligned the performance pay of their risk managers and FO employees more strongly (see Tables VI and VII) seems to be consistent with this prediction. Possibly, weak bonus correlations between risk management and FOs constitute a governance failure that makes risk managers too conservative and unresponsive to good, positive-NPV investments: *When risk management becomes too inflexible, it destroys value because the institution no longer has the ability to invest in valuable opportunities when they become available, and it also becomes less effective in making sure that the firm has the right amount of risk* (Stulz, 2016, p.44).

In fact, anecdotal evidence suggests that even a certain degree of collaboration between risk managers and FOs could be desirable. Supervisors from the U.S., U.K., France, Germany, and Switzerland concluded from a bank survey that *the degree to which risk management functions interacted with business line management was lower at firms that experienced greater difficulties during the turmoil [of the last financial crisis]* (Senior Supervisors Group, 2008, p.9). In a clinical study of two banks, Hall, Mikes, and Millo (2015) find that more collaborative working relationships between risk managers and FOs create value by sharing information and risk management tools. Bouvard and Lee (2019) show theoretically how conservative risk management can create costly delays in trade execution when prioritizing accurate over timely investment decisions.

A. Extension to Socialized Bank Loss

In this section, we consider the effect of socializing bank losses on risk manager pay in the model. We assume that the bank bears only a share τ of L and that the tax payer (deposit insurance or bailout fund) bears $(1-\tau)L$ without receiving any risk compensation ex ante.

As the loss born by the bank is reduced from L to τL, the NPV of the type-II project increases from the bank's perspective. It follows from Part (b) of Proposition 2 that the higher NPV changes the bank's willingness to pay the risk manager and to provide him with incentives to spend effort on screening. As L is reduced to τL, A^* and C^* decrease and so does the screening intensity $m^*(A^*, C^*)$. Hence, the socialization of bank losses increases the probability that risk management approves project II. How regulators should respond to this increase in risk taking depends on the amount of loss socialization:

Moderate loss socialization. If the tax payer bears only a moderate share $(1-\tau)$ of bank losses, the NPV of the type-II project increases but remains negative from the bank's perspective $\big(\pi\overline{R} - (1-\pi)\tau L < 0\big)$. Hence, although the bank reduces its willingness to pay for screening, it does still not actively seek investment into project II. In particular, the bank still ensures that the *No Excessive Approval* constraint remains satisfied. This implies that the regulator need not introduce any regulatory requirements that limit the risk manager's participation in the upside of FO performance. Such constraints targeting the design of compensation would be non-binding at best and possibly violate the *No Excessive Rejection* constraint at worst. Instead, the regulator should just correct the bank's too low willingness to pay for screening—for example, through a subsidy or through a regulatory requirement to spend an appropriate amount on risk management.

Extreme loss socialization. If the tax payer bears such a large share $(1-\tau)$ of bank losses that the NPV of the type-II investment turns positive from the bank's perspective $(\pi\overline{R} - (1-\pi)\tau L > 0)$, the bank actually wants the FO employee to invest into project II. The bank optimally fires the risk manager or, equivalently, reduces his compensation and, thereby, his screening intensity $m^*(A, C)$ to zero. Importantly, in this case of extreme loss socialization, a regulatory subsidy or requirement to spend a strictly positive amount on risk management would fail to deter excessive risk taking. The bank would simply set $\pi A > C$ and thereby deliberately violate the *No Excessive Approval* constraint. Unlike moderate loss socialization, extreme loss socialization would indeed call for additional regulation that

imposes the *No Excessive Approval* constraint as a regulatory requirement.

B. Extension to Capture through Side Payments

Finally, we consider the possibility that the FO undermines the bank's efforts to provide the risk manager with incentives to screen and reject bad investments. We assume that, unnoticed by the bank, the FO employee credibly promises a side payment that increases the risk manager's compensation A for high return realizations $\overline{R}$ by a factor of $b > 1$. As a result, the risk manager's screening intensity decreases to $m = (1-\lambda)(C - \pi b A)$, preventing project II with a lower probability. In the extreme case in which $\pi b A > C$, the *No Excessive Approval* constraint is violated and the risk manager simply approves all investment projects.

One interpretation of b would be that the FO can *implement a transfer to the risk manager, for instance, through career opportunities in the FO* (Landier et al., 2009a, p.454). In general, risk managers that hope to transition to a lucrative job in a FO could be concerned how the rejection of investments affects their personal relationships with FO employees and, hence, their career prospects. However, whether career opportunities in FOs are indeed lucrative enough to potentially capture risk managers is an empirical question. We estimate the following regression to provide some initial, descriptive evidence in this regard:

$$\begin{aligned} Log\left(\frac{total\ pay_{i,t}}{total\ pay_{i,t-1}}\right) \;=\; & \beta_1\ \mathbb{1}\left(RM \rightarrow FO\ markets\right)_{i,t} \;+\; \beta_2\ \mathbb{1}\left(RM \rightarrow FO\ credit\right)_{i,t} \\ & +\; \beta_3\ \mathbb{1}\left(RM \rightarrow Back\ office\right)_{i,t} \;+\; Controls \;+\; \epsilon_{i,t}\ , \end{aligned} \tag{17}$$

where the dependent variable denotes the log change of risk manager i's total remuneration (=base salary + bonus) from year $t-1$ to t. The three binary regressors equal one if the risk manager has transitioned from risk management to another back office or to a (capital markets-oriented or credit-oriented) FO between $t-1$ to t. The wage effects of these job moves are measured relative to risk managers that stay in risk management.

Table VIII confirms that job transitions to FOs are financially attractive. Columns (1)

to (3) show that risk managers experience significant wage growth after they transition to capital markets-oriented FOs. Focusing on job rotations in the opposite direction in columns (4) to (6), we find that FO employees only earn significantly more after they move to risk management divisions that mainly supervise market risk. By contrast, job transitions to credit-oriented services or to back offices are not associated with significant pay changes—neither for risk managers nor for FO employees.

The salary increase following job rotations between market-oriented risk management and FOs seems to confirm concerns that career prospects can capture risk managers and undermine their incentives to screen. However, there are two reasons why such a conclusion would be premature. First, we find that job rotations, while financially attractive, are relatively rare. In total, we observe only 249 cases in which a risk manager moves to a FO. Second, our descriptive analysis ignores the endogeneity of job rotations. For example, risk managers that move tend to be more junior and younger (see Table IA.2 in the Internet Appendix) and, hence, are likely to experience higher wage growth in general and independently of any job rotation. Comparing columns (1) and (2) of Table VIII, we find that the inclusion of age and tenure fixed effects does indeed attenuate the coefficient of $\mathbb{1}\left(RM \rightarrow FO\ markets\right)_{i,t}$.[20]

Overall, the evidence that career prospects in FOs have the potential to capture risk managers is only limited.[21]

VII. Conclusion

In this paper, we revisit the seminal question by Alchian and Demsetz (1972) how firms should remunerate internal monitors. Based on unique data on the remuneration of risk managers and those they oversee, we provide first empirical evidence that the financial

[20] Age and tenure do not have the same attenuating effect on $\mathbb{1}\left(FO \rightarrow RM\ markets\right)_{i,t}$. This is consistent with the observation that age and tenure do not explain job rotations from FOs towards risk management (see Internet Appendix, Table IA.2).

[21] We also test whether crisis performance is different for banks with more job transitions between risk management and FOs in 2003-2007. We find no conclusive evidence in this regard (Table IA.3 in the Internet Appendix). However, we do find some evidence that the bonuses of risk managers who previously worked in a FO tend to be more sensitive to FO performance (Table IA.4 of the Internet Appendix).

incentives between banks' control units and front offices are positively aligned. We find no evidence that labor markets, risk sharing between banks and employees, or governance failures are responsible for this finding. If anything, more aligned incentive pay between risk management and front offices is associated with better bank performance.

In a model with multiple agents, we show how aligned incentive pay between risk management and front offices can arise as the result of efficient contracting. The main insight is that risk manager pay must satisfy a *No Excessive Approval* as well as a *No Excessive Rejection* constraint. Whereas the first ensures that the risk manager does not collude with the front office, the second constraint ensures that the risk manager does not shirk by rejecting projects without screening. Both constraints together imply a moderate albeit strictly positive correlation between risk manager pay, front office pay, and financial performance.

Appendix A. Variable Definitions

Employee-level variables:

- $Age_{i,t}$: Age of bank employee i in year t.
- $Tenure_{i,t}$: Number of years for which employee i has worked for his current employer.
- $Base\ salary_{i,t}$: Fixed (cash) remuneration paid to bank employee i in year t.
- $Bonus_{i,t}$: Variable (cash) bonus paid to bank employee i in year t.
- $Total\ compensation_{i,t}$: Sum of $Base\ salary_{i,t}$ and $Bonus_{i,t}$.
- $Bonus\ share_{i,t}$: $Bonus_{i,t}$ / $Base\ salary_{i,t}$
- $\mathbb{1}\left(Managerial\ position\right)_{i,t}$: One for employees in managerial positions, zero otherwise.
- $Hierarchy\ level_{i,t}$: Level of seniority of bank employee i from 1 (junior) to 6 (senior).

Bank-level variables:

- $Avg.\ FO\text{-}markets\ bonus_{b,t}$: Average bonus that bank b pays to its employees in capital markets-oriented front offices (FOs) in year t.
- $Avg.\ RM\text{-}markets\ bonus_{b,t}$: Average bonus that bank b pays to its risk managers that supervise capital markets-oriented FOs in year t.
- $\rho(FO\text{-}markets,\ RM\text{-}markets)_b$: The correlation between $Avg.\ FO\text{-}markets\ bonus_{b,t}$ and $Avg.\ RM\text{-}markets\ bonus_{b,t}$ measured over the years 2003 to 2007.

