# Bank Bonus Pay as a Risk Sharing Contract

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October 25, 2021

**Abstract**

We argue that risk sharing motivates the bank-wide structure of bonus pay. In the presence of financial frictions that make external financing costly, the optimal contract between shareholders and employees involves some degree of risk sharing whereby bonus pay partially absorbs negative earnings shocks. Using payroll data for 1.26 million employee-years in all functional divisions of Austrian, German, and Swiss banks, we uncover several empirical patterns in bonus pay that are difficult to rationalize exclusively with incentive theories of bonus pay—but support an important risk sharing motive.

JEL Classification: G20, G21, D22
Keywords: banker compensation, risk sharing, bonus pay, operating leverage

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**Acknowledgment**

The authors thank Ramin Baghai, Bruno Biais, Jean-Edouard Colliard, Roman Goncharenko, Denis Gromb, Thomas Mosk, John Thanassoulis, Konstantin Wagner, Brian Waters, and conference/seminar participants at FIRS 2019, the European Winter Finance Summit 2019, the 12th Swiss Winter Conference on Financial Intermediation, the 17th Paris December Finance Meeting, the 17th International Conference on Credit Risk Evaluation, the Annual meeting of the Committee for Organizational Economics 2019 (Berlin), HEC Paris, Goethe University (Frankfurt), Science Po/Banque de France (joint seminar), and ACPR for helpful comments. Matthias Efing acknowledges financial support from Investissements d'Avenir (ANR-11-IDEX-0003/Labex Ecodec/ANR-11-LABX-0047). This research project also benefited from a Sinergia Research Grant from the Swiss National Science Foundation (SNSF). The authors declare that they have no relevant or material financial interests that relate to the research described in this paper.

# 1 Introduction

Bankers typically manage large amounts of capital and their effort is notoriously difficult to monitor (Axelson and Bond, 2015). For this reason, high bonus pay in banks is often interpreted as performance-linked compensation designed to solicit effort (Holmström, 1979). In the aftermath of the 2008-2009 financial crisis, bonus pay has also been blamed for creating perverse incentives to take excessive risk.[1] As a consequence, various new regulations seek to curtail bankers' bonuses.[2] This paper focuses on an entirely different role of bonus pay in banks which is independent of any incentive effects. As highlighted in Thanassoulis (2012), bonus pay can contribute to optimal risk sharing between shareholders and employees and, thereby, improve bank resilience against financial shocks. Based on comprehensive payroll data for 1.26 million employee-years, we uncover several new findings that support the risk sharing motive of bonus pay.

Early contributions to the implicit contract theory literature see little scope for bonus pay to provide risk sharing between diversified shareholders and risk averse employees. Wages should be perfectly insulated from earnings shocks (Azariadis, 1975; Baily, 1974; Knight, 1921).[3] Yet, such complete wage insurance can break down in the presence of financial frictions. If external financing is costly, the value of internal cash increases in times of financial distress and shareholder value becomes a concave function of cash reserves (Froot, Scharfstein, and Stein, 1993; Froot and Stein, 1998). The optimal contract between shareholders and employees then involves some degree of risk sharing: part of employee compensation is paid in the form of variable bonuses which are sensitive to firm-wide earnings.

Risk sharing through bonus pay is especially attractive to the financial industry which is

[1] For example, US Treasury Secretary Geithner argued in his testimony to Congress on June 6, 2009: "I think that although many things caused this crisis, what happened to compensation and the incentives in creative risk taking did contribute in some institutions to the vulnerability that we saw in this financial crisis."

[2] The European Parliament proposed new EU-wide legislation on bank bonuses in 2013 (see Colonnello, Koetter, and Wagner, 2018); in the U.S. executive pay was reformed in the Say-on-Pay rule included in the 2010 Dodd-Frank Act; and for the UK debate see http://www.nortonrosefulbright.com/knowledge/technical-resources/the-uk-corporate-governance-portal/executive-pay. At the international level, the G20 has established the Financial Stability Board (FSB) which proposes principles for sound compensation practices.

[3] The provision of employment and wage insurance rests on firms' credibility to honor implicit contracts. Such commitment appears more credible in the case of family-owned firms and in firms with high employee participation in governance (Ellul, Pagano, and Schivardi, 2017; Kim, Maug, and Schneider, 2018; Pagano, 2020).

characterized by high labor intensity. Focusing on Austrian, German, and Swiss banks, we find that labor costs just before the financial crisis amount to one half of total overhead costs and to one third of gross income for the median bank. In the U.S., labor costs seem to be even larger. According to the Office of the New York State Comptroller (2014), the remuneration of Wall Street employees amounts to 47% of their employers' revenues. Considering this high labor intensity, Murphy (2013a, p.633) notes that *"the heavy reliance on bonuses has been a defining feature of investment-banking remuneration for decades [...] Such firms kept fixed costs under control by keeping base salaries low and paying most of the remuneration in the form of year-end cash bonuses based on realized company profits. Indeed, the initial purpose for year-end cash bonuses was not the provision of incentives, per se, but rather a mechanism to ensure that remuneration expense would be low in years with low profitability, and high in years with high profitability."* Overall, labor expenses condition bank resilience unless they can be adjusted whenever external funding conditions deteriorate, internal cash flows dry up, and liquidity needs increase.[4]

To study the risk sharing dimension of bonus pay, we analyze comprehensive remuneration data that is directly extracted from the payroll records of 327 Austrian, German, and Swiss banks. For the years 2003 to 2010, we observe the variable (short-term performance-related bonus) and fixed (base) compensation of 1.26 million employee-year observations. Whereas previous work has mostly focused on executive compensation (see literature reviews in Murphy, 2013b; Edmans, Gabaix, and Jenter, 2017), our data covers all levels (below the executive level) of the employment hierarchy and all bank divisions. Hence, the high granularity and coverage of the data allow us to exploit variation across different occupational areas inside banks. We document several new stylized facts that support the risk sharing motive of bonus pay.

First, variable (bonus) pay is prevalent at all hierarchy levels and in all occupations and even exposes bank employees in back offices and support functions like accounting or IT to income risk. However, variation in employee pay has different sources for different groups of bank employees. Controlling for pay variation induced by the labor market, a model-based variance decomposition reveals that incentive pay and risk sharing between banks and employees explain roughly 75% and 25% of pay variation, respectively. For junior employees, which represent 59% of the sample, risk

[4]We note that the difference between banks and other firms is more quantitative than qualitative. Apart from high labor costs shared for example with consulting and law firms, recapitalization is difficult because of the inherent opaqueness of banking, and return on equity is volatile in part due to high leverage.

sharing accounts for roughly 30% to 45% of pay variation. Employees in banks' support functions and in retail banking, which make up for 83% of the sample, bear between 25% and 35% of their pay risk due to risk sharing. By contrast, for divisions that are typically assumed to require high-powered incentives (like trading), the incentive pay component explains indeed significantly more pay variation than risk sharing (at a ratio of roughly 10:1). Overall, risk sharing explains a sizable share of pay risk. Its importance relative to incentive-related variation depends strongly on employees' job functions and seniority.

The risk sharing theory predicts that high labor intensity translates into high operating leverage if employees hold large debt-like claims (fixed salaries). Bonus pay, on the other hand, should reduce operating leverage and alleviate financial distress in times when external funding is costly. To test this prediction, we consider the 2008-2009 financial crisis as a shock to banks' external financing conditions. We find that banks that had designed compensation plans with low fixed salaries but high variable pay before the crisis were able to adjust labor costs downward inside the crisis. Employees with a one standard deviation higher bonus share (bonus-to-base ratio) in 2007 suffered a 10% stronger reduction in total compensation from 2007 to 2008. Consistent with risk sharing, an employee suffered a larger pay reduction if his or her bank was more financially constrained in 2008. Overall, the evidence shows that bonus pay indeed reduces operating leverage.

From an identification viewpoint, studying the financial crisis is useful because it constitutes a large shock to banks' financial constraints. However, the crisis likely affected the finance labor market as well and could confound the analysis through changes in employees' participation constraints (Oyer, 2004). To address this concern, we would ideally compare employees that work for constrained and unconstrained banks but that belong to the same labor market segment. Our analysis seeks to implement this setting by controlling for interacted job division $\times$ hierarchy level $\times$ age $\times$ tenure fixed effects. As our data provider, the pay consultancy Willis Towers Watson, uses the same data to sell salary-benchmarking services (estimates of employees' fair market rates) to clients, we are confident that the interacted fixed effects span most labor market segments. We note that the consultancy also collects data on employees' cognitive skills, capabilities, and job responsibilities to sort employees into the different career levels of the employment hierarchy. Hence, the (interacted) hierarchy level fixed effects in our regression analysis at least partly control for employees' productivity, which could covary with employees' outside options.

Our risk sharing theory further predicts that the bonus of any given employee should be contingent on bank-wide earnings and, hence, on earnings shocks that are beyond the employee's control because they originate in other divisions of the bank. We show that bonus pay does indeed feature significant cross-divisional earnings sensitivity. For example, the bonus pay of loan officers covaries positively with the income generated by the traders of the same bank and *vice versa*. These cross-divisional earnings sensitivity also extends to support functions like accounting, human resources, or IT: service employees receive higher bonuses in years when traders and loan officers generate higher earnings. These cross-divisional earnings sensitivities are qualitatively robust when we restrict the analysis to the years 2003 to 2007 to eliminate any confounding effect of the crisis on the labor market, condition on year $\times$ job division $\times$ hierarchy level $\times$ age $\times$ tenure fixed effects to control for time variation in employees' participation constraints, and further include employee fixed effects to control for time-invariant employee heterogeneity.

The cross-divisional earnings sensitivities of bonus pay are fully consistent with the risk sharing hypothesis. By contrast, they are difficult to explain with theories of incentive pay, which predict that an employee's bonus should not depend on factors beyond his or her control. Clearly, loan officers have no direct control over the trading strategies chosen in treasury/capital markets or investment banking divisions. Vice versa, traders do not interfere with lending decisions taken in retail or corporate banking. Similarly, employees in service divisions like accounting or human resources generally have no direct influence on operational decisions in the banks' front offices. Hence, the fact that the bonus pay of all these employees depends on lending as well as trading income seems more consistent with risk sharing than with incentive pay.

To delineate further the incentive and the risk sharing motive of bonus pay, we study in detail which employee groups suffered bonus cuts during the 2008-2009 financial crisis. Incentive pay theories predict that only those employees that were responsible for the crisis exposure of their bank should experience bonus cuts. Similarly, according to the incentive pay hypothesis, the crisis should not explain bonus pay once we condition on employees' individual or divisional performance. Our findings do not confirm these predictions. We show that the crisis triggered a bank-wide contraction of bonus pay. For example, even conditional on trading performance, the bonus shares of traders drop by 30 percentage points in 2008 and remain depressed until 2010. Bonuses in support functions like accounting, human resources, or IT are cut in half notwithstanding their

lack of involvement in any operational decisions related to the crisis.[5] Bonus cuts are not limited to the senior employees that choose the risk appetite and crisis exposure of their banks. Also the bonuses of junior employees without decision-making power are cut during the crisis. Overall, the bank-wide bonus cuts during the crisis seem to be largely independent of individual performance.

Our empirical evidence for bonus pay as a risk sharing mechanism is consistent with known industry practices of bonus determination. According to a survey conducted by Kampkötter and Sliwka (2018), bonus pay in Austrian, German, and Swiss banks is usually determined in a top-down allocation process.[6] At the end of each year, the executive board of a bank determines the aggregate amount available for bonus payments. The survey confirms that bank-wide earnings and financial health are the dominant criteria for the calculation of this bank-wide bonus pool, which indirectly confirms the risk sharing motive of bonus pay. At the same time, such risk sharing is compatible with a differentiated merit-based allocation of bonus funds. Typically, a combination of divisional, team, and individual performance determines how the bonus pool is split among employees. Nevertheless, the top-down bonus pool approach clearly limits the scope for merit-based performance pay in years when financial distress prevents boards from setting aside significant bonus pools.

Finally, our findings raise important questions about the benefits of bonus regulation. Since 2014, the European Capital Requirements Directive caps (and defers) bonuses with the intent to reduce incentives for excessive risk taking. However, our research suggests that such regulatory constraints could impede risk sharing between banks and employees. The consequences of banks' impaired risk bearing capacity will necessarily depend on banks' endogenous response to regulation. However, if bank risk-taking remains unchanged, it is easy to imagine an unintended effect of restrictive bonus regulation: Negative earnings or financing shocks could generate even higher financial distress with pronounced adverse effects on borrowers and the real economy and with higher bank funding costs ex ante. More research is needed on how this transmission channel is influenced by risk sharing within banks.

[5]The labor market does not explain the bonus cuts in these administrative support functions either. Data from the German Federal Employment Agency reveal that the labor market for accountants, HR, IT, etc. was not depressed between 2008 and 2010. Employees in these administrative occupations only suffer pay reductions in the crisis if they are working in the financial industry, but not if they are employed by non-financial firms.

[6]A survey by Mercer (2013) finds that the top-down bonus pool approach is also used in North America.

# 2 Literature

Different strands of literature propose alternative hypotheses why perfect wage insurance can break down in practice. Contract theory emphasizes the need to incentivize unobservable effort through performance-linked compensation (Holmström, 1979, 1982; Holmström and Milgrom, 1987). As effort appears particularly hard to monitor in the financial industry (Axelson and Bond, 2015), many papers interpret the high variable pay component in banking as incentive pay (e.g., Bijlsma, Boone, and Zwart, 2012; Biais and Landier, 2013; Cheng, Hong, and Scheinkman, 2015).

The risk management literature provides an alternative explanation why variable (or bonus) pay can supersede wage insurance. In the presence of financial frictions with respect to external financing, shareholders seek to share risk with third parties (Froot, Scharfstein, and Stein, 1993; Froot and Stein, 1998). Most papers here focus on risk sharing with financial counterparties. However, if financial counterparties face similar frictions in the same distressed states as the bank or firm seeking insurance (Rampini and Viswanathan, 2010, 2013), the latter may share risk with employees instead. Gambler (1988) provides one of the first theoretical frameworks that describe such risk sharing under bankruptcy constraints. Another theoretical paper that predicts risk sharing is Thanassoulis (2012). He builds a comprehensive model of competition for talent but, unlike us, assumes risk neutrality of bankers.

Empirical research on risk sharing with employees dates back to early contributions like, for example, Core and Guay (2001) who show that constrained firms grant stock option plans more often than unconstrained firms. Guiso, Pistaferri, and Schivardi (2005) and Caggese and Cuñat (2008) provide evidence of risk sharing between employees and firms in Italy.[7] Benmelech, Bergman, and Enriquez (2012) show that U.S. airlines negotiate wage concessions in financial distress. A paper related to our own is Ibert, Kaniel, Van Nieuwerburgh, and Vestman (2018) who show that the sensitivity of Swedish fund manager compensation to individual performance is surprisingly weak and particularly low for unprofitable fund companies. One interpretation of their finding would be

[7]Imperfect wage and employment insurance can influence various corporate policies. For example, Simintzi, Vig, and Volpin (2015) show that an increase in employment protection and, therefore, in operating leverage crowds out financial leverage. Albuquerque, Cabral, and Guedes (2019) show theoretically that risk sharing between shareholders and managers can itself create systematic risk when relative performance pay incentivizes CEOs to choose correlated investments across firms. Colonnello, Koetter, and Wagner (2018) find that the systematic and systemic risk of banks with high executive bonuses increased after the European Union imposed bonus caps in 2014 and, thereby, limited risk sharing on the payroll. Berk, Stanton, and Zechner (2010) study a model with human costs of bankruptcy in which employees require higher compensation in firms with high financial leverage.

that fund managers only receive variable pay out of a firm-wide bonus pool when fund companies are making positive profits, which would be in line with our own findings about bank employees.[8]

We contribute to the empirical risk sharing literature in four ways. First, we study wages as well as bonuses across banks over a wide range of employees in different job positions. Second, we estimate a model-based decomposition of wage variation and quantify risk sharing with employees. Third, we show evidence that bonus pay is the preferred contractual mechanism to implement risk sharing and reduces banks' operating leverage during times of high financial distress. Fourth, we show that an employee's bonus pay responds to shocks to bank-wide performance that are reasonably orthogonal to the employee's own individual performance.

A third literature has interpreted incentive pay with only tenuous links to individual performance as evidence for rent-seeking behavior and management entrenchment (e.g., Bertrand and Mullainathan, 2001; Bebchuk and Fried, 2003; Davis and Hausman, 2018). Here, bonus pay is not seen as the outcome of optimal contracting, but linked to top executives that capture the pay-setting process. We highlight that this agency perspective is less relevant for bonus pay at lower levels of the bank hierarchy. Junior employees and recent recruits are certainly not entrenched insiders even if they experience considerable bonus variation as we document in this paper.

A fourth literature highlights that time-varying labor market conditions can also induce commonality in variable pay. For example, Oyer (2004) proposes a model in which the contractual choice is between equity compensation and fixed pay, which is costly to adjust. Our theoretical framework focuses on discretionary bonus pay devoid of wage rigidity. Moreover, we argue that variation in outside labor market opportunities cannot explain the heterogeneous bank-specific bonus cuts across employees in different banks but in very similar job positions and, hence, labor markets. In this context, we highlight anecdotal evidence for large bank-wide reduction in bonus pay after bank-specific shocks. In February 2021, Credit Suisse shrank its 2020 group-wide bonus pool by 7% following a $4.7bn of losses related to the Archegos fund (Walker, 2021).

Finally, our work contributes to a broader literature on the growth of finance wages (Philippon and Reshef, 2012) and the positive wage premium in finance relative to other sectors (Oyer 2008;

[8]Ma, Tang, and Gómez (2019) also study portfolio managers and conclude that their compensation does provide incentives and mitigates agency conflicts. Other recent papers that analyze wage variation but do not focus on the financial industry include, for example, Ouimet and Simintzi (2020), Moser, Saidi, Wirth, and Wolter (2020), and Arabzadeh, Balleer, and Gehrke (2020).

Kaplan and Rauh 2010).[9] Glode and Lowery (2016) propose a model that explains the historical increase in finance wages with an increasing employment share of traders and Boustanifar, Grant, and Reshef (2018) show empirical evidence that trading-related activities account for 50% of the increase in finance wages. One possible explanation could be that trading increases banks' income risk, which is partly born by risk averse employees who require a risk premium in expectation.

# 3 Theory

This section extends the incentive model of Holmström (1979) to a firm or bank that is subject to refinancing frictions. Our setup generates an optimal employment contract with variable compensation that can be decomposed into a risk sharing and an incentive pay component, which also depends on labor market conditions. Whereas the incentive pay component is driven by the employee's individual performance and labor market conditions, the risk sharing component is driven by bank-wide performance and financial resources. In the second part of this section, we derive several predictions that will guide our empirical analysis.

## 3.1 An Incentive Model with Financial Frictions

A bank has $n$ employees $k = 1, 2, ...n$ who make individual earning contributions $e_k \in [\underline{e}_k, \infty)$. The density of $e_k$ is a differentiable function $f_k(e_k, a_k)$ of a non-contractible action $a_k$. The private cost of this action is a convex function $c_k(a_k)$ defined for $a_k \in [0, \infty)$. The optimal action of employee $k$ is

$$a_k^* = \arg\max E\left\{U_k[w_k]\,|a_k\right\} - c_k(a_k), \tag{1}$$

where $U_k(w_k)$ denotes the employee's concave utility function and $w_k$ his/her compensation.

Accounting for the optimal action by each employee introduces incentive compatibility constraints ($\text{ICC}_k$) into the contracting problem. We assume that the first-order approach is valid and replace these incentive compatibility constraints by the first-order condition of the employees' problem, namely

$$E\left\{U_k[w_k]g_k(e_k, a_k^*)\,|a_k^*\right\} = \frac{dc_k}{da_k}(a_k^*), \tag{2}$$

[9] Célérier and Vallée (2019) attribute the wage premium to higher returns to talent in finance, whereas Böhm, Metzger, and Strömberg (2018) find no evidence that the concentration of skill is increasing in the finance sector.

where

$$g_k(e_k, a_k^*) = \frac{\partial}{\partial a_k} \ln f_k(e_k, a_k^*). \tag{3}$$

We assume that $g_k(e_k, a_k) > 0$ is increasing in $e_k$ (monotone likelihood ratio property). Following Oyer (2004), we also assume that the reservation utility of each employee is a function of an aggregate state variable $s$ that captures his/her outside options on the labor market at the beginning of the period:

$$E\left\{U_k[w_k]\,|a_k^*\right\} \geq U_k^0(s). \tag{4}$$

Compensation contracts specify the wage of each employee as a function of the ex-ante variable $s$ as well as the vector of ex-post variables

$$x \equiv (M, e_1, e_2, ...e_n), \tag{5}$$

that capture the situation of the bank at the end of the period. $M$ is a random variable representing the bank's cash holdings and external funding resources. The bank's total available funds are thus

$$F \equiv M + \sum_k e_k. \tag{6}$$

The objective of the bank is to maximize shareholder value, i.e. the expectation of future dividends $\delta(x)$, under the incentive compatibility constraints (2), the participation constraints (4), the budget constraint

$$\delta(x) + \sum_k w_k(x) = F, \tag{7}$$

and finally the limited liability constraint

$$\delta(x) \geq 0, \tag{8}$$

imposing that dividends are non-negative. The problem is parameterized by the ex ante state variable $s$. We denote the Lagrange multipliers by $\mu_k(s)$ for the incentive compatibility constraints, $\alpha_k(s)$ for the participation constraint, and $\lambda(s, x)$ for the budget constraint. The Lagrangian

follows as

$$L = E_x\left\{\delta(x)[1-\lambda(s,x)] + \lambda(s,x)[F - \sum_k w_k(x)] + \sum_k \alpha_k(s) U_k[w_k(x)]\right\} \quad (9)$$
$$+ \sum_k \mu_k(s)\left\{g_k(e_k, a_k^*) U_k[w_k(x)] - \frac{dc_k}{da_k}(a_k^*)\right\}.$$

For simplicity, we assume that employees have identical CRRA utility functions $U(w_k) = \frac{1}{1-1/\rho} w_k^{1-1/\rho}$, where $\rho > 0$ is the relative risk tolerance parameter. This assumption implies in particular that the optimal compensation in the constrained state is a scaled-down version of the optimal compensation in the unconstrained state with sufficient funds. Formally:

**Proposition 1: Optimal Contract**

*The optimal compensation contract for employee k in state s is given by*

$$w_k(s,x) = \left[\frac{\alpha_k(s) + \mu_k(s) g_k(e_k, a_k^*)}{\lambda(s,x)}\right]^{\rho}. \quad (10)$$

*When total available funds F are large* $[F \geq F^0(s)]$*, dividend payments are positive and the optimal contract [labeled H for Holmström (1979)] is characterized by*

$$w_k(s,x) = [\alpha_k(s) + \mu_k(s) g_k(e_k, a_k^*)]^{\rho} \equiv w_k^H(s, e_k). \quad (11)$$

*When total available funds F are low* $[F < F^0(s)]$*, dividends are zero and the optimal contract is characterized by*

$$w_k(s,x) = \frac{w_k^H(s,e_k)}{\frac{1}{n}\sum_l w_l^H(s,e_l)} \overline{w}(s,x), \quad (12)$$

*where* $\overline{w}(s,x)$ *denotes the average wage and* $F^0(s) = \frac{1}{n}\sum_l w_l^H(s,e_l)$.

**Proof:** The first-order condition is

$$\frac{\partial L}{\partial w_k(x)} = [\alpha_k(s) + \mu(s)_k g_k(e_k, a_k^*)]\, U'[w_k(s,x)] - \lambda(s,x) = 0. \quad (13)$$

The result in Eq. (11) follows from $U'[w_k(x)] = w_k^{-\frac{1}{\rho}}$ and $\lambda(s,x) = 1$. In the constrained state

$[\lambda(s,x) < 1]$, Eq. (13) implies proportional scaling of $w_k^H(s,e_k)$ by the same factor $\lambda(s,x)^{-\rho}$, namely

$$w_k(s,x) = \lambda(s,x)^{-\rho} w_k^H(s,e_k). \tag{14}$$

This directly yields

$$\frac{w_k(s,x)}{\frac{1}{n}\sum_l w_l(s,e_l)} = \frac{w_k^H(s,e_k)}{\frac{1}{n}\sum_l w_l^H(s,e_l)} \quad \Longleftrightarrow \quad w_k(s,x) = \frac{w_k^H(s,e_k)}{\frac{1}{n}\sum_l w_l^H(s,e_l)}\overline{w}(s,x). \tag{15}$$

The optimal contract in Eq. (10) depends on the employee's Lagrange multipliers $\alpha_k(s)$ (for the participation constraint) and $\mu_k(s)g_k(e_k,a_k^*)$ (for the incentive compatibility constraint). The latter depends on the employee's individual performance $e_k$. If the bank's funding constraint is not binding $[\lambda(s,x) = 1]$, we obtain in Eq. (11) the Holmström (1979) salary as the solution to the contracting problem. In particular, the optimal remuneration of each employee $k$ is independent from the bank's other funding resources $M$ and from earnings generated by other employees $\Sigma_{l\neq k}e_l$.

However, if the bank's funding resources are insufficient $[F < F^0(s)]$, the optimal Holmström salary $w_k^H(s,e_k)$ is scaled down by the factor $\lambda(s,x)^{-\rho} < 1$. This scaling factor is the same for all employees under the assumption of identical CRRA utility functions. The "scaling" aspect of the optimal contract is consistent with the "bonus pool approach" that is observed in practice (see Section 5). Typically, total variable pay of a bank is not determined by a bottom-up aggregation of individual incentive pay. Instead, available financial resources determine a bank-wide bonus pool, which is then cascaded top-down to different divisions, teams, and employees based on individual performance. In other words, any incentive component of variable compensation is constrained (scaled) by the amount of available financial resources of the bank.

Based on Proposition 1, we can write the optimal employee compensation $w_k$ as the product of two terms $\Lambda_k(s,e_k)$ and $\Xi(s)$. The first term $\Lambda_k(s,e_k)$ is the (Holmström) compensation of employee $k$ relative to the average wage $\overline{w}^H(s)$ for all employees in the unconstrained case, namely

$$\Lambda_k(s,e_k) = \frac{[\alpha_k(s) + \mu_k(s)g_k(e_k,a_k^*)]^\rho}{\frac{1}{n}\sum_l w_l^H(s,e_l)} = \frac{w_k^H(s,e_k)}{\overline{w}^H(s,x)}, \tag{16}$$

which represents the individual (incentive-based) component of pay. All else equal, $\Lambda_k(s,e_k)$ is larger and more sensitive to individual performance $e_k$ for employees with a severe hidden-action

problem [high $\mu_k(s)g_k(e_k, a_k^*)$]. For employees whose earnings distribution is relatively insensitive to $a_k(s)$, $\Lambda_k(s, e_k)$ is mainly driven by the multiplier $\alpha_k(s)$ of the participation constraint. The second term $\Xi = \overline{w}(s, x)$ denotes the average wage of all employees, which can be constrained by the available resources $F$ defined in Eq. (6). Note that the state of the labor market $s$ impacts both the incentive [through the participation constraint $U_k^0(s)$] and the risk sharing component [through available resources $F(s)$]. Variation in the average wage represents the risk sharing component of the optimal compensation contract. As the decomposition of employee pay has an insightful empirical counterpart examined in Section 6.1, we summarize it in the following corollary:

**Corollary 1: Incentive and Risk Sharing Components of Wage Variation**

*Conditionally on the state $s$ of the labor market, the individual log wage $\ln w_k(s, x)$ can be decomposed into an incentive component $\ln \Lambda_k(s, e_k)$ proportional to the Holmström compensation $w_k^H(s, e_k)$ and a risk sharing component $\ln \Xi(s) = \ln \overline{w}(s)$ common to all employees:*

$$\ln w_k(s, x) = \ln \frac{w_k^H(s, e_k)}{\overline{w}^H(s)} + \ln \overline{w}(s) \equiv \ln \Lambda_k(s, e_k) + \ln \Xi(s). \tag{17}$$

*A variance decomposition of the individual wage (conditionally on $s$) implies*

$$Var\left[\ln w_k(s, x)\right] = Var\left[\ln \Lambda_k(s, e_k)\right] + 2Cov[\ln \Lambda_k(s, e_k), \ln \Xi(s)] + Var\left[\ln \Xi(s)\right]. \tag{18}$$

*The share of log wage variation due to incentive pay and bank risk sharing follows as*

$$\frac{Var\left[\ln \Lambda_k(s, e_k)\right]}{Var\left[\ln w_k(s, x)\right]} \quad \textit{and} \quad \frac{Var\left[\ln \Xi(s)\right]}{Var\left[\ln w_k(s, x)\right]}, \tag{19}$$

*respectively.*

In our static model, financial frictions are simply captured by the constraint that dividends cannot be negative. In a dynamic model, they would be associated with a recapitalization cost, that makes shareholder value a concave function of internal cash.[10] More generally, the risk sharing mechanism can also be useful in the presence of other rigidities than financial frictions. What is

[10] See Décamps, Mariotti, Rochet, and Villeneuve (2011) and Bolton, Chen, and Wang (2011).

needed is a variation in shareholders' marginal rate of substitution between (internal or external) funds and wages. Consider for example a two-period extension of our model where shareholders can decide to downscale the firm if economic conditions at the interim date are bad. If it is costly to lay off workers, cutting their compensation can induce some of them to leave the firm voluntarily, thereby increasing shareholder value.[11]

Figure 1 provides a graphical illustration of our model. For simplicity, we drop the variable $s$. The vertical axis shows the individual compensation $w_k(x)$ of two employees $k = 1, 2$ with different (relative) Holmström compensation $\Lambda_1 < \Lambda_2$. The horizontal axis shows the average compensation $\overline{w}$ of all bank employees 1,2,...$n$. Risk sharing implies that individual compensation $w_k$ increases in $\overline{w}$, which itself increases in available bank funds $F$ up to the threshold $F_0$. For larger $F > F_0$, employee compensation is capped at $w_k^H(e_k)$ and residual funds are paid out as dividends $\delta$.[12] Differences in the incentive component of compensation are reflected by the different slopes $\Lambda_1$ and $\Lambda_2$ for employees 1 and 2.