- *Avg. FO-credit bonus*$_{b,t}$: Average bonus that bank b pays to its employees in credit-oriented FOs in year t.
- *Avg. RM-credit bonus*$_{b,t}$: Average bonus that bank b pays to its risk managers that supervise credit-oriented FOs in year t.
- ρ*(FO-credit, RM-credit)*$_b$: The correlation between *Avg. FO-credit bonus*$_{b,t}$ and *Avg. RM-credit bonus*$_{b,t}$ measured over the years 2003 to 2007.
- ρ*(all FO, all RM)*$_b$: The correlation between the (average) bonus that bank b pays to its employees in (capital markets- as well as credit-oriented) FOs and the (average) bonus that bank b pays to all its risk managers measured over the years 2003 to 2007.
- ρ*(FO-markets, Support ex RM)*$_b$: The correlation between *Avg. FO-markets bonus*$_{b,t}$ and the average bonus that bank b pays to its service employees in support divisions like accounting, HR, IT, etc. (excluding risk managers).
- *Avg. FO-markets bonus other banks*$_{-b,t}$: Average bonus paid in the capital markets-oriented FOs of all sample banks excluding bank b itself.
- *Avg. FO-credit bonus other banks*$_{-b,t}$: Average bonus paid in the credit-oriented FOs of all sample banks excluding bank b itself.
- *Avg. RM-markets bonus other banks*$_{-b,t}$: Average bonus paid to risk managers that supervise capital markets-oriented FOs, considering risk managers of all sample banks except bank b.
- *Avg. RM-credit bonus other banks*$_{-b,t}$: Average bonus paid to risk managers supervising credit-oriented FOs, considering all sample banks except bank b.
- *Governance quality*$_{b,t}$: The first principal component of the risk management variables:
  (a) $\mathbb{1}$ (*CRO present*)$_{b,t}$: Binary variable that equals one if bank b reports a chief risk officer (CRO) in year t and zero otherwise.
  (b) $\mathbb{1}$ (*CRO exclusive*)$_{b,t}$: Binary variable that equals one if the bank reports a CRO in year t that only serves as CRO and occupies no other executive position.
  (c) *Avg. total experience of SB*$_{b,t}$: Average work experience of bank b's supervisory board members measured in years.
  (d) *Avg. finance experience of SB*$_{b,t}$: Average work experience in the finance industry of bank b's supervisory board members measured in years.
  (e) *Avg. executive experience of SB*$_{b,t}$: Average work experience as a corporate executive of bank b's supervisory board members measured in years.
  (f) *% of SB with experience abroad*$_{b,t}$: Fraction of supervisory board members with work experience outside Germany.
  (g) *% of SB with Ph.D. in economics*$_{b,t}$: Fraction of supervisory board members with a Ph.D. in economics (or in closely related studies).

Risk manager-specific variables:

- $\mathbb{1}\left(RM\ for\ markets\right)_{i,t}$: Binary variable that equals one if risk manager i supervises capital markets-oriented FOs and zero if risk manager i supervises credit-oriented FOs in year t.
- $Avg.\ FO\ bonus_{i,t} = \begin{cases} Avg.\ FO\text{-}markets\ bonus_{b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 1 \\ Avg.\ FO\text{-}credit\ bonus_{b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 0 \end{cases}$
- $Avg.\ FO\ bonus\ other\ banks_{i,t} =$
$$\begin{cases} Avg.\ FO\text{-}markets\ bonus\ other\ banks_{-b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 1 \\ Avg.\ FO\text{-}credit\ bonus\ other\ banks_{-b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 0 \end{cases}$$
- $Avg.\ RM\ bonus\ other\ banks_{i,t} =$
$$\begin{cases} Avg.\ RM\text{-}markets\ bonus\ other\ banks_{-b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 1 \\ Avg.\ RM\text{-}credit\ bonus\ other\ banks_{-b(i),t} & \text{if } \mathbb{1}\left(RM\ for\ markets\right)_{i,t} = 0 \end{cases}$$
- $Relative\ RM\ bonus_{i,t} = Bonus_{i,t}\ /\ Avg.\ RM\ bonus\ other\ banks_{i,t}$
- $Relative\ FO\ bonus_{i,t} = Avg.\ FO\ bonus_{i,t}\ /\ Avg.\ FO\ bonus\ other\ banks_{i,t}$

Appendix B. Solution of the Model

We consider the bank's maximization problem in (16).

LEMMA 3: *If it is optimal to hire a risk manager, then the No Excessive Approval constraint holds as a strict inequality.*

Assume the *No Excessive Approval* constraint was binding. In that case, $m^*(A, C) = 0$, the risk manager would not screen, the bank's expected profit would be lower than in (7), and the bank would be better off without the risk manager.

LEMMA 4: *If it is optimal to hire a risk manager, then the No Excessive Rejection constraint is binding.*

Assume that both incentive compatibility constraints held as strict inequalities. In that case, A and C would have to be strictly positive. But then the bank could find a new $A' < A$ and a new $C' < C$ such that the bank reduces its labor cost while keeping m, the probability of detecting project II, constant. Specifically, assume that $\tau(1-\pi) > 0$ is the slack in the *No Excessive Rejection* constraint (15). Then, the bank can pick $C' = C - \kappa$ and $A' = A - \tau$ for $\kappa = \pi\tau$. This keeps $m = (1-\lambda)(C - \pi A) = (1-\lambda)(C' - \pi A')$ unchanged. At the same

time, it reduces labor costs without violating (15):

$$\begin{aligned} A' &\geq C' + \frac{m^*}{\lambda}\left(1 - \frac{m^*}{2}\right) \\ \Leftrightarrow C' &\leq A' - \frac{1-\lambda}{\lambda}\cdot(C' - \pi A') + \frac{(1-\lambda)^2}{2\lambda}\cdot(C' - \pi A')^2 \\ \Leftrightarrow (C - \pi\tau) &\leq A - \tau - \frac{1-\lambda}{\lambda}\cdot(C - \pi A) + \frac{(1-\lambda)^2}{2\lambda}\cdot(C - \pi A)^2 \\ \Leftrightarrow C + \tau(1-\pi) &\leq A - \frac{1-\lambda}{\lambda}\cdot(C - \pi A) + \frac{(1-\lambda)}{2\lambda}\cdot(C - \pi A)^2 \end{aligned}$$

Hence, if it is optimal to hire a risk manager, then (15) is binding.

It follows from the binding constraint (15) that

$$\underbrace{(1-\lambda)^2\cdot(C - \pi A)}_{(1-\lambda)\cdot m^*} = 1 \pm \sqrt{1 - 2(1-\pi)\cdot(1-\lambda)^2\lambda A}$$

As $(1-\lambda)\cdot m^* < 1$, the only admissible solution for C is given by

$$C = \frac{1}{(1-\lambda)^2} + \pi A - \frac{\sqrt{1 - 2(1-\pi)\cdot(1-\lambda)^2\lambda A}}{(1-\lambda)^2}, \tag{18}$$

allowing us to rewrite expected bank profit only as a function of A:

$$\begin{aligned} \max_A \mathrm{E}\left[Profit^{Bank}\right] &= \lambda\left(\overline{R} - \overline{e} - A\right) \\ &+ \underbrace{\left(\sqrt{1 - 2(1-\pi)(1-\lambda)^2\lambda A} - \lambda\right)}_{(1-\lambda)\cdot(1-m^*)}\cdot\left(\pi\cdot\left(\overline{R} - \overline{e} - A\right) - (1-\pi)L\right) \qquad (19) \\ &- \underbrace{\left(1 - \sqrt{1 - 2(1-\pi)(1-\lambda)^2\lambda A}\right)}_{(1-\lambda)\cdot m^*}\cdot\left(\frac{1}{(1-\lambda)^2} + \pi A - \frac{\sqrt{1 - 2(1-\pi)\cdot(1-\lambda)^2\lambda A}}{(1-\lambda)^2}\right) \end{aligned}$$

The first and second derivatives are given by:

$$\frac{\partial \mathrm{E}\left[Profit^{Bank}\right]}{\partial A} = \underbrace{\frac{(1-\pi)\cdot\lambda}{\sqrt{1-2(1-\pi)(1-\lambda)^2\lambda A}}}_{>0} \cdot \underbrace{\left[(1-\lambda)^2\cdot\left((1-\pi)L-\pi\left(\overline{R}-\overline{e}\right)\right)-2\right]}_{\gtrless 0}$$

$$\underbrace{-\left(\pi-(1-\pi)\lambda\right)}_{\gtrless 0} \tag{20}$$

$$\frac{\partial^2 \mathrm{E}\left[Profit^{Bank}\right]}{\partial A^2} = \frac{(1-\pi)^2\cdot\lambda^2(1-\lambda)^2}{\left[1-2(1-\pi)(1-\lambda)^2\lambda A\right]^{\frac{3}{2}}} \cdot \left[(1-\lambda)^2\cdot\left((1-\pi)L-\pi\left(\overline{R}-\overline{e}\right)\right)-2\right] \tag{21}$$

Assume that (20)=0 at $A = A^{int}$ and $\left[(1-\lambda)^2\cdot\left((1-\pi)L-\pi\left(\overline{R}-\overline{e}\right)\right)-2\right] < 0$. Then expected bank profit is concave with a maximum at:

$$A^{int} = \frac{1}{2(1-\pi)(1-\lambda)^2\lambda} - \frac{(1-\pi)\lambda}{2(1-\lambda)^2}\cdot\frac{\left[(1-\lambda)^2\cdot\left((1-\pi)L-\pi\left(\overline{R}-\overline{e}\right)\right)-2\right]^2}{\left[\pi-(1-\pi)\lambda\right]^2} \tag{22}$$

If $A^{int} > 0$ and $m^*\left(A^{int}\right) < 1$, then A^{int} constitutes an interior solution A^* to (16). First derivatives show that A^{int} is strictly increasing in L and $\overline{e}$ and decreasing in $\overline{R}$. From (18), it follows that C^{int} is increasing in A^{int}. Solving (18) for $m^* = (1-\lambda)(C-\pi A)$ shows that m^* is increasing in A^{int}. Finally, as (15) is binding, $C^{int} - A^{int}$ is increasing in m. Hence, C^{int}, $m\left(A^{int}, C^{int}\right)$, and $C^{int} - A^{int}$ are also increasing in L and $\overline{e}$ and decreasing in $\overline{R}$.