It is clear from Figure 1 that an employee contributes more to bank-wide risk sharing if his or her compensation has a larger incentive pay component. As $\Lambda_2 > \Lambda_1$, employee 2 suffers a larger drop in compensation than employee 1 when bank-wide financial resources decrease from $F_{high}$ to $F_{low}$.[13] In other words, employees with high-powered incentives are relatively more sensitive to bank-wide shocks. It follows that the scope for incentive-based wage differentiation decreases as the bank's financial constraints tighten (see Moser, Saidi, Wirth, and Wolter, 2020). Wage inequality, i.e. the difference $w_2 - w_1$ between employees 1 and 2, decreases as bank funds decline from $F_{high}$ to $F_{low}$. The following corollary summarizes these observations:

**Corollary 2: Individual Contribution to Risk Sharing and Wage Inequality**

*In the constrained case of $F < F_0$, a change in bank-wide resources $\Delta F$ and, hence, in the average wage $\Delta\overline{w}$ causes a larger change in individual compensation $\Delta w_k (= \Lambda_k \cdot \Delta\overline{w})$ for employees with a large incentive pay component $\Lambda_k$. As a result, the scope for merit-based wage differentiation declines as financial constraints tighten.*

A unique aspect of our data set is that it reports each employee's fixed (base) salary and his

[11] We are grateful to the Editor, Itay Goldstein, and an anonymous referee for pointing this out.

[12] This result is consistent with industry practices of capping pay at an upper threshold (Murphy, 2013b, p. 242).

[13] For the individual employee with given earnings contribution $e_k$, it is irrelevant whether the shock to $F$ (and $\overline{w}$) is caused by a change in aggregated earnings $\Sigma_k e_k$ or by changes in the bank's other funding resources $M$.

or her variable bonus separately. Empirically, it is more efficient to analyze the variable bonus (standardized by fixed salary) because it is less subjected to nominal wage rigidity. In the model, we define the base salary, the variable bonus, and the standardized bonus share as follows:

**Definition: Base Salary, Bonus, and Bonus Share**

*We define the base salary* $\underline{w}_k(s)$ *for employee* $k$ *as the lower bound of* $w_k(s,x)$ *for all possible realizations of* $x(a^*)$*, that is* $\underline{w}_k(s) \equiv \min_{x(a^*)} \Lambda_k(s,e_k)\overline{w}_k(s,x)$*. The bonus pay* $(Bonus_k(s))$ *can then be characterized as*

$$Bonus_k(s) \equiv w_k(s,x) - \underline{w}_k(s) \tag{20}$$

*and the bonus share as*

$$BonusShare_k(s) \equiv \frac{Bonus_k(s)}{\underline{w}_k(s)} = \frac{w_k(s,x) - \underline{w}_k(s)}{\underline{w}_k(s)}. \tag{21}$$

Finally, as optimal employee pay depends on the bank's total available funds $F$, it also features risk sharing across individual employees or different groups of bank employees. The bonus share $BonusShare_l(s,x)$ and total compensation $w_l(s,x)$ of employee $l$ (equivalently, of employee group $l$) are sensitive to the earnings contribution of employee (group) $k$ and vice versa. However, this result requires additional structure on the maximal effectiveness of employee action and local risk aversion to rule out degenerate (or excessive) marginal incentive pay, whereby employees obtain more than 100% of their marginal profit contribution to the bank.

**Proposition 2: Risk Sharing Across Divisions**

*Assume that the marginal incentive effect on pay is reasonably bounded so that it does not exceed the employee's earnings contribution* $[dw_k^H(e_k)/de_k < 1]$ *for all* $e_k \in [\underline{e}_k, \infty]$*. It follows that in the constrained state* $(F < F^0)$*, the marginal compensation and the marginal bonus share of employee* $l$ *with respect to marginal profit contributions by employee* $k$ *are both (strictly) positive; therefore*

$$\frac{dw_l(x)}{de_k} > 0 \qquad \text{and} \qquad \frac{dBonusShare_l(x)}{de_k} > 0. \tag{22}$$

**Proof:** In the high resource state $\overline{w}^H \leq \overline{e}+m$, $w_l(x) = w_l^H$ does not depend on $e_k$. For $\overline{w}^H > \overline{e}+m$, we find

$$\frac{dBonusShare_l}{de_k} = \frac{1}{\underline{w}_l}\frac{d}{de_k}w_l(x) = \frac{\Lambda_l(e_l)}{\underline{w}_l}\left[1 - \frac{\overline{w}}{\overline{w}^H}\frac{dw_k^H(e_k)}{de_k}\right] > 0, \tag{23}$$

as $0 < \frac{\overline{w}}{\overline{w}^H} < 1$, and $0 < \frac{dw_k^H}{de_k} < 1$.

## 3.2 Testable Predictions

Next, we derive testable predictions from our theoretical framework. Financial frictions (modeled as non-negative dividends in Section 3.1) imply that an employee's total compensation is simultaneously determined by an incentive pay component $\Lambda_k(s, e_k)$ and a risk sharing component $\Xi(s)$. Corollary 1 suggests a simple variance decomposition to quantify the relative contribution of each component to total log wage variability $Var\left[\ln w_k(s,x)\right]$.

We expect that the relative contribution of incentive pay to overall pay variation increases in employees' hierarchy levels and is more pronounced in divisions like trading, which are typically assumed to require high-powered incentives due to hidden effort.

**Prediction 1: Sources of Individual Pay Variation**

*Employee pay varies for incentive and risk sharing reasons. A variance decomposition with respect to the (log) average bank wage identifies the risk sharing component and allows us to discern its importance for different hierarchy levels and bank divisions.*

Second, Corollary 2 states that employees with a large incentive pay component contribute more to risk sharing than other employees. Intuitively, if incentive needs make it optimal to design a larger part of compensation as a variable bonus in year $t$, the bank should find it easier to reduce compensation in $t+1$ in case that financial conditions deteriorate. Studying the banking crisis of 2008-2009, we predict that employees with compensation plans characterized by low fixed salaries but high variable pay before the crisis experienced larger reductions in total compensation in 2008 when funding conditions deteriorated. In other words, banks should have been in a better position to reduce the labor costs for those employees that had few debt-like claims (fixed salaries) against the bank. Hence, risk sharing through bonus pay should reduce operating leverage.

**Prediction 2: Labor Cost Reduction in the Crisis**

*Employees with a higher bonus share at the outset of the banking crisis suffer larger pay reductions in 2008 than other employees. Moreover, conditional on their job positions and their ex-ante bonus shares, employees suffer larger pay reductions in 2008 if they work for constrained banks that experience a sharp decline in internal and external funding.*

For $F < F_0$, Corollary 2 predicts that a change in compensation of employee $k$ is proportional to the change in average compensation across all employees $k = 1, 2...n$ ($\Delta w_k = \Lambda_k \cdot \Delta \overline{w}$), which itself increases in the change of the bank's total financial resources $\Delta F$. Hence, Prediction 2 suggests that, ceteris paribus, an employee suffers a larger pay reduction in 2008 if he or she is working for a more constrained bank. Our test of this prediction conditions on employees' *ex-ante* bonus shares before the crisis and on division × hierarchy × age × tenure fixed effects to ensure that we compare employees that enter the crisis with identical scope for pay reductions and that work in the same labor market. Hence, Prediction 2 distinguishes the risk sharing hypothesis from flexible wage models, which predict that all banks — regardless of their funding constraints — cut bonuses homogeneously in response to falling reservation wages (Oyer, 2004).

As variable pay depends on bank-wide earnings and financial resources, Proposition 2 states that an employee's (standardized) bonus depends on the earnings generated by his or her colleagues and even on earnings generated in other bank divisions. Earnings risk is even shared with bank divisions that do not contribute directly and measurably to earnings generation themselves (accounting, IT, human resources, etc.).[14]

**Prediction 3: Risk Sharing Across Bank Divisions**

*An employee's bonus depends on bank-wide financial resources, therefore, also on earnings generated in other divisions. In particular, bonus shares of loan officers, traders,*

[14]Hence, an employee's participation in the bank-wide bonus pool is generally not proportional to his/her individual contribution to bank-wide earnings. Another reason for this result is limited liability, which protects loss-generating employees from paying negative bonuses. We note that provisions for bonus clawback and deferred compensation, which allow a "negative bonus" for one given year to reduce overall bonus pay calculated over a multiple-year performance period, are not prevalent before the end of our sample period in 2010. The Capital Requirements Directive of the European Union stipulates that 25% of variable remuneration should be deferred. However, it was applied, for the first time, to bonuses paid in 2015 for performance in 2014.

*and even employees in banks' internal service functions (accounting, human resources, IT, etc.) all depend on both lending and trading income.*

Fourth, in times of extreme financial distress and low bank-wide earnings, all bank employees contribute to risk sharing. A bank-wide suspension of bonuses even affects those employees that continue to generate positive earnings as well as employees that bear no responsibility for the financial distress of their employer.

**Prediction 4: Risk Sharing by Employee Group in the Crisis**

*During the banking crisis 2008-09, banks respond to financial distress with a bank-wide suspension of bonuses, irrespective of employees' individual performance. In particular, bonus shares also drop for employees in operational divisions even after controlling for divisional performance and for employees with little or no responsibility for their banks' crisis exposure—e.g., even for employees in service divisions like accounting, human resources, or IT.*

A bonus contraction among bank employees whose individual performance is reasonably unrelated to the global crisis shock (junior employees, employees in accounting, IT, etc.) is difficult to explain with theories of incentive pay alone, but fully consistent with our risk sharing hypothesis.

# 4 Data

## 4.1 Compensation Data

This paper draws on a large payroll data set from the financial service sectors of Austria, Germany, and Switzerland, which is documented in detail in Efing, Hau, Kampkötter, and Steinbrecher (2015) and in Kampkötter (2015). Data on individual compensation contracts were collected by the international pay consultancy firm Willis Towers Watson and directly sourced from the banks' payroll records. The data undergo several quality checks by the pay consultants and bank representatives. Every data submission is reviewed and validated by survey analysts and compensation consultants, processed by special software for data anomalies, and then double-checked by the banks' and the consultancy's compensation specialist.

The data sample used in this study ranges from 2003 to 2010 and includes more than 1.26 million employee-year observations from payroll records of 54 Austrian, 185 German, and 88 Swiss commercial banks. Benchmarked against the total employment in commercial banks, our payroll data covers, on average, 44% of all commercial bank employees in Germany, 50% in Switzerland, and 30% in Austria. Banks do not report executive pay but are required to report data from at least 80% of all employees below executive level.[15] The bank sample is representative and accounts for a large fraction of bank assets in the three countries. However, depending on the specification, we dispose of accounting data only for an unbalanced subsample of the 82 larger banks. For example, in 2008, we only observe 5 Austrian, 35 German, and 13 Swiss banks with both matched compensation and accounting data. Yet, these 53 banks alone account for approximately 26%, 83%, and 87% of total bank assets in Austria, Germany, and Switzerland, respectively.

The pay consultant uses a standardized and globally consistent method to make employee pay comparable across banks. This method classifies employees into a predefined set of different occupations (retail banker, asset manager, trader, etc.) and assigns them to specific divisions and functional areas in the financial services industry. The pay consultant further sorts employees into six distinct career levels in the employment hierarchy. This classification assumes that careers can be broken down into different steps that are characterized by different sets of distinct abilities and tasks including, for example, problem-solving skills, general abilities, planning and organization skills, business orientation, customer orientation, cost and profit orientation, team working, coaching, or networking. Hence, employees located at the same hierarchy level (at the same step in the career ladder), can be assumed to be similar with respect to their cognitive skills and capabilities. Table I in the Internet Appendix shows examples of skills evaluated by the consultancy.

The pay consultant's data collection and standardization procedures offer at least three advantages for our own analysis. First, hierarchy levels allow us to control at least partly for employees' different abilities and skill sets. Second, we are able to compare employees that work in identical occupations but for different banks. For example, we can compare a 40 years-old and 10 years-tenured retail-loan officer in Bank A to another retail-loan officer with identical characteristics in Bank B. Third, the data allow us to study bank employees that are often missing in other data

[15] If a bank decides to report less than 100% of its (non-executive) headcount, it is required to sample employees in a representative manner. Our regression analysis can mitigate remaining concerns regarding sample selection by tightly controlling for employee characteristics in terms of job position, hierarchy level, age, and tenure.

sets. For example, we also observe very junior employees and employees in banks' back offices and internal support functions.

Pay information includes the fixed annual base salary $\underline{w}_k$ as well as the end-of-year $Bonus_k$ of each employee. Total compensation $w_k$ is defined as the sum of these two pay components. We standardize the bonus by the base salary to calculate the $BonusShare_k$, which captures the relative size of the variable pay component. Equity-based compensation is not included in our data. According to our data provider, the practice of granting shares and stock options to employees below the executive level is extremely rare in the countries and years we consider and less than 1% of employees are entitled to equity pay.[16] We subject the raw data to only minor modifications: First, we discard extremely low compensation levels with a base salary below €24,000 as these positions correspond to interns or trainees on short-term contracts. Second, we winsorize all variables at the first and 99th percentile to reduce the influence of outliers.

The information on individual employees includes the name of the employee's bank, his age, employment tenure, seniority level in the employment hierarchy (ranging from 1 to 6), and the specific position in one of eight bank divisions: Logistical Services (D1) include support functions like customer support, IT, or communications, whereas Headquarter (HQ) Services (D2) include, for example, accounting, human resources, and marketing. Both divisions D1 and D2 belong to the functional area Internal Services. Retail Banking (D3) and Corporate Banking (D4) mainly manage loan business and deposit taking and belong to the functional area Loan Business. The area Wealth Management offers financial services to corporate clients and high-net-worth individuals and comprises the divisions Private Banking (D5) and Asset Management (D6). Proprietary trading is carried out by employees in Investment Banking (D7) and Treasury/Capital Markets (D8), which are subsumed under the functional area Trading Business. In total, the observed hierarchy levels and bank divisions span $6 \times 8$ uniquely defined job positions.

Although sampled repeatedly, the large majority of employees cannot be tracked over time. Unique employee identifiers exist only for a subset of 299,899 employee-years and 52 banks. After we drop observations with missing employee or bank characteristics, the size of this employee panel decreases further to 124,632 employee-years and 13 banks. The employee panel only comprises German banks and was discontinued for data protection concerns in 2007, i.e. before the crisis

[16]This claim is consistent with Fernandes, Ferreira, Mato, and Murphy (2013), who show that, even at the executive level, equity-based pay in Europe is low compared to the U.S.

reaches the German banking sector.[17] In the empirical analyses, we use the full employee sample as well as the smaller pre-crisis panel.

## 4.2 Bank Data

We complement the bank compensation data with bank balance sheet data from Bankscope (Bureau van Dijk). The overlapping coverage comprises 273 bank-years or 82 banks for which we have compensation data and accounting data in at least one year over the period 2003–2010.

Given our focus on risk sharing with employees, we do not calculate returns on assets but standardize earnings by employment. As the pay consultant requires banks to report at least 80% of their employees (see Section 4.1), employment numbers in our data can vary artificially from year to year. To reduce the effect of reporting variation, we use the largest number of employees reported by a given bank over the sample period to standardize income from lending and trading business in all years. *Lending Income/Employees* is defined as the ratio of interest income less changes in loan loss provisions to employment.

## 4.3 Descriptive Analysis

Table 1, Panel A, reports summary statistics for the 1.26 million employee-year observations pooled across the three countries. Total compensation $w_k$ amounts to an average of €70,095, with a standard deviation of €42,397. Ten percent of all banking employees earn more than €110,000. The average $Bonus_k$ per bank employee is €10,138 with a median of €3,873. The median $BonusShare_k$ amounts to 7.7% and increases in the fixed base salary $\underline{w}_k$. The variable component of pay amounts to more than 30% of base salary for 10% of all employee-years.

Panel B shows the summary statistics for the same variables as in Panel A in the pre-crisis panel with unique employee identifiers. The distributions in Panel A and B are similar although $Tenure_k$ and $BonusShare_k$ are slightly higher whereas $\underline{w}_k$ is lower in the employee panel.

Panel C provides the breakdown of the $BonusShare_k$ and base salary $\underline{w}_k$ by bank division and employee group. We find the lowest $BonusShare_k$ in Logistical Services and Retail Banking with sample averages of 6.8% and 8.3%, respectively. By contrast, the variable pay component reaches

[17] The employee identifiers in this subsample change when an employee moves from one bank to another one. Hence, we can only track employees for as long as they stay at the same bank.

an average of about 42% in Investment Banking and Treasury/Capital Markets. Similarly, base salary $\underline{w}_k$ tends to be lowest in Logistical Support and Retail Banking and highest in Trading. Panel C shows that employees' hierarchy levels correlate positively with their bonus shares and base salaries. The average junior employee (bottom three hierarchy levels) has a $BonusShare_k$ of only 6.2% compared to 22.5% for the average senior employee (top three hierarchy levels).

Table 2 reports multivariate regressions with bank and year fixed effects for the (log) total compensation Log $w_k$ and $BonusShare_k$ in the full employee sample. The coefficient estimates confirm that total pay and bonus shares increase in hierarchy levels and are higher in trading-oriented occupations. Similar to Mincer earnings functions, our regressions include quadratic polynomials of $Age_k$ and $Tenure_k$. The coefficients suggest that total pay and bonus shares first increase in age and tenure and decrease again for old age and high job experience, consistent with, for example, Baker, Gibbs, and Holmström (1994), Grund (2005), or Grund and Kräkel (2012).

Finally, Panel D of Table 1 provides summary statistics for the accounting data of 273 bank-year observations. Mean total assets equal €171,465m, albeit with a large standard deviation of €378,978m. The median bank has an asset size of €40.2 billion, of which 72% are deposits on the liability side and 37% are loans on the asset side. The median bank has only 4.2% (book) equity relative to total assets. Mean and median of *Lending Income/Employees* equal €1.629m and €0.857m per employee, respectively. Mean and median of *Trading Income/Employees* are two orders of magnitude lower. Lending and trading income combined amount to, on average, €1.703m per employee.

# 5 Institutional Background

Before we present our empirical results, we review how banks set variable bonuses in practice. According to survey evidence on 36 bonus plans from 25 Austrian, German, and Swiss banks (Kampkötter and Sliwka, 2018), 64% of the surveyed banks use a top-down decision process to allocate a bank-wide bonus pool to individual employees. As shown in Section 3.2, such a *modus operandi* is fully compatible with centralized sharing of bank-wide earnings risk (Proposition 1).

The total annual bonus pool is determined at the board level and the allocated funds are cascaded down to the divisional level and smaller organizational units. The survey shows that bank

earnings at the top level are the dominant criterion for the calculation of these bonus pools, with operating revenue as major performance metrics used to measure bank success. The bonus pools are assigned to supervisors in the respective operational units (typically also depending on the unit's financial performance), who then have to allocate these pools to subordinates according to some combination of subjective and objective performance assessment. The institutional practice of bonus pools is also widespread in global banking outside the three countries examined in this paper. A survey by the consultancy Mercer (2013) in North America, Europe, and Emerging Markets concluded that *"the top-down pool approach is predominant in the banking industry."*

Two related types of bonus allocation systems are the so-called "additive bonus system" and "multiplicative bonus system". In additive systems, the individual bonus usually depends on a combination of individual performance, the performance of the employee's organizational unit or a team and on the earnings of the entire bank. In multiplicative bonus systems, the supervisor first assesses the performance of her subordinates, and this performance evaluation is then multiplied by a certain factor, which depends on the profitability of the whole bank and the specific unit. Around 40% of the surveyed banks use either the additive or the multiplicative bonus system in one of their plans.

Almost all of the surveyed bonus plans include individual performance assessments, which are based on qualitative or discretionary assessments (all plans) and objective performance indicators (86%). The survey evidence also reveals that the structure of bonus plans remained very stable during the time period 2004–2013. Overall, the prevalence of top-down planning of bonus pools lends credibility to the employee risk sharing motive of bonus pay. At the same time, such a risk sharing motive is not incompatible with differentiated merit-based allocations at the individual level: as predicted by our model, it only scales its scope (Proposition 1) and wage inequality driven by variation in individual performance decreases when financial constraints tighten (Corollary 2).

# 6 Empirical Analysis

The analysis here matches the predictions stated in Section 3.2. First, we undertake a variance decomposition to evaluate the relative contribution of the risk sharing and the incentive channel for total log wage variation for different employee groups. This establishes the economic significance

of risk sharing for individual pay variation. In Section 6.2, we shift the focus to the financial crisis 2008-09. We show to what extent variable compensation allowed banks to reduce their labor costs in the crisis and how wage reductions covary with banks' financial constraints. In Section 6.3, we seek to identify the risk sharing effect (across bank divisions) based on a within-bank analysis. Here, we document that individual performance is not the only bonus determinant. An employee's variable compensation also depends on earnings shocks that are beyond his or her direct control.

## 6.1 A Variance Decomposition of Pay Risk

Prediction 1 suggests that incentive pay as well as risk sharing are sources of individual pay variation. In this section, we decompose the part of (log) pay variation that is not explained by a set $C$ of labor market proxies into its incentive pay and its risk sharing component and estimate their relative importance. In a first step, we correct total annual compensation $w_{k,t}$ for variation explained by $C = \{Age \times Tenure \times Division \times Hierarchy \times Year\ FE\}$.[18] Under the assumption that this interaction of different fixed effects spans most labor market segments, $C$ should control for most cross-sectional and temporal variation in the participation constraints of employees that perform similar tasks across banks and share comparable traits. We denote remaining variation in (log) residual pay as $\ln w_{i,k}|C$.[19]

In a second step, we calculate the incentive component of log pay variation as $Var[\ln \Lambda_{k,t}|\, C] = Var[\ln w^H_{k,t}|C - \ln \overline{w}^H_{b(k),t}|C] = Var[\ln w_{k,t}|C - \ln \overline{w}_{b(k),t}|C]$, where the last equality follows from Eq. (12) and $\overline{w}_{b(k),t}|C$ denotes the average (residual) compensation paid by employee $k$'s bank in year $t$. Hence, the incentive component $Var[\ln \Lambda_{k,t}|\, C]$ of total log pay variance $Var[\ln w_{k,t}|\, C]$ captures variation due to pay dispersion within banks. By contrast, the risk sharing component, calculated as $Var[\ln \Xi_{k,t}|\, C] = Var[\ln \overline{w}_{b(k),t}\big|\, C]$, captures variation due to changes in the average compensation per bank.

Panels A and B of Table 3 report the variance decomposition for employees classified by their hierarchy or divisional affiliation, respectively. Columns (1) and (2) state the number of employee-year observations and their percentage distribution. The total pay variance $Var[\ln w_{k,t}|\, C]$ is reported in Column (3). It is less than 4% for the three lowest hierarchy levels and increases to 9%

[18] To ensure a sufficient number of employee-year observations for each interaction, we use four age and five tenure cohorts instead of the continuous age and tenure variables.

[19] Internet Appendix A describes in detail how we calculate residual pay $w_{i,k}|C$.

at hierarchy level 6. Trading business shows a high level of pay risk at 13.1% for investment banking employees (D7) and 15.5% for those in treasury and capital markets (D8), whereas logistical services (D1) have an overall pay variance of only 3.5%. Considering employees of all hierarchy levels and divisions together, we find that $Var[\ln w_{k,t} | C]$ in Column (3) is equal to 4.1%.

Columns (5) to (7) show the percentage break-down of overall pay variation into its different components. Considering employees of all hierarchy levels and divisions together, the incentive component accounts for 77.6% of total pay risk and the risk sharing component for 23.9%. The covariance component is negative and economically small at $-1.5\%$. Although the risk sharing component explains generally less pay variation than the incentive component (at a ratio of roughly 1:3), it is economically significant and large for several subgroups of employees. For example, for hierarchy levels 1 to 3, which account for 59% of all employee-year observations in the sample, risk sharing explains between 29.1% and 44.2% of pay variation. Service employees (D1+2) and retail banking (D3), which together make up for 83% of our sample, bear between 24.5% and 34.2% of their pay risk due to risk sharing.

One concern could be that the set of conditioning fixed effects $C$ captures not only labor market variation but also earnings and funding shocks that are common to all banks and could affect the risk sharing as well as the incentive component of employee compensation. As a robustness check, we use different sets of conditioning variables $C$ and also estimate an unconditional variance decomposition in Table II of the Internet Appendix. We find that the relative importance of the risk sharing and the incentive component is remarkably stable across different specifications of $C$.

Overall, the risk sharing component is economically significant but smaller than the incentive component over the period 2003-2010. In the next section, we restrict the analysis to the year 2008 and test to what extent bonus pay helped banks reduce labor costs in the financial crisis.

## 6.2 Pre-Crisis Bonus Pay and Labor Cost Reduction in the Crisis

High labor intensity in banking can translate into high operating leverage and aggravate financial distress during banking crises if employees hold high debt-like claims (fixed salaries). Ideally, banks would like to reduce labor costs in times when external funding constraints tighten and internal cash flow generation is low. As far as layoffs are concerned, strict labor protection laws often impede such risk sharing with employees, in particular, in many European countries. Figure

2, Panel A, confirms that the banking crisis 2008-09 had no immediate effect on bank employment in Austria, Germany, and Switzerland.

Constrained in their ability to undertake large-scale layoffs, banks can reduce labor costs only through wage adjustments. Further, in the presence of downward wage rigidity for the base salary, only variable pay can be decreased.[20] Therefore, high bonus pay becomes the privileged contractual mechanism to limit the operating leverage in banks (Prediction 2). Consistent with this prediction, Panel B of Figure 2 shows that the average bank employee in our sample suffered a large bonus cut in 2008, whereas his fixed base salary sustained its long-term trend throughout the entire sample period.

The aggregate time series statistics in Figure 2 suggest a direct link between bonus cuts in 2008 (Panel B) and labor cost reductions of roughly €282.6m per bank (Panel A) or 23.7% (= 282.6m/1,191.2m). To substantiate this claim, we test whether banks found it easier to reduce labor costs in 2008 for employees with high bonus shares at the outset of the crisis (Prediction 2).

Ideally, we would estimate the following cross-sectional, employee-level regression:

$$\Delta w_{k,2008} \quad = \quad \beta_B \; BonusShare_{k,2007} + Controls + \epsilon_k \; , \tag{24}$$

where the dependent variable is the relative change $(w_{k,2008} - w_{k,2007})/w_{k,2007}$ in employee $k$'s total compensation from 2007 to 2008. The coefficient $\beta_B$ should be negative as a high ex-ante bonus share should allow a bank to reduce the labor cost for employee $k$ in the crisis (Prediction 2). However, our data do not allow us to estimate Eq. (24) directly. As explained in Section 4.1, we only have employee identifiers for a subsample of employees that ends before the crisis. For a given employee $k$ in 2008, we do not observe the lagged bonus share or total compensation in 2007.