LEMMA 5: *If (20)=0 at $A = A^{int}$ and $\left[(1-\lambda)^2\cdot\left((1-\pi)L-\pi\left(\overline{R}-\overline{e}\right)\right)-2\right] < 0$, then A^{int}, C^{int}, $C^{int} - A^{int}$, and $m\left(A^{int}, C^{int}\right)$ are strictly increasing in L and $\overline{e}$ and decreasing in $\overline{R}$.*

Finally, it follows from (20) and (21) that, for sufficiently large L or $\overline{e}$ or for sufficiently low $\overline{R}$, there is no interior solution and the bank pays a maximum amount of:

$$A^{max} = \frac{1-\lambda^2}{2(1-\pi)(1-\lambda)^2\lambda}, \tag{23}$$

which determines C^{max} and a screening intensity of $m\left(A^{max}, C^{max}\right) = 1$ through (18).[22] Similarly, for sufficiently small L or $\overline{e}$ or for sufficiently large $\overline{R}$, there is no interior solution and the bank does not pay the risk manager anything ($0 = A = C\ (= m(A,C))$), i.e., the bank does not hire a risk manager and, instead, remunerates the FO employee according to Proposition 1.

[22] (23) implies that, for $A \leq A^{max}$, the radicand in (18) is strictly positive.

REFERENCES

Agarwal, Sumit, and Itzhak Ben-David, 2013, Do loan officers' incentives lead to lax lending standards?, Working paper, NBER.

Aghion, Philippe, and Jean Tirole, 1997, Formal and real authority in organizations, *Journal of Political Economy* 105, 1–29.

Alchian, Armen A., and Harold Demsetz, 1972, Production, information costs, and economic organization, *The American Economic Review* 62, 777–795.

BaFin, 2019, Regulation on the Supervisory Requirements for Institutions' Remuneration Systems – Institutsvergütungsverordnung, Technical report, Bundesanstalt für Finanzdienstleistungsaufsicht.

Berg, Tobias, 2015, Playing the devil's advocate: The causal effect of risk management on loan quality, *The Review of Financial Studies* 28, 3367–3406.

Berg, Tobias, Manju Puri, and Jörg Rocholl, 2019, Loan officer incentives, internal rating models, and default rates, *Review of Finance* 24, 529–578.

Bonelli, Maxime, 2019, Labor mobililty and capital misallocation in the mutual fund industry, Working paper, HEC Paris.

Bouvard, Matthieu, and Samuel Lee, 2019, Risk Management Failures, *The Review of Financial Studies* Forthcoming.

Brunnermeier, Markus K, Gang Nathan Dong, and Darius Palia, 2020, Banks' Noninterest Income and Systemic Risk, *The Review of Corporate Finance Studies* 9, 229–255.

Cheng, Ing-Haw, Harrison Hong, and José A. Scheinkman, 2015, Yesterday's heroes: Compensation and risk at financial firms, *The Journal of Finance* 70, 839–879.

Cole, Shawn, Martin Kanz, and Leora Klapper, 2015, Incentivizing calculated risk-taking: Evidence from an experiment with commercial bank loan officers, *The Journal of Finance* 70, 537–575.

Cornaggia, Jess, Kimberly J. Cornaggia, and Han Xia, 2016, Revolving doors on wall street, *Journal of Financial Economics* 120, 400 – 419.

Dewatripont, Mathias, and Jean Tirole, 1999, Advocates, *Journal of Political Economy* 107, 1–39.

Edmans, Alex, Xavier Gabaix, and Dirk Jenter, 2017, Executive compensation: A survey of theory and evidence, in Benjamin E. Hermalin, and Michael S. Weisbach, eds., *The Handbook of the Economics of Corporate Governance*, volume 1 of *The Handbook of the Economics of Corporate Governance*, 383–539 (North-Holland).

Efing, Matthias, Harald Hau, Patrick Kampkötter, and Jean-Charles Rochet, 2018, Bank bonus pay as a risk sharing contract, Working paper, HEC Paris.

Efing, Matthias, Harald Hau, Patrick Kampkötter, and Johannes Steinbrecher, 2015, Incentive pay and bank risk-taking: Evidence from austrian, german, and swiss banks, *Journal of International Economics* 96, S123–S140.

Ellul, Andrew, Marco Pagano, and Annalisa Scognamiglio, 2019, Career Risk and Market Discipline in Asset Management, *The Review of Financial Studies* 33, 783–828.

Ellul, Andrew, and Vijay Yerramilli, 2013, Stronger risk controls, lower risk: Evidence from U.S. bank holding companies, *The Journal of Finance* 68, 1757–1803.

Fahlenbrach, Rüdiger, Robert Prilmeier, and René M. Stulz, 2012, This time is the same: Using bank performance in 1998 to explain bank performance during the recent financial crisis, *The Journal of Finance* 67, 2139–2185.

Falk, Armin, and Michael Kosfeld, 2006, The hidden costs of control, *American Economic Review* 96, 1611–1630.

Federal Reserve Board, 2011, Incentive compensation practices: A report on the horizontal review of practices at large banking organizations, Technical report, Board of Governors of the Federal Reserve System.

Gao, Janet, Kristoph Kleiner, and Joseph Pacelli, 2020, Credit and Punishment: Are Corporate Bankers Disciplined for Risk-Taking?, *The Review of Financial Studies* 33, 5706–5749.

Griffin, John M., Samuel Kruger, and Gonzalo Maturana, 2019, Do labor markets discipline? Evidence from RMBS bankers, *Journal of Financial Economics* 133, 726–750, JFE Special Issue on Labor and Finance.

Hall, Matthew, Anette Mikes, and Yuval Millo, 2015, How do risk managers become influential? A field study of toolmaking in two financial institutions, *Management Accounting Research* 26, 3–22.

Hau, Harald, and Marcel Thum, 2014, Subprime crisis and board (in-) competence: private versus public banks in Germany, *Economic Policy* 24, 701–752.

Heider, Florian, and Roman Inderst, 2012, Loan prospecting, *The Review of Financial Studies* 25, 2381–2415.

Hoenig, Thomas M., 2008, Perspectives on the recent financial market turmoil, Remarks at the 2008 Institute of International Finance Membership Meeting, Rio de Janeiro, Brazil, Available at https://www.kansascityfed.org/speeches.

Holmstrom, Bengt, and Paul Milgrom, 1991, Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design, *Journal of Law, Economics, and Organization* 7, 24–52.

Kampkötter, Patrick, and Dirk Sliwka, 2018, More dispersion, higher bonuses? on differentiation in subjective performance evaluations, *Journal of Labor Economics* 36, 511–549.

Kashyap, Anil K., Raghuram G. Rajan, and Jeremy C. Stein, 2008, Rethinking capital regulation, Federal Reserve Bank of Kansas City Symposium on Maintaining Stability in a Changing Financial System, Jackson Hole, Wyoming, Available at http://www.kc.frb.org/publicat/sympos/ 2008/KashyapRajanStein.08.08.08.pdf.

Kempf, Elisabeth, 2020, The job rating game: Revolving doors and analyst incentives, *Journal of Financial Economics* 135, 41 – 67.

Landier, Augustin, David Sraer, and David Thesmar, 2009a, Financial risk management: When does independence fail?, *The American Economic Review: Papers & Proceedings* 99, 454–458.

Landier, Augustin, David Sraer, and David Thesmar, 2009b, Optimal Dissent in Organizations, *The Review of Economic Studies* 76, 761–794.

Lucca, David, Amit Seru, and Francesco Trebbi, 2014, The revolving door and worker flows in banking regulation, *Journal of Monetary Economics* 65, 17 – 32, Carnegie-Rochester-NYU Conference Series on Public Policy "A Century of Money, Banking, and Financial Instability" held at the Tepper School of Business, Carnegie Mellon University on November 15-16, 2013.

Oyer, Paul, 2004, Why do firms use incentives that have no incentive effects?, *The Journal of Finance* 59, 1619–1650.

Rahman, David, 2012, But who will monitor the monitor?, *American Economic Review* 102, 2767–97.

Senior Supervisors Group, 2008, Observations on risk management practices during the recent market turbulence, Policy report, Available at https://www.newyorkfed.org/newsevents/news/banking/2008/rp080306.

Shive, Sophie A., and Margaret M. Forster, 2016, The Revolving Door for Financial Regulators, *Review of Finance* 21, 1445–1484.

Stein, Jeremy C., 2002, Information production and capital allocation: Decentralized versus hierarchical firms, *The Journal of Finance* 57, 1891–1921.

Steinbrecher, Johannes, 2015, Board expertise and bank efficiency: Evidence from 2-tier-boards, Working paper, Ifo Institute - Leibniz Institute for Economic Research at the University of Munich.

Stulz, René M., 2008, Risk management failures: What are they and when do they happen?, *Journal of Applied Corporate Finance* 20, 39–48.

Stulz, René M., 2016, Risk management, governance, culture, and risk taking in banks, *FRBNY Economic Policy Review* 22, 43–59.

Tetlock, Paul C., 2007, Giving content to investor sentiment: The role of media in the stock market, *The Journal of Finance* 62, 1139–1168.

Thanassoulis, John, 2012, The case for intervening in bankers' pay, *The Journal of Finance* 67, 849–895.

Udell, Gregory F., 1989, Loan quality, commercial loan review and loan officer contracting, *Journal of Banking and Finance* 13, 367–382.

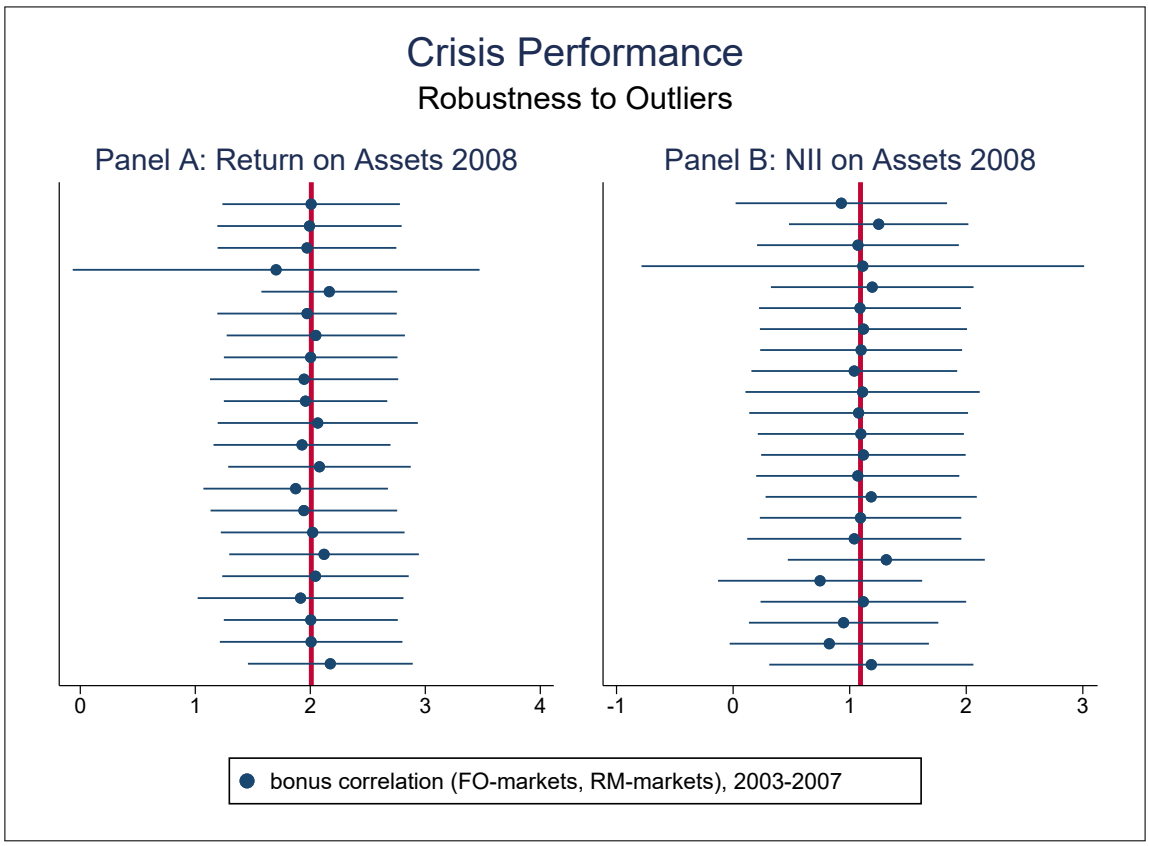

Figure 1. Bonus Pay Sensitivities of Risk Managers and Crisis Performance
The figure illustrates the influence of outliers on the relation between bonus pay sensitivities in risk management and banks' crisis performance in 2008. In Panel A, the blue circles and bars represent the new point estimates and 95% confidence intervals for the coefficient $\rho\,(FO\text{-}markets,\ RM\text{-}markets)_b$ after we repeatedly drop one single bank from the regression sample in column 3 of Table VI. Similarly, Panel B shows new point estimates and confidence intervals when we repeatedly drop banks from the regression sample in column 6 of Table VI. The vertical red lines in Panels A and B represent the original point estimates of 2.009 and 1.093 in the full bank sample.

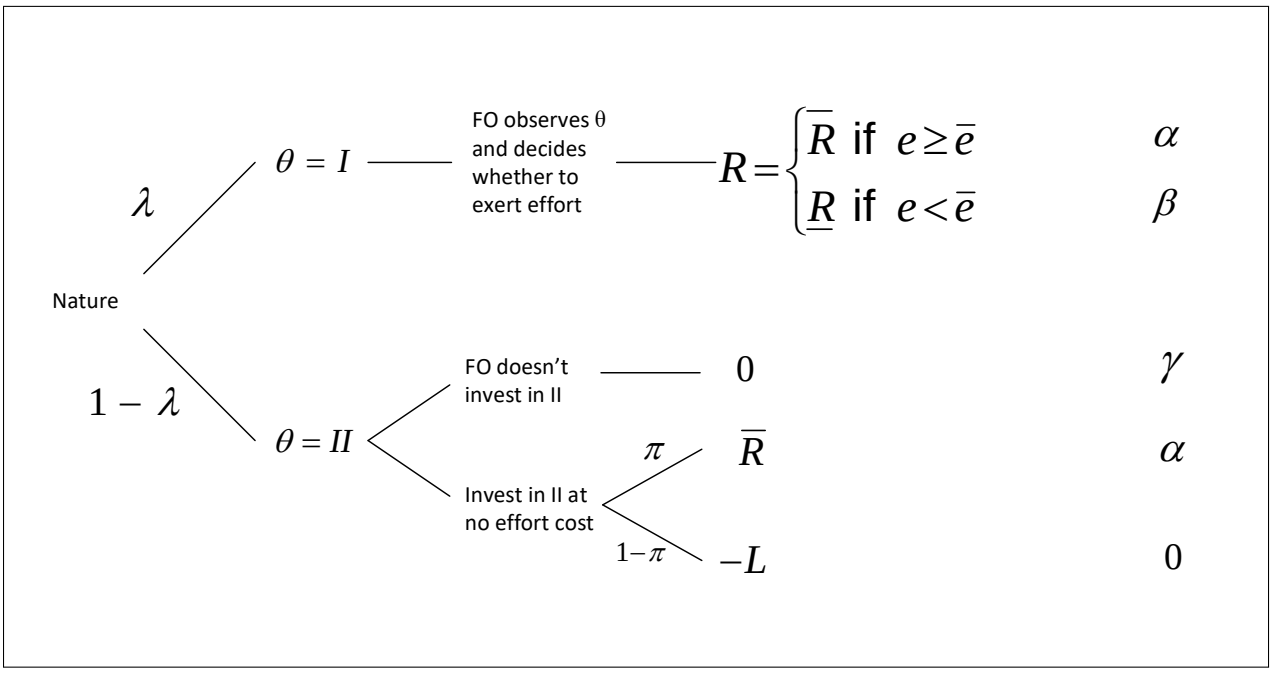

Figure 2. Timing in the Case without a Risk Manager
The figure summarizes the timing of the model without a risk manager in Section V.A. Parameters (α, β, γ) denote the compensation that the bank pays the front office employee for the different return realizations.

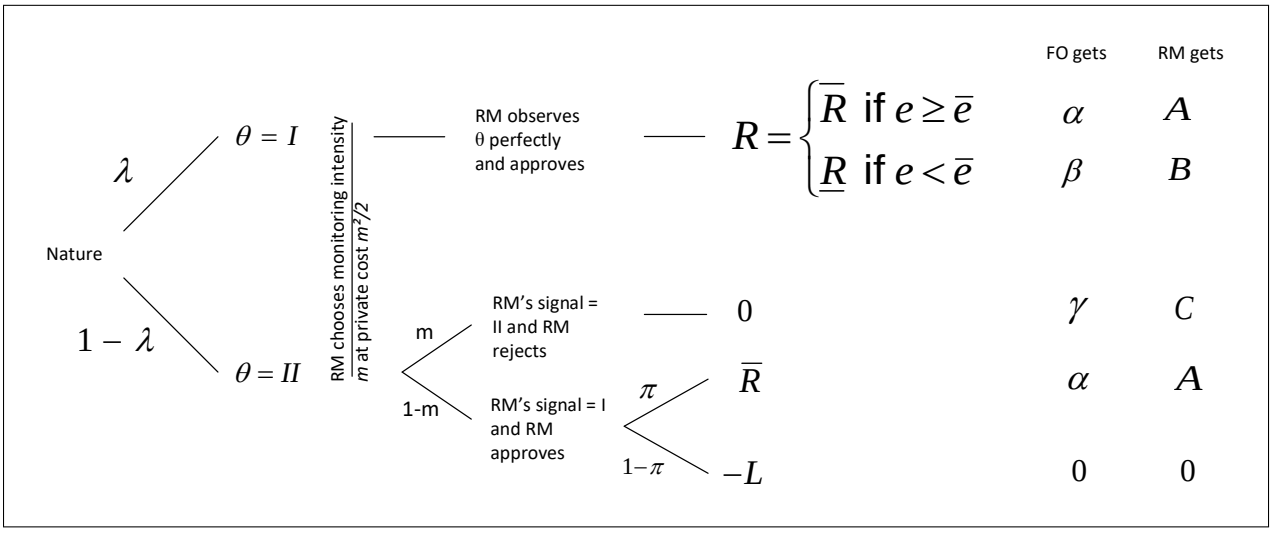

Figure 3. Timing in the Case with a Risk Manager
The figure summarizes the timing of the model with a risk manager in Section V.B. Parameters (α, β, γ) and (A, B, C) denote the compensation that the bank pays the front office employee and, respectively, the risk manager for the different return realizations.