To circumvent this data limitation, we estimate Eq. (24) for employee groups and not for individual employees. We define homogeneous groups at the bank × division × hierarchy × age × tenure level.[21] For example, one such group comprises all employees that work (i) at Bank A, (ii) in asset management, (iii) attained hierarchy level 4, (iv) were born between 1970 and 1979,

[20] The high degree of downward real and nominal wage rigidity in Germany is documented, for example, by Knoppik and Beissinger (2003) and Bauer, Bonin, Goette, and Sunde (2007).

[21] As in Section 6.1, we distinguish between four age and five tenure cohorts.

(v) and hired by their bank between 2000 and 2004. For each employee group $g$, we calculate the mean $BonusShare_{g,2007}$ before the crisis, the mean total compensation $w_{g,2007}$ and $w_{g,2008}$, and the relative change in total compensation $\Delta w_{g,2008} = (w_{g,2008} - w_{g,2007})/w_{g,2007}$ when the crisis reaches Germany, Austria, and Switzerland. We estimate the following group-level variant of Eq. (24):

$$\begin{aligned} \Delta w_{g,2008} &= \beta_B \; BonusShare_{g,2007} + \beta_C \; BankCharacteristics_{b(g),2007} + \\ &\quad + Country\ FE + Division \times Hierarchy \times Age \times Tenure\ FE + \epsilon_k \ , \end{aligned} \tag{25}$$

where we control for various bank characteristics (loans, deposits, and book equity, all standardized by total assets, and (log) assets) and country fixed effects. The interacted job division × hierarchy level × age × tenure fixed effects ensure that we compare identical employee group observations that only differ with respect to their ex ante bonus share before the crisis and with respect to the bank at which they are working. We compute two-way standard errors. First, we cluster them by bank as regression residuals are likely correlated across employee groups that work for the same institution. Second, we cluster by division × hierarchy × age × tenure group. This is warranted as employees who are identical along those dimensions should be located in the same labor market and, hence, be exposed to similar shocks to their outside options/reservation wages.[22]

Table 4 documents the percentage labor cost reduction $\Delta w_{g,2008}$ from 2007 to 2008 at the employee group-level as a function of the pre-crisis $BonusShare_{g,2007}$. Columns (1) and (2) report specifications without and with bank controls. In both columns, the pre-crisis bonus share $BonusShare_{g,2007}$ has a significant coefficient of approximately $-0.265$. Hence, an increase by one standard deviation (=0.388) implies that employees suffer an, on average, 10% larger pay reduction in 2008. Consistent with Prediction 2, Columns (1) and (2) show that a higher pre-crisis bonus share reduces downward wage rigidity and allows banks to reduce labor costs in the financial crisis. We emphasize that this effect on banks' operating leverage is independent of banks' ulterior reasons to decrease labor costs in 2008. Pay reductions free financial resources in the crisis regardless of whether they are motivated by deteriorating funding conditions (risk sharing), the need to punish employees for bad performance (incentive provision), or by deteriorating market wages and outside options of employees (labor markets). Nevertheless, it is interesting to ask

[22]Our results are robust if we do not cluster by labor market (i.e., by division × hierarchy × age × tenure).

whether the risk sharing mechanism is at work independently of any alternative explanations.

The risk sharing motive of bonus pay suggests that the magnitude of a contraction in available financial resources by $\Delta F$ determines the extent of pay reductions (Prediction 2). Conditionally on given ex-ante bonus shares, labor costs should decrease more dramatically in 2008 for banks that experience a larger contraction in external funding. Ideally, we would like to use market prices to measure changes in banks' funding conditions. Banks' equity prices dropped sharply in the crisis along with an increase in credit default swap (CDS) rates (Internet Appendix, Figure I). However, market prices are unavailable for most banks in our sample. Instead, we use banks' change in short-term debt funding (deposits and wholesale debt) between 2007 and 2008 ($\Delta ST$ *Debt Funding 2008*) as our main proxy for external funding access. A large literature has shown the fragility of wholesale debt funding during the financial crisis when lenders disinvested formerly information-insensitive claims like repurchase agreements, interbank loans, certificates of deposits, and other short-term debt claims (e.g., Dang, Gorton, and Holmström, 2012; Gorton, 2009; Gorton and Metrick, 2012; Pérignon, Thesmar, and Vuillemey, 2018). Panel A of Figure 3 shows that $\Delta ST$ *Debt Funding 2008* exhibits considerable cross-sectional variation in our bank sample.

Table 4, Column (3) shows a positive and statistically significant coefficient of 0.143 for the interaction term $BonusShare_{g,2007} \times \Delta ST$ *Debt Funding 2008*$_{b(g)}$. As we include the full set of fixed effects, this result should be interpreted as follows: Employees that work in different banks but have the same pre-crisis bonus share in 2007, and are identical along observable characteristics, suffer different pay reductions $\Delta w$ depending on their banks' access to outside funding. In the regression sample of Column (3), the 75th percentile of $BonusShare_{g,2007}$ equals 0.266. At this bonus share, the marginal effect of $\Delta ST$ *Debt Funding 2008*$_{b(g)}$ on $\Delta w$ equals roughly 5% ($= 0.005 + 0.143 \times 0.266$). By contrast, for a pre-crisis $BonusShare_{g,2007}$ of zero, the marginal effect of $\Delta ST$ *Debt Funding 2008*$_{b(g)}$ equals 0.005 and is statistically insignificant. Employees with a bonus share of zero only receive a guaranteed fixed salary and do not contribute to risk sharing when short-term debt funding dries up.

It is reasonable to assume that the crisis affected banks' financial constraints as well as employees' participation constraints simultaneously. Deteriorating outside options and reservation wages of finance employees could partly explain pay reductions in 2008. To control for this labor market mechanism, one should ideally compare employees that work for constrained and uncon-

strained banks but belong to the same labor market and experience an identical crisis shock to their participation constraints. We believe that our regression comes reasonably close to such a setting as division × hierarchy × age × tenure fixed effects should span most labor market segments. However, one could still be concerned that these fixed effects fail to control for employees' education, skill, or innate productivity, which could all covary with employees' outside options.[23] Our analysis addresses this concern in three ways.

First, we include bank fixed effects in Column (4) and, hence, control for unobserved employee differences at the level of a bank's entire workforce. This should alleviate concerns that some banks systematically hire the most productive and skilled employees, for example, because these banks have a higher reputation and can attract the best university graduates. Conditionally on bank fixed effects, identification in Column (4) then relies on variation in pre-crisis bonus shares across employee groups within a given bank. We find that the coefficient of the interaction between pre-crisis $Bonus\ Share_{2007}$ and $\Delta ST\ Debt\ Funding\ 2008_{b(g)}$ remains positive and significant.

Second, the interacted hierarchy fixed effects in Eq. (25) should go a long way in controlling for differences in employee productivity. As discussed in Section 4.1, the pay consultancy (our data provider) assigns hierarchy levels based on employees' capabilities and skills. It undertakes this assignment for the same purpose that we are using the data for, namely to benchmark the compensation of a given employee to that of workers with similar capabilities (and similar job position, age, and tenure). This benchmarking service provides the consultancy's clients with informative estimates of employees' market rates precisely because the data allow the consultancy to compare employees in the same labor market segment. We also note that, for this purpose, it is not necessary to measure employee productivity and skill perfectly, but only to the extent that they are observable and priced in the labor market.

Third, we show in Section 7 that the constrained banks in 2008 did not pay higher or lower salaries *before the crisis* than banks that are unconstrained in 2008. If the constrained banks in 2008 were employing, for example, systematically less qualified/productive workers (with worse outside options), then we would expect them to pay lower salaries already before the crisis than the unconstrained banks. This is not the case. Finally, we use a subsample of employees with unique identifiers to show in Section 7 that the bank and the division × hierarchy × age × tenure

[23] We thank an anonymous referee for raising this point.

fixed effects in Table 4 control for unobserved heterogeneity similarly well as employee fixed effects.

Overall, we are confident to control successfully for the crisis shock to employees' participation constraints in Columns (3) and (4). The positive interaction terms suggest that banks' financial constraints partly explain pay reductions in 2008, and that this mechanism works through the bonus component of employee pay. This result is robust if we replace $\Delta ST\ Debt\ Funding\ 2008_{b(g)}$ by alternative proxies for banks' funding conditions. In Column (5), we use changes in banks' off-balance sheet activity in 2008 because bank investments into the U.S. subprime market had often been financed through off-balance sheet vehicles like asset-backed commercial paper conduits—many of which experienced funding dry-ups in the crisis. In Column (6), we consider changes in banks' cash holdings because they are part of banks' total financial resources in the model.

## 6.3 Within-Bank Risk Sharing

The compensation literature often portrays bonuses as incentive pay needed to curb moral hazard in job positions with high levels of unobservable effort (see Section 2). For example, for certain employees, large pay reductions in 2008 could be punishment for weak performance. In this section, we try to delineate further the risk sharing from the incentive pay hypothesis. Following Predictions 3 and 4, we test whether earnings shocks that are beyond the control of individual employees affect their bonus pay, which would be consistent with within-bank risk sharing, but less with purely incentive-based theories of optimal compensation.

### 6.3.1 Risk Sharing Across Bank Divisions

The universal bank model prevalent in Austria, Germany and Switzerland implies that banks combine different activities under the same roof. The traditional loan business is often complemented by trading activities in financial markets and annual accounting profits are reported separately for both activities. The traditional incentive view on variable pay predicts that an employee's bonus should covary with the operating performance of the division that she or he is working in, but not with the operating performance of other bank divisions. More generally, bonuses should reward individual or team performance, but should not depend on factors beyond the employee's control.

By contrast, our risk sharing hypothesis of bank bonus pay implies that *all* employees share some of the risk of lower bank-wide earnings through bonus pay reductions (Prediction 3). Risk

sharing at the bank level implies that higher operating performance in one division has repercussions for the bonus pay in an unrelated division. For example, higher trading profits imply a higher bonus share not only for those working in treasury management/capital market (D8) and investment banking (D7), but also spill over into a larger bonus share for those employees working in the loan business (D3 and D4) or even in internal service divisions (D1 and D2). In the extreme case of complete risk sharing we predict that the performance sensitivity of bonus pay is identical across divisions and with respect to any earnings source.

Table 5 provides evidence for such risk sharing across bank divisions. Considering all sample years 2003 to 2010, we regress employees' bonus shares on *Trading Income/Employees* and on *Lending Income/Employees*, defined as (per capita) trading income and (per capita) interest income less changes in loan loss provisions, respectively. To begin, Table 5 focuses on a parsimonious model with only bank × division × hierarchy fixed effects, which we will refine later. The specification in Column (1) is estimated based on employee-year observations from all divisions D1 to D8 in the regression sample. We find that both income variables have (similar) positive and statistically significant point estimates. When lending or trading businesses generate €1m higher income per bank employee, (standardized) bonuses of employees across all bank functions increase by, on average, 2.6 and 2 percentage points, respectively.

In Column (2), we restrict the sample to employee-years in Logistical (D1) and Headquarter Services (D2). Standardized lending and trading income have significant and similar point estimates of 1.2 and 1.3 percentage points. Thus, an increase in lending income by €1m has roughly the same effect on bonus shares in Internal Services as an increase in trading income by €1m. This finding is fully consistent with the risk sharing hypothesis, which predicts a positive relation between bonus shares and *bank-wide* earnings, which themselves are directly proportional to trading and lending income. By contrast, pure incentive pay theories (without risk sharing) cannot easily rationalize the rather strong income-sensitivity of bonus pay in Internal Services. Although service employees provide internal support to front office operations, income generation remains largely beyond their direct control. As human resources, accounting, communications, etc. never interfere directly with lending or trading decisions, punishing or rewarding them for low or high operating income will produce only weak (if any) incentive effects.

In Columns (3) to (5), we study the income-sensitivities of bonus pay in banks' operating units

themselves. In Column (3), we only consider employee-years from Loan Business (i.e., D3 Retail Banking and D4 Corporate Banking). Unsurprisingly, the point estimate for lending income at 0.032 is larger than for trading income at 0.013—suggesting that performance-related incentive pay does matter. Yet, bonus shares in the Loan Business segment also covary significantly with trading income even though loan officers exercise no control over trading performance. The point estimate of 0.013 suggests that an additional €1m of trading income per capita has a similar effect on the bonus shares in the Loan Business segment as on the bonus shares in Internal Services. When focusing on Trading Business in Column (4), we observe a larger coefficient estimate for trading than for lending income, which is again consistent with theories of incentive pay. Consistent with risk sharing, traders' estimated bonus sensitivity to lending income is positive, but imprecisely estimated and, hence, statistically insignificant. Finally, Column (5) shows results for employees in Wealth Management, which provide financial services to high-net-worth individuals and institutional investors. Again, we find that their bonus shares covary with lending as well as (proprietary) bank trading income.

Again, we acknowledge that changes in employees' participation constraints could confound the analysis in Table 5. For example, the 2008-2009 financial crisis likely changed income generation as well as outside options simultaneously. To address this concern, we refine the analysis in three ways. First, we drop employee-years after 2007 from the sample to eliminate all possible influence of the financial crisis. Second, we condition all estimates on interacted division $\times$ hierarchy $\times$ age $\times$ tenure $\times$ year fixed effects. Again, the underlying assumption is that employees that are comparable along these characteristics have similar outside options in the labor market. The interaction with year fixed effects allows for the possibility that employees' outside options in a given labor market segment are time-varying. Third, we include employee fixed effects to control for any time-invariant employee characteristics that correlate with employees' outside options, such as innate employee productivity.

The refined specification is reported in Table 6. In Column (1), dropping the crisis years and all employee observations without a unique identifier reduces sample size from 906,707 employee-year observations and 82 banks in Table 5 to 122,486 observations and 12 banks in Table 6. The small number of banks makes it problematic to cluster standard errors at the bank level as the asymptotic, cluster-robust estimate of the covariance matrix converges only for a sufficiently large

number of clusters. Therefore, we report two sets of standard errors. In Panel A of Table 6, we calculate two-way standard errors clustered by bank and by labor market (like in Table 5). In Panel B, we cluster only by labor market (by division × hierarchy × age × tenure). Considering the small number of banks, we also drop the bank-level control variables to avoid overspecification.