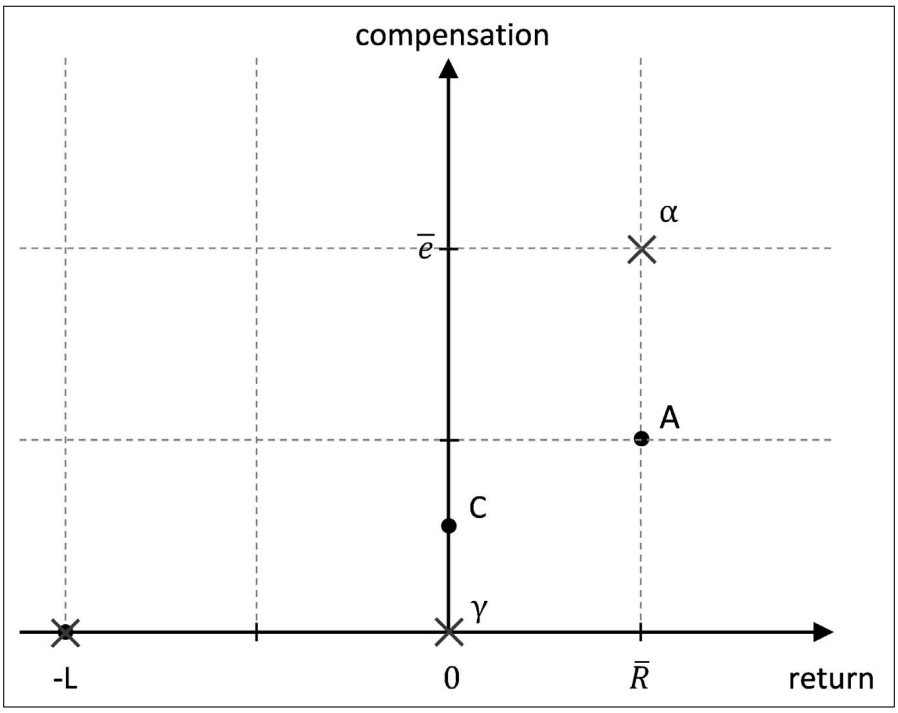

Figure 4. Employee Compensation in the Case with a Risk Manager
The figure illustrates employee compensation for different return realizations and the assumption that $m^* > 0$. The risk manager earns A, C, and 0 for returns of $\overline{R}$, 0, and $-L$. The FO employee earns α for $\overline{R}$ and 0 for a return of 0 or $-L$.

Table I. Summary Statistics

This table reports summary statistics for the payroll data of 127 German banks and the years 2003 to 2007. Panel A of this table reports separate statistics for different front office (FO) and back office (BO) areas. Panel B reports statistics for the subsample of risk managers (RMs) that is used in the main regression analysis. The data were retrieved from the banks' human resource departments by a pay consulting firm, which uses a standardized and globally consistent methodology to ensure comparability across banks. See Appendix A for variable definitions.

Panel A: Employee compensation by functional area

	(1) Obs.	(2) Mean	(3) S.D.	(4) Obs.	(5) Mean	(6) S.D.	(7) Obs.	(8) Mean	(9) S.D.
BO support:	Risk management (RM)			Headquarter support ex RM			Logisitical support		
$Age_{i,t}$	51,507	41.3	8.4	89,188	40.7	8.1	126,709	41.3	9.6
$Tenure_{i,t}$	50,951	14.9	9.7	87,757	11.7	9.1	124,132	14.7	10.1
$Hierarchy\ level_{i,t}$ [1-6]	51,794	3.6	1.0	90,498	3.8	1.0	128,353	2.3	1.0
$Total\ compensation_{i,t}$	51,795	66,511	26,416	90,503	73,094	36,107	128,354	47,846	17,962
$Base\ salary_{i,t}$	51,795	58,112	16,395	90,503	62,127	19,046	128,354	44,196	12,627
$Bonus_{i,t}$	51,795	8,399	12,648	90,503	10,967	22,049	128,354	3,650	7,546
$Bonus\ share_{i,t}$ [=bonus/base]	51,795	0.13	0.13	90,503	0.15	0.18	128,354	0.07	0.10
Capital markets-oriented FOs:	Treasury / capital markets			Investment banking			Asset management		
$Age_{i,t}$	12,570	38.8	7.4	6,403	39.0	7.5	7,284	38.3	6.8
$Tenure_{i,t}$	14,425	10.8	8.7	6,764	9.0	7.6	7,621	6.7	5.7
$Hierarchy\ level_{i,t}$ [1-6]	14,681	4.2	1.1	7,225	4.4	1.0	8,117	4.2	1.0
$Total\ compensation_{i,t}$	14,686	145,554	166,107	7,228	135,651	129,735	8,119	121,223	91,659
$Base\ salary_{i,t}$	14,686	81,134	30,991	7,228	81,888	30,459	8,119	79,031	27,686
$Bonus_{i,t}$	14,686	64,420	147,283	7,228	53,762	108,516	8,119	42,192	73,945
$Bonus\ share_{i,t}$ [=bonus/base]	14,686	0.61	0.99	7,228	0.50	0.73	8,119	0.45	0.59
Credit-oriented FOs:	Retail banking			Corporate banking			Private banking		
$Age_{i,t}$	180,878	38.3	9.6	26,764	42.5	8.3	17,600	40.3	8.2
$Tenure_{i,t}$	174,913	14.8	9.7	26,589	15.8	9.7	17,596	13.6	10.0
$Hierarchy\ level_{i,t}$ [1-6]	189,068	2.7	1.2	27,645	4.2	1.0	17,913	4.0	1.0
$Total\ compensation_{i,t}$	189,068	51,372	19,563	27,647	84,185	46,654	17,913	78,286	44,724
$Base\ salary_{i,t}$	189,068	46,147	13,031	27,647	67,634	21,713	17,913	63,842	20,093
$Bonus_{i,t}$	189,068	5,225	8,450	27,647	16,551	30,688	17,913	14,445	29,844
$Bonus\ share_{i,t}$ [=bonus/base]	189,068	0.10	0.11	27,647	0.20	0.23	17,913	0.18	0.26

Continued on next page

Panel B: Regression sample statistics (risk managers)

	(1) Obs.	(2) Mean	(3) S.D.	(4) Skew	(5) P5	(6) P25	(7) P50	(8) P75	(9) P95
RM bonus$_{i,t}$	50,840	8,345	12,581	6.63	0	2,000	5,000	10,000	27,000
Avg. RM bonus other banks$_{i,t}$	50,840	8,524	2,558	0.92	5,576	6,168	8,237	9,999	13,534
Avg. FO bonus$_{i,t}$	50,840	14,004	19,575	4.10	2,789	4,690	7,092	14,773	49,361
Avg. FO bonus other banks$_{i,t}$	50,840	14,988	18,058	2.04	5,727	6,927	7,842	8,149	62,767
Relative RM bonus$_{i,t}$	50,840	1.01	1.45	5.36	0.00	0.25	0.58	1.22	3.40
Relative FO bonus$_{i,t}$	50,840	1.10	0.94	3.63	0.28	0.58	0.76	1.17	2.77
RM base salary$_{i,t}$	50,840	57,940	16,286	2	38,138	47,710	55,134	64,523	87,970
$\mathbb{1}\left(\textit{Managerial position}\right)_{i,t}$	50,840	0.12	–	–	–	–	–	–	–
$\mathbb{1}\left(\textit{RM for markets}\right)_{i,t}$	50,840	0.16	–	–	–	–	–	–	–

Table II. Bonus Pay Sensitivities of Risk Managers

This table reports coefficient estimates from panel regressions. In columns 1 to 4, the dependent variable is the bonus received by risk manager (RM) i in year t. The regressor *Avg. FO bonus*$_{i,t}$ is the average bonus paid to employees in the front offices (FOs) supervised by RM i. We control for two labor market variables. *Avg. FO bonus other banks*$_{i,t}$ is the market-wide bonus level in the type of FOs supervised by RM i. *Avg. RM bonus other banks*$_{i,t}$ controls for the market-wide bonus level of risk managers that supervise the same type of FOs as RM i. We further include the RM's (fixed) base salary *RM base salary*$_{i,t}$ and $\mathbb{1}\,(\textit{Managerial position})_{i,t}$, which equals one if RM i bears managerial responsibility and zero otherwise. In columns 5 to 7, we use the labor market variables *Avg. RM bonus other banks*$_{i,t}$ and *Avg. FO bonus other banks*$_{i,t}$ to standardize the bonuses of RMs and FOs and calculate the *Relative RM bonus*$_{i,t}$ and *Relative FO bonus*$_{i,t}$. Fixed effects for age and tenure buckets, hierarchy levels, risk managers, years or bank-years are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	RM bonus$_{i,t}$				*Relative RM bonus*$_{i,t}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Avg. FO bonus$_{i,t}$	0.136***	0.122**	0.070***	0.038***			
	(0.037)	(0.051)	(0.023)	(0.012)			
Avg. FO bonus other banks$_{i,t}$		−0.005	−0.031	−0.018			
		(0.026)	(0.020)	(0.037)			
Avg. RM bonus other banks$_{i,t}$		0.273	−0.195*	0.154			
		(0.206)	(0.104)	(0.391)			
Relative FO bonus$_{i,t}$					0.360***	0.132**	0.080**
					(0.087)	(0.054)	(0.033)
$\mathbb{1}\,(\textit{Managerial position})_{i,t}$			4,486.146	3,882.6		0.494	0.440
			(2,997.045)	(2,538.9)		(0.339)	(0.294)
RM base salary$_{i,t}$			0.192***	0.141**		0.000*	0.000
			(0.047)	(0.060)		(0.000)	(0.000)
Risk manager F.E.	No	No	Yes	Yes	No	Yes	Yes
Age, tenure, & hierarchy F.E.	No	No	Yes	Yes	No	Yes	Yes
Year F.E.	No	No	Yes	No	No	Yes	No
Bank-year F.E.	No	No	No	Yes	No	No	Yes
No. of observations	50,840	50,840	22,461	22,451	50,840	22,461	22,451
R^2	0.04	0.05	0.86	0.87	0.05	0.87	0.88

Table III. Bonus Pay Sensitivities and Risk Manager Characteristics

This table reports coefficient estimates from panel regressions. In columns 1 and 2, the dependent variable $RM\ bonus_{i,t}$ is the bonus received by risk manager (RM) i in year t. The main regressor $Avg.\ FO\ bonus_{i,t}$ is the average bonus paid to employees in the front offices (FOs) supervised by RM i. We interact this variable with two binary variables $\mathbb{1}\left(Managerial\ position\right)_{i,t}$ and $\mathbb{1}\left(RM\ age_{i,t} \leq 35\right)$, which equal one if RM i bears managerial responsibility and, respectively, if he is at most 35 years old. In columns 1 and 2, we further include the labor market controls $Avg.\ FO\ bonus\ other\ banks_{i,t}$ and $Avg.\ RM\ bonus\ other\ banks_{i,t}$, which are defined as in Table 2. In columns 3 and 4, we use both labor market variables to standardize the bonuses of RMs and FOs and calculate the $Relative\ RM\ bonus_{i,t}$ and $Relative\ FO\ bonus_{i,t}$. Further controls and fixed effects are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	$RM\ bonus_{i,t}$		$Relative\ RM\ bonus_{i,t}$	
	(1)	(2)	(3)	(4)
$Avg.\ FO\ bonus_{i,t} \times \mathbb{1}\left(Managerial\ position\right)_{i,t}$	0.264^{***}	0.208^{***}		
	(0.068)	(0.071)		
$Avg.\ FO\ bonus_{i,t} \times \mathbb{1}\left(RM\ age_{i,t} \leq 35\right)$	-0.036^{*}	-0.018^{*}		
	(0.018)	(0.009)		
$Avg.\ FO\ bonus_{i,t}$	0.071^{*}	0.015		
	(0.042)	(0.015)		
$Relative\ FO\ bonus_{i,t} \times \mathbb{1}\left(Managerial\ position\right)_{i,t}$			0.385^{**}	0.301^{**}
			(0.183)	(0.144)
$Relative\ FO\ bonus_{i,t} \times \mathbb{1}\left(RM\ age_{i,t} \leq 35\right)$			-0.123^{*}	-0.002
			(0.063)	(0.036)
$Relative\ FO\ bonus_{i,t}$			0.281^{**}	0.021
			(0.110)	(0.023)
$\mathbb{1}\left(Managerial\ position\right)_{i,t}$	$12,387.3^{***}$	-804.6	1.425^{***}	0.008
	(2,211.8)	(713.1)	(0.376)	(0.158)
$\mathbb{1}\left(RM\ age_{i,t} \leq 35\right)$	$-2,583.1^{***}$	-190.5	-0.242^{***}	-0.041
	(499.0)	(250.0)	(0.082)	(0.054)
$RM\ base\ salary_{i,t}$		0.146^{**}		0.000
		(0.064)		(0.000)
Labor market controls	Yes	Yes	No	No
Risk manager F.E.	No	Yes	No	Yes
Bank-year F.E.	No	Yes	No	Yes
No. of observations	50,738	22,432	50,738	22,432
R^2	0.27	0.87	0.27	0.88

Table IV. Bonus Pay Sensitivities by Risk Management Activity

This table reports coefficient estimates from panel regressions. In columns 1 and 2, the dependent variable *RM bonus*$_{i,t}$ is the bonus received by risk manager (RM) i in year t. *Avg. FO-credit bonus*$_{i,t}$ and *Avg. FO-markets bonus*$_{i,t}$ are the average bonuses received in credit-oriented and in capital markets-oriented front offices (FOs) of RM i's bank. We interact both variables with the binary regressor $\mathbb{1}\,(\textit{RM for markets})_{i,t}$, which equals one if RM i supervises capital markets-oriented front offices. In columns 1 and 2, we further include the labor market controls *Avg. FO-credit bonus other banks*$_{b,t}$, *Avg. FO-markets bonus other banks*$_{b,t}$, *Avg. RM-credit bonus other banks*$_{b,t}$, and *Avg. RM-markets bonus other banks*$_{b,t}$. In columns 3 and 4, we use these labor market variables to standardize the bonuses of RMs and FOs and calculate the *Relative RM bonus*$_{i,t}$, *Relative FO-credit bonus*$_{i,t}$, and *Relative FO-markets bonus*$_{i,t}$. Different fixed effects are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	RM bonus$_{i,t}$		*Relative RM bonus*$_{i,t}$	
	(1)	(2)	(3)	(4)
Avg. FO-credit bonus$_{b,t}$	0.278***	0.090***		
	(0.074)	(0.033)		
Avg. FO-markets bonus$_{b,t}$	0.045	−0.037*		
	(0.028)	(0.019)		
$\mathbb{1}\,(\textit{RM for markets})_{i,t}$ × *Avg. FO-credit bonus*$_{b,t}$	−0.160***	0.047		
	(0.058)	(0.057)		
$\mathbb{1}\,(\textit{RM for markets})_{i,t}$ × *Avg. FO-markets bonus*$_{b,t}$	0.028**	0.048***		
	(0.011)	(0.010)		
Relative FO-credit bonus$_{i,t}$			0.381***	0.122**
			(0.091)	(0.055)
Relative FO-markets bonus$_{i,t}$			0.033	−0.269
			(0.087)	(0.203)
$\mathbb{1}\,(\textit{RM for markets})_{i,t}$ × *Relative FO-credit bonus*$_{i,t}$			−0.286***	−0.005
			(0.074)	(0.030)
$\mathbb{1}\,(\textit{RM for markets})_{i,t}$ × *Relative FO-markets bonus*$_{i,t}$			0.086**	0.221
			(0.035)	(0.232)
$\mathbb{1}\,(\textit{RM for markets})_{i,t}$	4,102.9***	−3,554.2**	0.199**	−0.798***
	(1145.5)	(1627.5)	(0.082)	(0.136)
RM base salary$_{i,t}$		0.145***		0.000**
		(0.049)		0.000
$\mathbb{1}\,(\textit{Managerial position})_{i,t}$		3,977.3		0.469
		(2647.3)		(0.329)
Labor market controls	Yes	Yes	No	No
Risk manager F.E.	No	Yes	No	Yes
Age, tenure, & hierarchy F.E.	No	Yes	No	Yes
Year F.E.	No	Yes	No	Yes
No. of observations	50,300	22,283	50,300	22,283
R^2	0.09	0.86	0.06	0.87

Table V. Bonus Pay Sensitivities of Risk Managers and Bank Governance

This table reports coefficient estimates from panel regressions. In columns 1 and 2, the dependent variable *RM bonus*$_{i,t}$ is the bonus received by risk manager (RM) i in year t. The main regressor *Avg. FO bonus*$_{i,t}$ is the average bonus paid to employees in the front offices (FOs) supervised by RM i. We interact this variable with an index of bank governance quality *Governance quality*$_{b,t}$ (see Internet Appendix, Table IA.1). In columns 1 and 2, we further include the labor market controls *Avg. FO bonus other banks*$_{i,t}$ and *Avg. RM bonus other banks*$_{i,t}$. In columns 3 and 4, we use these labor market variables to standardize the bonuses of RMs and FOs and calculate the *Relative RM bonus*$_{i,t}$ and *Relative FO bonus*$_{i,t}$. Different fixed effects are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	RM bonus$_{i,t}$		*Relative RM bonus*$_{i,t}$	
	(1)	(2)	(3)	(4)
Avg. FO bonus$_{i,t}$ × *Governance quality*$_{b,t}$	−0.009	0.007*		
	(0.007)	(0.003)		
Avg. FO bonus$_{i,t}$	0.124*	0.029***		
	(0.070)	(0.007)		
Relative FO Bonus$_{i,t}$ × *Governance quality*$_{b,t}$			0.103	0.011
			(0.087)	(0.058)
Relative FO Bonus$_{i,t}$			0.346***	0.086*
			(0.072)	(0.043)
Governance quality$_{b,t}$	427.4		−0.061	
	(405.4)		(0.088)	
$\mathbb{1}$ (*Managerial position*)$_{i,t}$		4,097.2		0.484
		(2,899.5)		(0.326)
RM base salary$_{i,t}$		0.143*		0.000
		(0.065)		(0.000)
Labor market controls	Yes	Yes	No	No
Risk manager F.E.	No	Yes	No	Yes
Age, tenure, & hierarchy F.E.	No	Yes	No	Yes
Bank-year F.E.	No	Yes	No	Yes
No. of observations	39,370	20,334	39,367	20,334
R^2	0.04	0.86	0.57	0.87