We find that our findings from the full sample analysis in Table 5 are qualitatively robust in Table 6. The bonus sensitivity to lending and trading income remains positive for employees in all bank divisions, suggesting again that income risk is shared across employees in internal services, lending, trading, and wealth management. For the average employee (Column (1)), lending and trading income have significant marginal effects of 8.2 and 7.8 percentage points on bonus pay.

One remaining concern could be that the regressors *Lending Income/Employees* and *Trading Income/Employees* are endogenous because employees that generate lower income have worse outside options in the labor market. However, we believe that this alternative hypothesis is unlikely to explain bonus sensitivities *across* divisions. For example, we see no reason why traders' outside options in the labor market would deteriorate when loan officers perform worse.[24] To strengthen our analysis further, we replace both income variables with the variable $\Delta$ *LLP/Employees*, which is defined as the annual, per-capita change in loan loss provisions. Although loan losses may not be perfectly exogenous either, loan defaults before the crisis still tend to be more idiosyncratic and are hopefully uncorrelated with the labor markets of most bank employees. Consistent with risk sharing, Table 7 shows that an increase in loan losses decreases the bonus pay in bank divisions that are not involved in lending decisions.

### 6.3.2 Risk Sharing by Employee Group in the Crisis

The 2008-09 financial crisis represents a common negative shock that was transmitted to the European banking sector through exposures in the US subprime market. The crisis fully reached Austria, Germany, and Switzerland in 2008 when loan loss provisions rose sharply and the average bank incurred a trading loss of €287.5m (Internet Appendix, Figure II). But even those banks that did not incur large losses themselves were affected by a spike in economic uncertainty and worsening funding access.

[24]Income and labor markets could also be driven simultaneously by macroeconomic variables like the interest rate in the economy. The (interacted) year fixed effects should control for these macroeconomic factors.

The risk sharing and the incentive pay hypotheses make different predictions regarding the effect of the crisis on bonus pay. The former posits that banks should respond to the crisis with bonus cuts for all employees independently of their individual performance (Prediction 4). In particular, even the bonuses of employees that carry little or no responsibility for the crisis exposure of their banks should decline in 2008. By contrast, the incentive pay hypothesis predicts that employees suffer bonus cuts in 2008 only to the extent that they are partially responsible for the crisis exposure of their employer.

Figure 4 plots year fixed effects of (standardized) bonus pay, which we estimate in the panel regressions of Table 5 augmented by a vector of binary year indicators. The four graphs for the functional areas Internal Services, Loan Business, Trading Business and Wealth Management show a decline of the average divisional bonus share after 2007. For example, employees in Internal Services saw their share of bonus pay decline by approximately 3 percentage points during the crisis, which is large relative to the sample medians of 5% and 9% in Logistical and Headquarter Services, respectively (Table 1, Panel B). We argue that there is little reason to believe that performance in these job positions is pro-cyclical. Hence, the decline in bonus shares in Internal Services is more easily explained by the risk sharing than by the incentive pay hypothesis.

Turning to the income-generating units in banks (Figure 4, Panels B to D), we also observe a strong decline in bonus pay. For example, employees in Trading Business (Panel C) saw their bonus share drop by roughly 30 percentage points in 2008. Hence, traders suffer a much stronger reduction in (standardized) bonus pay than, for example, their colleagues in Internal Services (Panel A). This can be rationalized with Corollary 2 in Section 3.1, which states that employees with a higher incentive pay component are relatively more sensitive to bank-wide shocks.

For the trading business (and other income-generating units), the sharp decline in bonus pay after 2007 is consistent with both the risk sharing as well as the incentive pay hypothesis, as performance in trading deteriorated rapidly in 2008. However, we note that the year fixed effects in Figure 4 are estimated conditionally on trading income. Similarly, the sharp drop of bonus shares in Loan Business (Panel B of Figure 4) is estimated conditionally on lending income. Evidently, banks cut bonuses in these income-generating divisions to an extent that cannot be fully explained by the observed drop in divisional performance.

Again, we acknowledge that the crisis likely affected compensation through risk sharing and

through the labor market. However, while both effects may jointly explain the bonus cuts in banks' front offices (Panels B to D), the labor market channel less likely explains the bonus cuts in banks' internal service divisions (Panel A). Accountants, human resources, IT experts, and other service functions in banks belong to a larger job market with employment options outside the financial industry. Studying administrative data from the German Federal Employment Agency, we show that compensation in these occupations did not decline outside the financial industry: Figure 5 compares the evolution of gross wages (including bonus pay) in service functions like accounting, IT, etc. inside and outside the financial industry. Whereas service employees in financial firms experienced a significant wage cut during the crisis, no such wage cut is registered for employees that work in identical professions but for non-financial firms. This suggests that pay reductions in banks' service divisions are indeed driven by banks' financial constraints and not by the labor market.[25]

We conduct two robustness checks regarding the bonus pay dynamics in the crisis. First, we drop all accounting variables from the regression, which increases the sample from 64-82 banks in Figure 4 (Table 5) to 135-248 banks depending on the functional area. Second, we show that even the junior employees, who rarely make or influence strategic decisions with regard to the crisis exposure of their banks, suffer bonus cuts in 2008.[26] The regression estimates of these robustness tests are shown in Table III of the Internet Appendix.

Overall, the evidence is consistent with the hypothesis that banks responded to worsening sector-wide profitability, spiking economic uncertainty, and a tightening of external funding conditions in 2008 with a bank-wide reduction of bonuses—irrespective of employees' individual performance or contribution to their employers' crisis exposure.

# 7 Additional Robustness Tests

We showed in Table 4 of Section 6.2 that bonus pay reduces operating leverage and allows financially constrained banks to reduce labor costs in the crisis. Identification relied on the assumption

[25]Internet Appendix B describes the data of the German Federal Employment Agency for Figure 5.

[26]Indeed, the Principles for Sound Compensation Practices of the Financial Stability Board (FSB) consider sufficient seniority as an important characteristic of "material risk takers" defined as employees with "the potential to expose the firm to significant risk"(Financial Stability Board 2017, p.24). We call employees "junior" if they are employed at the bottom three levels of the employment hierarchy.

that division × hierarchy × age × tenure fixed effects control for employees' outside options in the labor market. In this section, we address concerns that these fixed effect do not perfectly control for employee productivity, which likely covaries with employees' outside options.

In competitive labor markets, more productive employees should receive higher compensation. In Table 8, we consider (log) total compensation *before the crisis* as a proxy for the productivity of employees with given observable characteristics. We test whether employees in banks that are constrained or unconstrained in 2008 received different compensation $w_{2007}$ in 2007. To distinguish between constrained and unconstrained banks, we split the sample at the medians of our different measures of banks' financial constraints. Table 8 shows that employee productivity, as proxied by compensation in 2007, is similar across banks that are constrained or unconstrained in 2008.

When we study risk sharing across divisions in Tables 6 and 7, we use employee fixed effects to control for innate productivity and other time-invariant heterogeneity. In our crisis analysis in Table 4, this is impossible because our subsample with unique employee identifiers ends already in 2007. Instead, Table 4 conditions only on bank and division × hierarchy × age × tenure fixed effects. We show now that, at least before 2008, these fixed effects explain pay variation similarly well as employee fixed effects.

In Table 9, we regress $\Delta w$ (the dependent variable in Table 4) on different sets of fixed effects. Column (1) shows that bank and division × hierarchy × age × tenure fixed effects explain 15% or 14% of variation depending on whether we consider the simple or the adjusted $R^2$. When we add employee fixed effects in Column (2), the simple $R^2$ triples. However, the high value of 46% exaggerates the goodness-of-fit because the simple $R^2$ increases mechanically (never decreases) in the number of regressors. The adjusted $R^2$, which is better suited to compare models with different numbers of parameters, actually decreases from Column (1) to Column (2). This suggests that bank and division × hierarchy × age × tenure fixed effects explain pay variation at least as well as employee fixed effects. This result is robust when we further interact with year fixed effects in Columns (3) to (6) to absorb time variation, which is absent in our cross-sectional regression of Table 4. Finally, we show in Table IV of the Internet Appendix that the share of pay variation explained by employee fixed effects is similar for constrained and unconstrained banks.[27]

[27]First, we estimate separately for each bank the share of pay variation explained by employee fixed effects. Then, we test whether this $R^2(\textit{Employee FE})_b$ is different for constrained and unconstrained banks.

# 8 Conclusion

This paper proposes a complementary interpretation of banker bonuses as a risk sharing contract between shareholders and employees. In the presence of financial constraints, shareholder value becomes concave in internal cash and the wage bill exhibits some degree of optimal risk sharing between employees and shareholders. In other words: bonus pay is a mechanism to reduce operating leverage, limiting the need to raise costly capital in times of distress, and thus procures financial benefits that can be shared between employees and shareholders.

To verify the empirical validity of this risk sharing motive of bonus pay in banking, we use granular payroll data for employees below the executive level in all functional areas of Austrian, German, and Swiss banks. We show that the dominant interpretation of banker bonuses as incentive pay is incomplete and cannot explain several novel findings uncovered in our analysis. In particular, we find that (i) bonus pay is prevalent at all hierarchy levels and in all occupations including support functions without any discernible direct contribution to operating performance; (ii) for the majority of bank employees, pay variation due to risk sharing motives and due to incentive motives are of similar quantitative importance; (iii) the bonus pay of a given bank employee is sensitive to earnings shocks beyond his control — i.e. to earnings shocks that originate in other bank divisions; and (iv) the financial crisis triggered a considerable bank-wide reduction in bonus pay even for employees that were not responsible for the crisis exposure of their bank.

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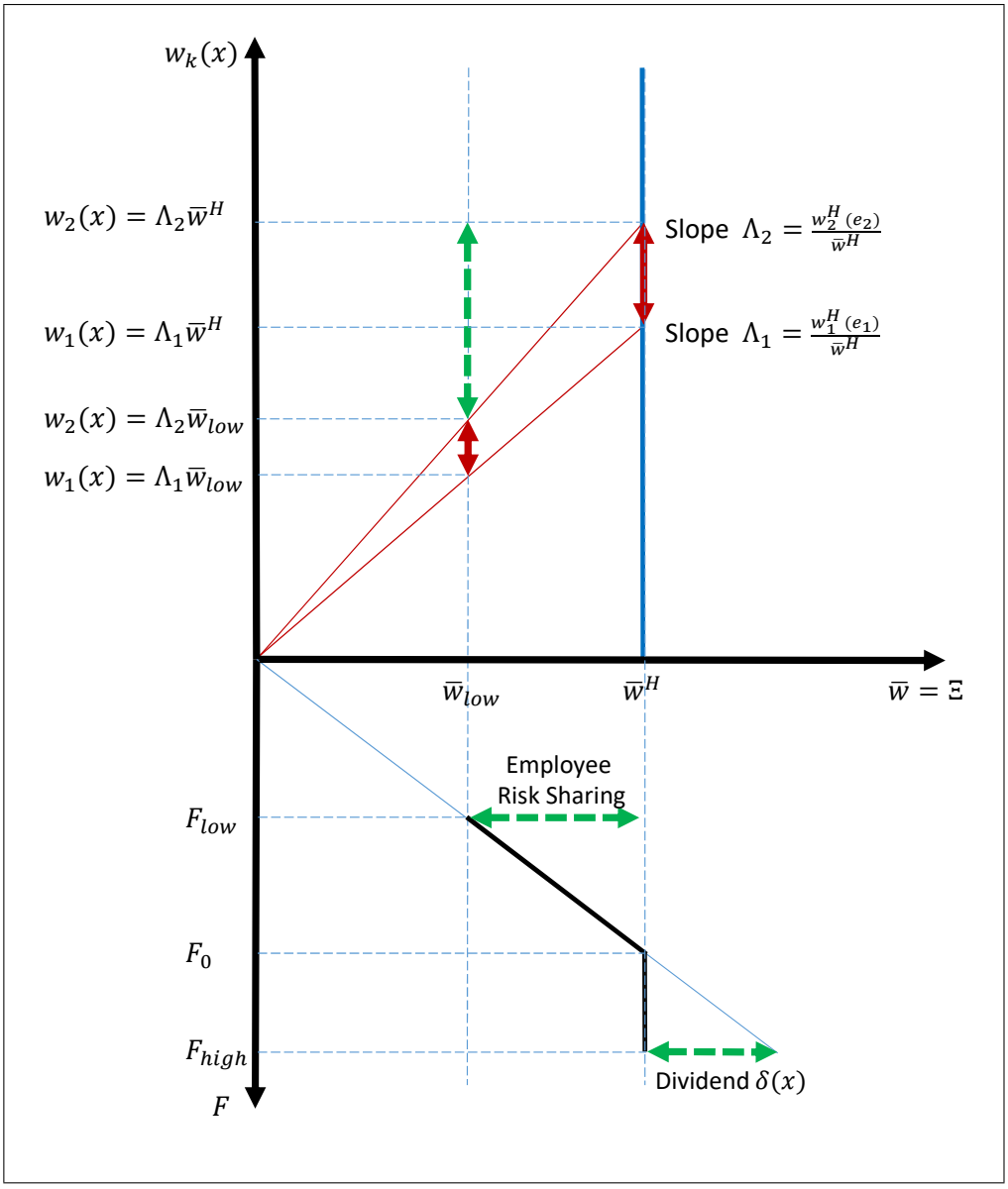


Figure 1: This graph illustrates our extension of the incentive model by Holmström (1979) to a firm or bank that is subject to refinancing frictions. Shown is the variable compensation $w_k(x)$ of two employees $k = 1, 2$. $w_k(x)$ equals the product of two terms. The first term is the average compensation $\Xi = \overline{w}$ (horizontal axis) that the bank pays to its $n$ employees ($n > 2$). This average wage $\overline{w}$ is an increasing function of the bank's total financial resources $F$. The second term of the product is the employee's relative Holmström compensation $\Lambda_k = \frac{w_k^H}{\overline{w}^H}$, which is defined for unconstrained states with $F \geq F_0$. Constrained banks with $F < F_0$ suspend dividends to shareholders and scale down $\Lambda_k$ by $\overline{w}$.

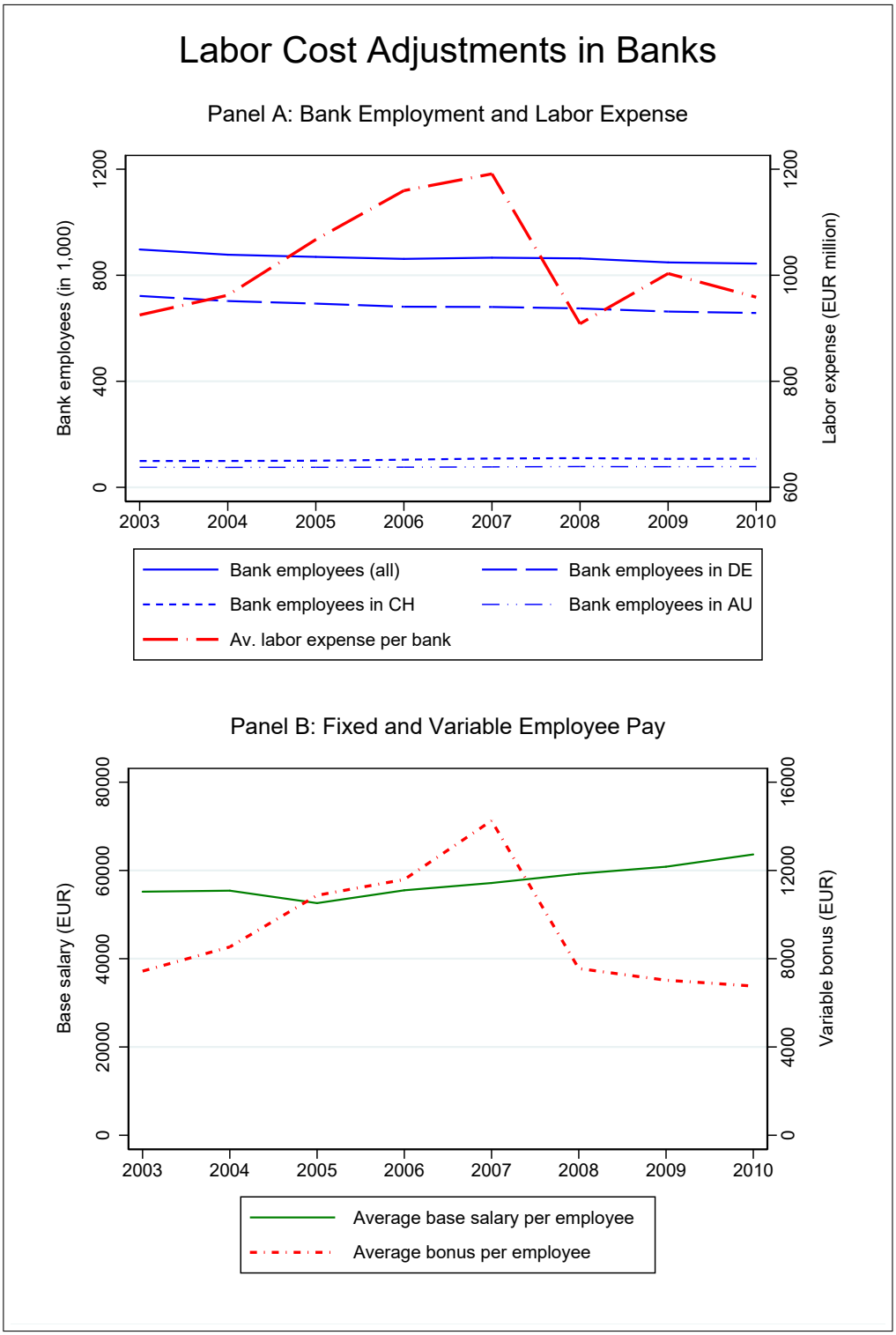


Figure 2: Panel A plots employment numbers at the country level and labor expenses of the average bank in our sample. Panel B plots the fixed base salary and variable bonus of the average bank employee in our sample. Employment numbers are sourced from the websites of national bank associations and chambers of commerce; bank-wide labor costs (including pension obligations) from Bankscope (Bureau van Dijk); and base and bonus pay of employees are sourced from Willis Towers Watson. Average labor expense, base and bonus pay are only calculated based on banks with data in all sample years.

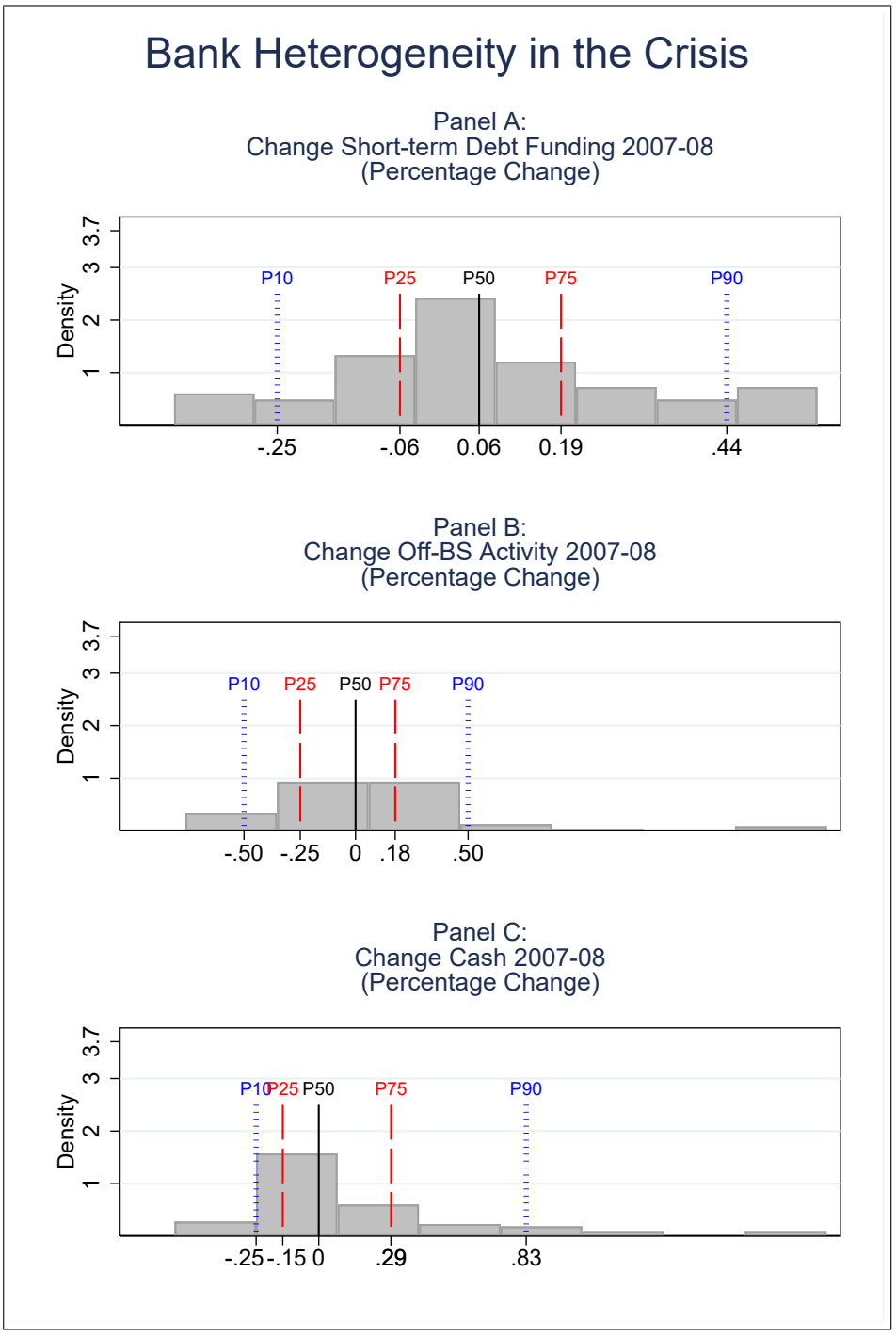


Figure 3: Panels A to C show histograms for three bank variables that capture the crisis shock to banks' financial (funding) constraints. *Change Short-term Debt Funding* measures the percentage change in short-term debt funding (deposits and wholesale debt) from 2007 to 2008, *Change Off-BS Activity* the percentage change in off-balance sheet activity, and *Change Cash* the change in cash holdings.

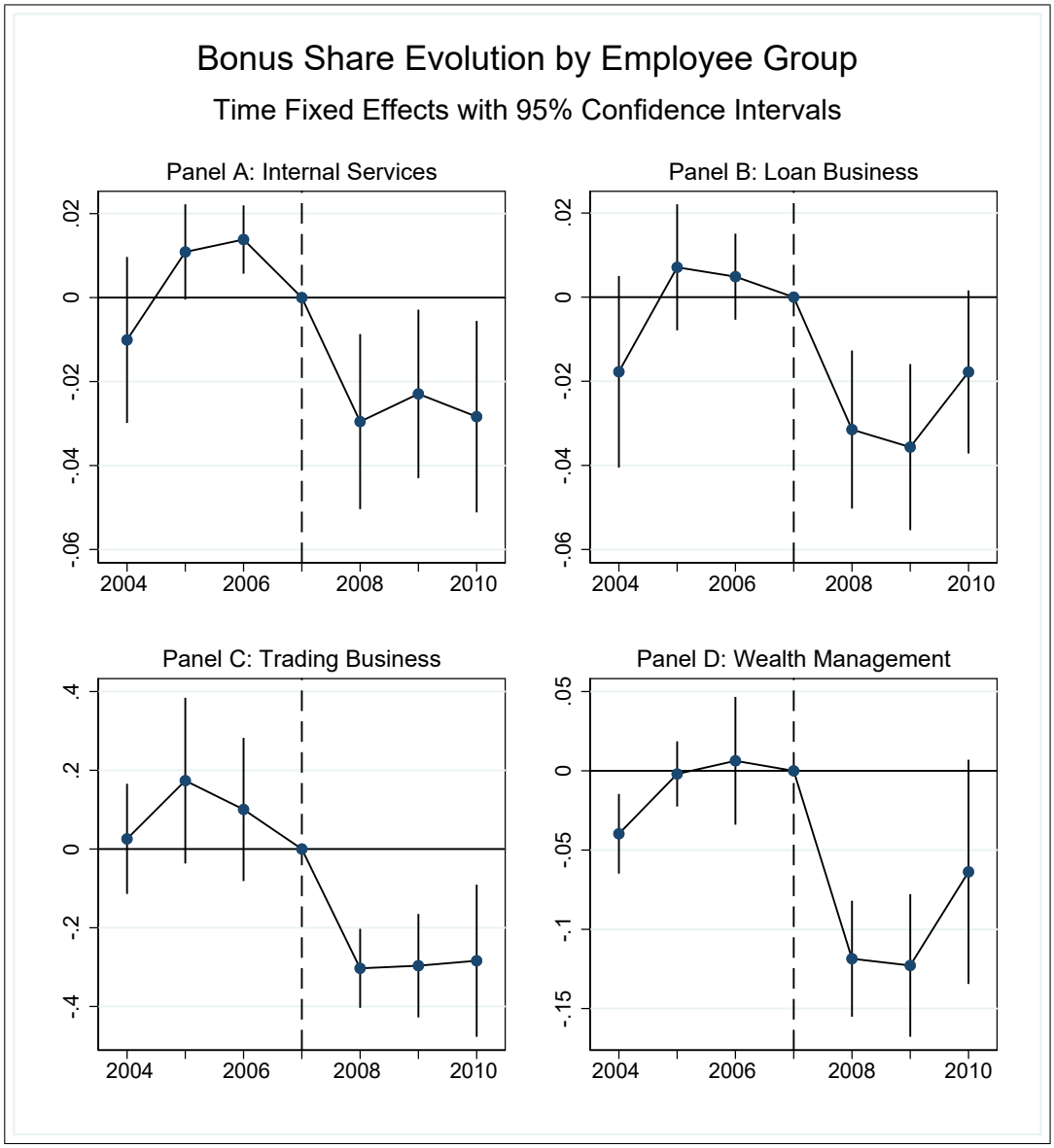


Figure 4: We show the effect of the financial crisis on employees' bonus shares in the four different functional areas defined in Table 1. Panel A shows the crisis effect for bank employees in Internal Support Services. Panels B to D show similar graphs for employees in Loan Business (Panel B), Trading Business (Panel C), and Wealth Management (Panel D). The plotted year fixed effects are estimated in the panel regressions of Table 5 augmented by a vector of binary year indicators. We show the 95%-confidence interval around the point estimate.

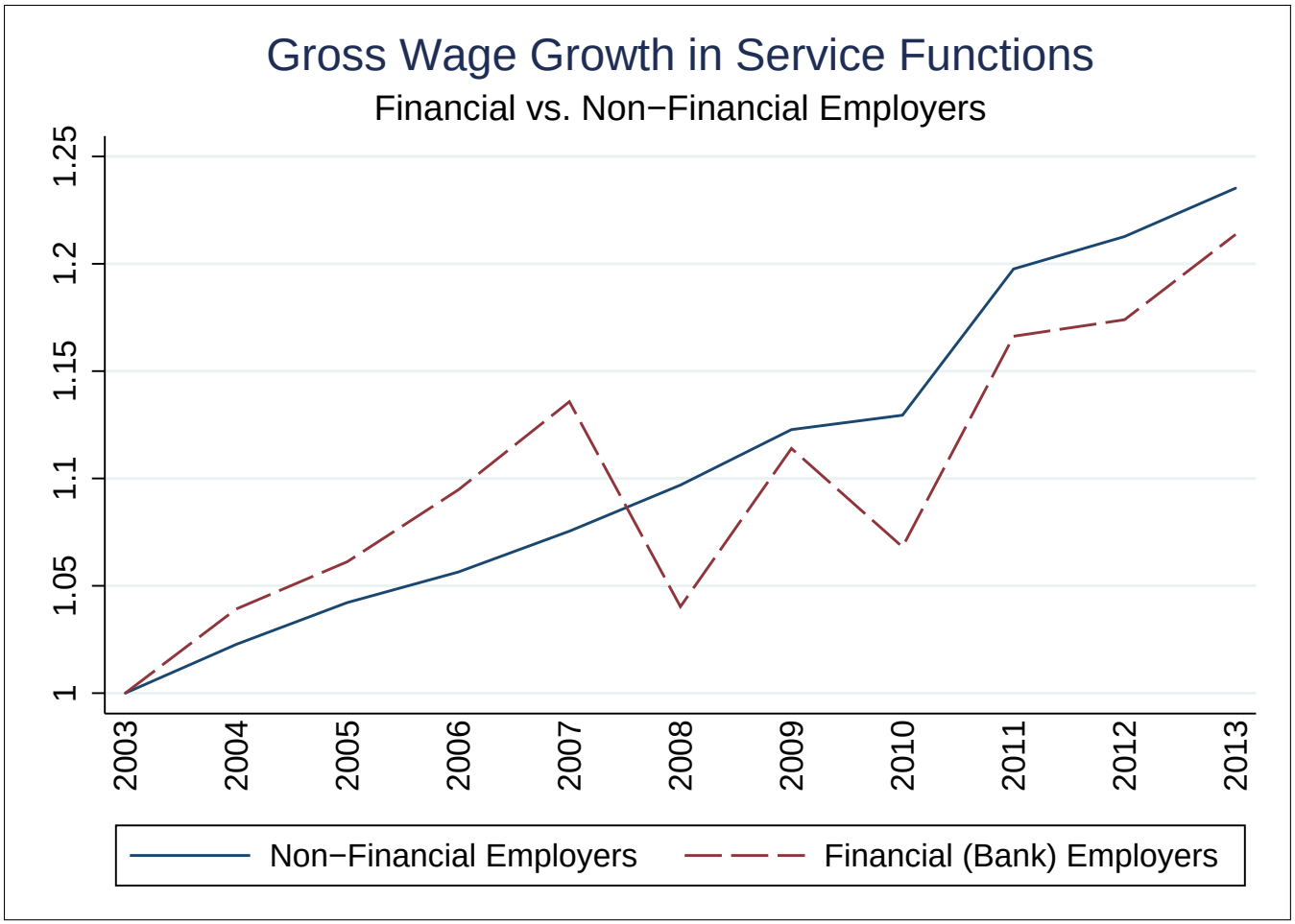


Figure 5: We show the evolution of daily gross wages (including bonus pay) of employees in service functions like accounting, IT, etc. employed inside and outside the financial industry. The graphs are calculated based on administrative data of the German Federal Employment Agency (DOI: 10.5164/IAB.LIABQM29319.de.en.v1). Internet Appendix B describes the data in detail.