Table VI. Bonus Pay Sensitivities of Risk Managers and Crisis Performance

This table reports coefficient estimates from ordinary least squares regressions. The dependent variables measure banks' operating performance in 2008. In columns 1 to 3, we use the return on assets in 2008 as dependent variable, which we calculate as the sum of interest and non-interest income less additions to loan loss provisions. We standardize this measure of bank-wide profitability by total bank assets. In columns 4 to 6, we focus on bank income that is mainly generated outside the banks' lending divisions and use trading plus fee and commission income in 2008 as dependent variable. We standardize this non-interest income by non-loan assets. The main independent variables measure the bonus sensitivities of risk managers (RMs) to front offices (FOs) in the pre-crisis period. $\rho(\textit{all FO, all RM})_b$ is the correlation between the average bonus that bank b pays to its RMs and the average bonus it pays to its FO employees between 2003 and 2007. Similarly, $\rho(\textit{FO-credit, RM-credit})_b$ and $\rho(\textit{FO-markets, RM-markets})_b$ are defined as bonus correlations only between bank b's credit-oriented FOs and RMs and, respectively, between its capital markets-oriented FOs and RMs. Robust standard errors are reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

Crisis performance in 2008:	*Return on assets*$_b$			*Non-interest income on assets*$_b$		
	(1)	(2)	(3)	(4)	(5)	(6)
Bonus correlations 2003-2007:						
$\rho(\textit{all FO, all RM})_b$	0.422			0.355		
	(0.414)			(0.227)		
$\rho(\textit{FO-credit, RM-credit})_b$		0.005			−0.250	
		(0.410)			(5.545)	
$\rho(\textit{FO-markets, RM-markets})_b$			2.009***			1.093**
			(0.356)			(0.404)
Equity / Assets$_b$	−4.618	−3.601	9.013	16.212**	−5.215	14.738***
	(6.628)	(8.648)	(5.202)	(6.996)	(6.695)	(4.935)
Deposits / Assets$_b$	0.207	1.174	1.588*	0.247	0.411	1.453
	(1.010)	(1.057)	(0.754)	(1.002)	(1.296)	(1.090)
Loans / Assets$_b$	2.402*	2.968	1.182	−2.193*	−1.605	−3.619**
	(1.331)	(1.851)	(1.306)	(1.107)	(1.222)	(1.250)
Log Assets$_b$	−0.603***	−0.622***	−0.498***	−0.485***	−0.484***	−0.511***
	(0.092)	(0.097)	(0.106)	(0.153)	(0.109)	(0.169)
No. of observations	28	24	22	29	24	23
R^2	0.54	0.53	0.69	0.69	0.56	0.80

Table VII. Instrumented Bonus Pay Sensitivities and Crisis Performance

This table reports coefficient estimates from two stage least squares regressions. Columns 1 and 2 report first stages with and without bank controls for ρ*(FO-markets, RM-markets)*$_b$, which is defined as the bonus correlation between bank b's capital markets-oriented FOs and RMs measured over the years 2003 to 2007. The excluded instrument is ρ*(FO-markets, Support ex RM)*$_b$, which is defined as the bonus correlation in 2003-2007 between bank b's capital markets-oriented FOs and its employees in logistical and headquarter support (ex risk management). Columns 3 and 4 report second stages for banks' return on assets in 2008, which we regress on the instrumented ρ*(FO-markets, RM-markets)*$_b$. Robust standard errors are reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	First stages		Second stages	
	ρ*(FO-markets, RM-markets)*$_b$		*Return on assets 2008*$_b$	
	(1)	(2)	(3)	(4)
Bonus correlations 2003-2007:				
ρ*(FO-markets, RM-markets)*$_b$			2.447***	2.267***
			(0.831)	(0.643)
ρ*(FO-markets, Support ex RM)*$_b$	0.595***	0.539***		
	(0.144)	(0.176)		
Equity / Assets$_b$		−1.811		10.334***
		(2.651)		(3.918)
Deposits / Assets$_b$		−0.180		1.714**
		(0.199)		(0.795)
Loans / Assets$_b$		0.172		0.981
		(0.242)		(1.017)
Log Assets$_b$		−0.011		−0.485***
		(0.042)		(0.090)
Kleibergen-Paap F-statistic	16.98	9.40		
No. of observations	22	22	22	22

Table VIII. Job Rotations & Wage Changes

This table reports coefficient estimates from panel regressions. The dependent variable is the log change in employee i's total remuneration (=base salary + bonus) between years $t-1$ and t. In columns 1 to 3, the regression sample is restricted to risk managers. The main regressors are a set of binary variables that identify observations when the employee has transitioned from risk management to another back office or to a (capital markets-oriented or credit-oriented) front office between $t-1$ and t. In columns 4 to 6, the sample is restricted to front office employees. The main regressors are a set of binary variables that identify observations when the employee has transitioned to (market-related or credit-related) risk management, another back office, or a different front office between $t-1$ and t. Fixed effects are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	Log (*total pay*$_{i,t}$ / *total pay*$_{i,t-1}$)					
	Risk managers			Front officers		
	(1)	(2)	(3)	(4)	(5)	(6)
Destination of job rotation:						
$\mathbb{1}(RM \rightarrow FO\ markets)_{i,t}$	0.128***	0.088**	0.082**			
	(0.043)	(0.040)	(0.034)			
$\mathbb{1}(RM \rightarrow FO\ credit)_{i,t}$	−0.054	−0.063	−0.039			
	(0.050)	(0.048)	(0.039)			
$\mathbb{1}(RM \rightarrow Back\ office)_{i,t}$	−0.002	−0.012	−0.006			
	(0.015)	(0.010)	(0.006)			
$\mathbb{1}(FO \rightarrow RM\ markets)_{i,t}$				0.076**	0.086**	0.095***
				(0.035)	(0.034)	(0.036)
$\mathbb{1}(FO \rightarrow RM\ credit)_{i,t}$				0.012	0.046	0.034
				(0.039)	(0.039)	(0.042)
$\mathbb{1}(FO \rightarrow Back\ office)_{i,t}$				0.000	−0.006	0.006
				(0.049)	(0.032)	(0.032)
$\mathbb{1}(FO \rightarrow Different\ FO)_{i,t}$				0.005	0.006	0.015*
				(0.016)	(0.012)	(0.008)
Age, tenure, & hierarchy F.E.	No	Yes	Yes	No	Yes	Yes
Year F.E.	No	Yes	Yes	No	Yes	Yes
Bank F.E.	No	No	Yes	No	No	Yes
No. of observations	13,026	13,025	13,025	89,405	89,403	89,402
R^2	0.00	0.18	0.25	0.00	0.12	0.15

Internet Appendix

Risk Managers in Banks

June 4, 2021

Table IA.1. Principal Components of Bank Governance Variables

This table reports the principal components of seven bank governance variables. The binary variable $\mathbb{1}\left(CRO\ present\right)_{b,t}$ equals one if bank b reports a chief risk officer (CRO) in year t and zero otherwise. $\mathbb{1}\left(CRO\ exclusive\right)_{b,t}$ equals one if the bank reports a CRO in year t that occupies no other executive position and only serves as CRO. *Avg. total experience of* $SB_{b,t}$, *Avg. finance experience of* $SB_{b,t}$, and *Avg. executive experience of* $SB_{b,t}$ measure the (average) total, financial, and executive experience of bank b's supervisory board members (in years). *% of SB with experience abroad*$_{b,t}$ and *% of SB with Ph.D. in economics*$_{b,t}$ are defined as the fraction of supervisory board members with work experience abroad and with a Ph.D. in economics, respectively. All variables were handcollected by Hau and Thum (2014) and Steinbrecher (2015) for the 30 largest German banks with total assets worth more than Euro 25bn. The principal components reported in this table are calculated over the pooled sample of all bank-year observations. However, in the regression analysis of Table V, we follow Tetlock (2007) and Ellul and Yerramilli (2013) and compute the first principal component on a year-by-year basis to avoid look-ahead bias in our governance quality index.

			Principal components						
	Mean	S.D.	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
$\mathbb{1}\left(CRO\ present\right)_{b,t}$	0.47	0.50	0.575	−0.199	−0.269	0.266	−0.046	0.151	0.679
$\mathbb{1}\left(CRO\ exclusive\right)_{b,t}$	0.36	0.48	0.589	−0.200	−0.292	−0.016	0.066	0.175	−0.702
Avg. total experience of $SB_{b,t}$	31.56	3.62	0.203	0.590	0.205	−0.353	−0.184	0.638	0.066
Avg. finance experience of $SB_{b,t}$	30.99	28.56	0.140	0.248	0.498	0.800	0.034	0.037	−0.167
Avg. executive experience of $SB_{b,t}$	19.93	4.52	0.429	0.406	0.151	−0.270	0.451	−0.588	0.083
% of SB with experience abroad$_{b,t}$	0.17	0.21	0.279	−0.325	0.524	−0.237	−0.641	−0.271	−0.014
% of SB with Ph.D. in economics$_{b,t}$	0.15	0.14	0.010	−0.490	0.504	−0.187	0.586	0.346	0.084
Eigenvalue			2.102	1.698	1.246	0.842	0.585	0.359	0.168
Variance explained			0.300	0.243	0.178	0.120	0.084	0.051	0.024

Table IA.2. Job Rotations and Employee Characteristics

This table reports average marginal effects from multinomial logit regressions. Models I and II describe job rotations of risk managers to other back offices and credit-oriented or capital markets-oriented front offices. Models III and IV are estimated for the job rotations of front office employees. The main regressors are employee age and tenure, the binary variable $\mathbb{1}\,(\textit{Managerial position})_{i,t}$, which equals one if employee i bears managerial responsibility and zero otherwise, the bonus share and (log) base salary of employee i, and bank governance quality (in Models II and IV only). Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

Panel A: Risk managers

	Model I				Model II			
Job rotation in t:	Stay RM (1)	Back office (2)	FO credit (3)	FO markets (4)	Stay RM (5)	Back office (6)	FO credit (7)	FO markets (8)
$Age_{i,t-1}$ / 10	−0.003	0.011*	−0.002	−0.006***	−0.007	0.014**	−0.002	−0.005**
	(0.007)	(0.006)	(0.001)	(0.002)	(0.007)	(0.006)	(0.001)	(0.002)
$Tenure_{i,t-1}$ / 10	0.020***	−0.012***	−0.001	−0.007**	0.017***	−0.012***	0.000	−0.005**
	(0.006)	(0.004)	(0.002)	(0.003)	(0.006)	(0.004)	(0.002)	(0.002)
$\mathbb{1}\,(\textit{Managerial position})_{i,t-1}$	−0.017	0.020	0.004	−0.007***	−0.024	0.028	0.003	−0.007***
	(0.031)	(0.030)	(0.006)	(0.003)	(0.037)	(0.036)	(0.005)	(0.003)
$Bonus\ /\ base\ salary_{i,t-1}$	0.078	−0.073	−0.016	0.011*	0.028	−0.035	−0.004	0.011
	(0.114)	(0.103)	(0.019)	(0.007)	(0.085)	(0.075)	(0.013)	(0.007)
$Log\ base\ salary_{i,t-1}$	0.086	−0.121**	0.008	0.027***	0.117*	−0.146**	0.004	0.026***
	(0.064)	(0.057)	(0.006)	(0.006)	(0.067)	(0.059)	(0.006)	(0.007)
$Governance\ quality_{b,t}$					−0.018	0.019**	0.001	−0.002
					(0.011)	(0.009)	(0.003)	(0.001)
No. of obs. & Pseudo R^2	13,013 & 0.06				11,886 & 0.08			

Panel B: Front officers

	Model III					Model IV				
Job rotation in t:	Stay FO (1)	Switch FO (2)	Back office (3)	RM credit (4)	RM markets (5)	Stay FO (6)	Switch FO (7)	Back office (8)	RM credit (9)	RM markets (10)
$Age_{i,t-1}$ / 10	0.003	−0.008	0.006*	−0.001	0.000	0.005	−0.008	0.004	0.000	0.000
	(0.007)	(0.005)	(0.003)	(0.001)	(0.000)	(0.007)	(0.006)	(0.004)	(0.000)	(0.000)
$Tenure_{i,t-1}$ / 10	0.020***	−0.007***	−0.016***	0.002	0.000	0.017***	−0.008***	−0.008***	0.000	0.000
	(0.006)	(0.002)	(0.005)	(0.003)	(0.000)	(0.003)	(0.003)	(0.002)	(0.000)	(0.000)
$\mathbb{1}\,(\textit{Managerial position})_{i,t-1}$	0.011	−0.020***	0.009	0.000	−0.000*	0.025**	−0.021***	−0.004	0.000	0, 000
	(0.021)	(0.005)	(0.019)	(0.001)	(0.000)	(0.010)	(0.005)	(0.007)	(0.001)	(0.000)
$Bonus\ /\ base\ salary_{i,t-1}$	0.208*	−0.014	−0.165	−0.029	−0.001	0.139	−0.016	−0.119	−0.003	−0.001
	(0.122)	(0.022)	(0.115)	(0.037)	(0.001)	(0.091)	(0.023)	(0.084)	(0.002)	(0.001)
$Log\ base\ salary_{i,t-1}$	−0.064**	0.076***	−0.024	0.011	0.001	−0.088***	0.084***	−0.003	0.005***	0.001**
	(0.030)	(0.016)	(0.028)	(0.007)	(0.001)	(0.028)	(0.021)	(0.027)	(0.002)	(0.001)
$Governance\ quality_{b,t}$						−0.001	0.002	0.000	0.000	0.000
						(0.011)	(0.006)	(0.005)	(0.000)	(0.000)
No. of obs. & Pseudo R^2	84,987 & 0.06					74,422 & 0.06				

Table IA.3. Job Rotations and Crisis Performance

This table reports coefficient estimates from ordinary least squares regressions. The dependent variables are *Return on assets*$_b$ and *Non-interest income on assets*$_b$, which measure banks' operating performance in 2008 and are defined as in Table VI. The main independent variables are two regressors that measure the strength of revolving doors between risk management (RM) and front offices (FO) during the pre-crisis period from 2003 to 2007. $\#\left(RM \rightarrow FO\right)_b$ is calculated as the average number of job rotations from RM to FOs per year and $\#\left(FO \rightarrow RM\right)_b$ is calculated as the average number of job rotations from FOs to RM per year. Robust standard errors are reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

Crisis performance in 2008:	*Return on assets*$_b$		*Non-interest income on assets*$_b$	
	(1)	(2)	(3)	(4)
No. of job rotations per year, averaged over 2003-2007:				
$\#\left(RM \rightarrow FO\right)_b$	0.088		0.125	
	(0.086)		(0.096)	
$\#\left(FO \rightarrow RM\right)_b$		−0.015**		−0.005
		(0.007)		(0.010)
Loans / Assets$_b$	3.235**	3.847**	−1.055	−0.83
	(1.521)	(1.602)	(1.759)	(1.907)
Deposits / Assets$_b$	0.81	1.344	0.975	1.336
	(1.077)	(1.066)	(1.315)	(1.183)
Equity / Assets$_b$	−3.418	−5.229	15.809**	16.765**
	(9.165)	(8.774)	(6.806)	(7.696)
Log Assets$_b$	−0.721***	−0.611***	−0.703**	−0.541**
	(0.179)	(0.118)	(0.281)	(0.213)
No. of observations	25	25	26	26
R^2	0.55	0.56	0.63	0.61

Table IA.4. Job Rotations and Bonus Pay Sensitivities

This table reports coefficient estimates from panel regressions. In columns 1 to 4, the dependent variable *RM bonus*$_{i,t}$ is the bonus received by risk manager (RM) i in year t. The main regressor *Avg. FO bonus*$_{i,t}$ is the average bonus paid to employees in the front offices (FOs) supervised by RM i. We interact this variable with two binary variables $\mathbb{1}(FO \to RM)_{i,t-1}$ and $\mathbb{1}(RM \to FO)_{i,t+1}$, which equal one if RM i worked in a FO in $t-1$ or, respectively, if RM i is going to work in a FO in $t+1$. In columns 1 to 4, we further include the labor market controls *Avg. FO bonus other banks*$_{i,t}$ and *Avg. RM bonus other banks*$_{i,t}$. In columns 5 to 8, we use these labor market variables to standardize the bonuses of RMs and FOs and calculate the *Relative RM bonus*$_{i,t}$ and *Relative FO bonus*$_{i,t}$. Risk manager controls *RM base salary*$_{i,t}$ and $\mathbb{1}(\textit{Managerial position})_{i,t}$ as well as different fixed effects are included as indicated. Robust standard errors are clustered by bank and reported in parentheses. The symbols *, **, and *** represent significance levels at 10%, 5%, and 1% respectively.

	RM bonus$_{i,t}$				*Relative RM bonus*$_{i,t}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Avg. FO bonus$_{i,t}$ × $\mathbb{1}(RM \to FO)_{i,t+1}$	0.092	0.080						
	(0.127)	(0.118)						
Avg. FO bonus$_{i,t}$ × $\mathbb{1}(FO \to RM)_{i,t-1}$			0.330*	0.112				
			(0.194)	(0.073)				
Avg. FO bonus$_{i,t}$	0.046	−0.008	0.065	−0.003				
	(0.043)	(0.017)	(0.049)	(0.015)				
Relative FO bonus$_{i,t}$ × $\mathbb{1}(RM \to FO)_{i,t+1}$					−0.034	0.029		
					(0.140)	(0.082)		
Relative FO bonus$_{i,t}$ × $\mathbb{1}(FO \to RM)_{i,t-1}$							0.662**	0.639***
							(0.321)	(0.136)
Relative FO bonus$_{i,t}$					0.234***	0.117	0.253**	0.187**
					(0.086)	(0.069)	(0.095)	(0.086)
$\mathbb{1}(RM \to FO)_{i,t+1}$	−434.3	−1,013.7			0.219	0.053		
	(2,325.0)	(1,564.4)			(0.229)	(0.058)		
$\mathbb{1}(FO \to RM)_{i,t-1}$			−2,466.6	751.7			−0.562*	−0.558**
			(3241.3)	(1211.8)			(0.294)	(0.227)
Labor market controls	Yes	Yes	Yes	Yes	No	No	No	No
Risk manager controls	No	Yes	No	Yes	No	Yes	No	Yes
Age, tenure, & hierarchy F.E.	No	Yes	No	Yes	No	Yes	No	Yes
Bank-year F.E.	No	Yes	No	Yes	No	Yes	No	Yes
No. of observations	12,945	12,940	13,105	13,102	12,945	12,940	13,105	13,102
R^2	0.06	0.56	0.06	0.62	0.03	0.56	0.06	0.58