**Table 1: Summary Statistics**

Panel A reports summary statistics at the employee-year level drawn from payroll records of 54 Austrian, 185 German, and 88 Swiss banks over the period 2003-2010. Total compensation $w$ is the sum of the annual fixed base salary $\underline{w}$ and the year-end *Bonus* (in EUR). The *Bonus Share* is defined as the ratio of *Bonus* to $\underline{w}$. Panel B reports the same summary statistics as in Panel A for the subsample of employee-year observations with unique employee identifiers (only 2003-2007). Panel C reports summary statistics for employees in eight different bank divisions (D1-D8) for the full sample of Panel A (2003-2010). We aggregate Logistical and HQ (headquarter) Services to Internal Services, Retail and Corporate Banking to Loan Business, Private Banking and Asset Management to Wealth Management, and Investment Banking and Treasury Management/Capital Markets to Trading Business. We report separate statistics for employees at the three lowest (juniors) and three highest (seniors) hierarchy levels. The bank-year statistics in Panel D are sourced from Bankscope. *Lending Income/Employees* is defined as interest income minus changes in loan loss provisions ($\Delta$LLP) standardized by bank-wide employment; *Trading Income/Employees* is calculated as trading income standardized by bank-wide employment.

Panel A: Employee-year statistics in the full sample (2003-2010)

| | Obs. | Mean | STD | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $w$ (Total Compensation) | 1,261,693 | 70,095 | 42,397 | 38,766 | 46,367 | 59,196 | 79,624 | 110,849 |
| $\underline{w}$ (Base Salary) | 1,262,994 | 60,014 | 23,639 | 37,068 | 44,092 | 54,648 | 69,882 | 89,195 |
| *Bonus* | 1,269,208 | 10,138 | 24,785 | 0 | 942 | 3,873 | 9,522 | 23,478 |
| *Bonus Share* | 1,262,145 | 0.129 | 0.209 | 0.000 | 0.020 | 0.077 | 0.152 | 0.302 |
| *Tenure* | 1,196,031 | 13 | 10 | 2 | 5 | 11 | 19 | 28 |
| *Age* | 1,096,976 | 41 | 9 | 28 | 34 | 41 | 48 | 54 |

Panel B: Employee-year statistics in the employee panel (2003-2007)

| | Obs. | Mean | STD | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $w$ (Total Compensation) | 124,632 | 64,023 | 44,042 | 36,755 | 42,892 | 53,263 | 72,600 | 97,375 |
| $\underline{w}$ (Base Salary) | 124,632 | 53,451 | 19,547 | 34,905 | 40,820 | 49,261 | 61,490 | 76,700 |
| *Bonus* | 124,632 | 10,688 | 30,589 | 0 | 968 | 4,840 | 10,563 | 22,000 |
| *Bonus Share* | 124,632 | 0.151 | 0.254 | 0.000 | 0.024 | 0.108 | 0.179 | 0.323 |
| *Tenure* | 103,745 | 15 | 10 | 4 | 7 | 15 | 21 | 30 |
| *Age* | 114,817 | 41 | 9 | 29 | 35 | 41 | 48 | 53 |

*Table 1 continued*

Panel C: Bonus share and base salary by bank division in the full sample (2003-2010)

| | *Bonus Share* | | | | *Base Salary* | | | |
|---|---|---|---|---|---|---|---|---|
| | Obs. | Mean | STD | P50 | Obs. | Mean | STD | P50 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Internal Services | | | | | | | | |
| D1 Logistical Services | 288,580 | 0.068 | 0.078 | 0.051 | 288,591 | 49,365 | 15,154 | 46,500 |
| D2 HQ Services | 371,715 | 0.133 | 0.145 | 0.091 | 371,970 | 67,631 | 21,834 | 63,600 |
| Loan Business | | | | | | | | |
| D3 Retail Banking | 374,658 | 0.083 | 0.094 | 0.066 | 374,820 | 49,590 | 14,581 | 46,980 |
| D4 Corp. Banking | 58,469 | 0.182 | 0.188 | 0.127 | 58,462 | 72,183 | 24,640 | 67,340 |
| Wealth Management | | | | | | | | |
| D5 Private Banking | 78,356 | 0.265 | 0.290 | 0.169 | 78,361 | 78,615 | 28,727 | 73,332 |
| D6 Asset Mgmt. | 22,112 | 0.366 | 0.377 | 0.263 | 22,520 | 84,863 | 30,449 | 80,000 |
| Trading Business | | | | | | | | |
| D7 Invest. Banking | 13,086 | 0.420 | 0.614 | 0.212 | 13,086 | 89,696 | 37,894 | 80,042 |
| D8 Treasury/Markets | 37,004 | 0.427 | 0.650 | 0.191 | 37,003 | 86,068 | 36,859 | 77,700 |
| Junior employees | 742,758 | 0.062 | 0.076 | 0.049 | 742,943 | 47,489 | 11,676 | 46,345 |
| Senior employees | 519,387 | 0.225 | 0.287 | 0.152 | 520,051 | 77,906 | 24,863 | 71,980 |

Panel D: Bank-year statistics (2003-2010)

| | Obs. | Mean | STD | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Assets (in EUR million)* | 273 | 171,465 | 378,978 | 2,891 | 8,251 | 40,165 | 158,889 | 357,657 |
| *Log Assets* | 273 | 10.504 | 1.897 | 7.969 | 9.018 | 10.601 | 11.976 | 12.787 |
| *Deposits/Assets* | 273 | 0.706 | 0.175 | 0.449 | 0.605 | 0.715 | 0.851 | 0.911 |
| *Loans/Assets* | 273 | 0.393 | 0.234 | 0.073 | 0.206 | 0.371 | 0.568 | 0.716 |
| *Equity/Assets* | 273 | 0.055 | 0.038 | 0.019 | 0.029 | 0.042 | 0.070 | 0.105 |
| *Trading Income/Employees* | 273 | 0.016 | 0.258 | −0.015 | 0.000 | 0.004 | 0.032 | 0.128 |
| *Lending Income/Employees* | 273 | 1.629 | 1.784 | 0.162 | 0.339 | 0.857 | 2.355 | 4.584 |
| *(Lending+Trading Income)/Employees* | 273 | 1.703 | 1.947 | 0.174 | 0.359 | 0.847 | 2.268 | 4.585 |
| $\Delta$ *LLP/Employees* | 273 | 0.027 | 0.312 | -0.085 | -0.017 | 0.000 | 0.024 | 0.114 |

**Table 2: Determinants of Bank Employee Pay**

We report coefficient estimates of panel regressions. We regress employees (log) total compensation $\ln w_{k,t}$ in Columns (1) to (3) and their bonus shares *Bonus Share*$_{k,t}$ in Columns (4) to (6) on quadratic polynomials of employees' age and tenure as well as on categorical variables for employees' hierarchy level and job division. All specifications include year and bank fixed effects. Robust standard errors are clustered by bank and reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | Log $\omega$ | | | *Bonus Share* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Age / 10 | 0.354*** | | 0.357*** | 0.058*** | | 0.031*** |
| | (0.015) | | (0.018) | (0.010) | | (0.006) |
| (Age / 10)$^2$ | -0.035*** | | -0.036*** | -0.007*** | | -0.005*** |
| | (0.002) | | (0.002) | (0.001) | | (0.001) |
| Tenure / 10 | | 0.072*** | 0.003 | | 0.035*** | 0.034*** |
| | | (0.006) | (0.005) | | (0.009) | (0.010) |
| (Tenure / 10)$^2$ | | -0.009*** | 0.002 | | -0.009*** | -0.008*** |
| | | (0.001) | (0.001) | | (0.002) | (0.002) |
| Hierarchy FE relative to level 1: | | | | | | |
| Hierarchy 2 | 0.137*** | 0.150*** | 0.135*** | 0.008 | 0.009* | 0.007 |
| | (0.010) | (0.010) | (0.009) | (0.006) | (0.006) | (0.005) |
| Hierarchy 3 | 0.312*** | 0.343*** | 0.310*** | 0.023*** | 0.025*** | 0.022*** |
| | (0.011) | (0.011) | (0.010) | (0.008) | (0.008) | (0.008) |
| Hierarchy 4 | 0.532*** | 0.579*** | 0.530*** | 0.079*** | 0.081*** | 0.079*** |
| | (0.014) | (0.015) | (0.014) | (0.014) | (0.014) | (0.014) |
| Hierarchy 5 | 0.822*** | 0.879*** | 0.820*** | 0.200*** | 0.200*** | 0.199*** |
| | (0.020) | (0.023) | (0.020) | (0.028) | (0.027) | (0.028) |
| Hierarchy 6 | 1.217*** | 1.280*** | 1.216*** | 0.400*** | 0.398*** | 0.399*** |
| | (0.021) | (0.023) | (0.021) | (0.044) | (0.042) | (0.044) |
| Bank division FE relative to logistical services: | | | | | | |
| HQ Services | 0.073*** | 0.068*** | 0.075*** | 0.002 | 0.005 | 0.004 |
| | (0.007) | (0.008) | (0.008) | (0.005) | (0.004) | (0.005) |
| Retail Banking | 0.032*** | 0.011 | 0.031*** | 0.002 | 0.004 | 0.002 |
| | (0.011) | (0.012) | (0.011) | (0.005) | (0.006) | (0.006) |
| Corporate Banking | 0.115*** | 0.102*** | 0.116*** | 0.022*** | 0.024*** | 0.023*** |
| | (0.012) | (0.013) | (0.012) | (0.008) | (0.007) | (0.007) |
| Private Banking | 0.153*** | 0.140*** | 0.154*** | 0.095*** | 0.099*** | 0.097*** |
| | (0.020) | (0.020) | (0.020) | (0.030) | (0.031) | (0.030) |
| Asset Management | 0.272*** | 0.266*** | 0.274*** | 0.155*** | 0.162*** | 0.160*** |
| | (0.020) | (0.021) | (0.020) | (0.026) | (0.026) | (0.026) |
| Investment Banking | 0.336*** | 0.326*** | 0.339*** | 0.196*** | 0.203*** | 0.201*** |
| | (0.033) | (0.033) | (0.033) | (0.043) | (0.043) | (0.043) |
| Treasury/Markets | 0.365*** | 0.352*** | 0.367*** | 0.257*** | 0.262*** | 0.260*** |
| | (0.021) | (0.021) | (0.021) | (0.035) | (0.036) | (0.035) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 1,045,077 | 1,045,077 | 1,045,077 | 1,045,416 | 1,045,416 | 1,045,416 |
| No. of banks | 248 | 248 | 248 | 248 | 248 | 248 |
| Adjusted $R^2$ | 0.81 | 0.81 | 0.79 | 0.42 | 0.42 | 0.42 |

**Table 3: Variance Decomposition of Employee Pay**

We decompose the part of (log) pay variation that is not explained by a set $C$ of labor market proxies into its incentive pay and its risk sharing component. To this end, we first correct total annual compensation $w_{k,t}$ for variation explained by $C = Age \times Tenure \times Division \times Hierarchy \times Year\ FE$ and then calculate the variance of (log) residual pay $Var[\ln w_{k,t}\,|C]$ reported in Column (3). Columns (5), (6), and (7) report the percentage variance contribution of the incentive component $Var[\ln \Lambda_{k,t}\,|C]$, the risk sharing component $Var[\ln \Xi_{k,t}\,|C]$, and the covariance component $2Cov[\ln \Lambda\,|C\,, \ln \Xi\,|C]$. Column (4) shows the percentage variance contribution of each hierarchy level (Panel A) and each bank division (Panel B) to the overall variance calculated across all bank employees. Column (8) reports the variance ratio of the risk sharing component relative to the incentive component. Internet Appendix A describes the details of these calculations.

| | Observations | | (Log) Pay Variance | | Percentage Variance Contribution | | | Ratio |
|---|---|---|---|---|---|---|---|---|
| | | | | | Incentive Component | Risk Sharing Component | Covariance Component | |
| | Number | % | $Var[\ln w_{k,t}\,\|C]$ | (2)×(3) | $\frac{Var[\ln \Lambda_{k,t}\|C]}{Var[\ln w_{k,t}\|C]}$ | $\frac{Var[\ln \Xi_{k,t}\|C]}{Var[\ln w_{k,t}\|C]}$ | $\frac{2Cov[\ln \Lambda\|C\,,\ln \Xi\|C]}{Var[\ln w_{k,t}\|C]}$ | $\frac{Var[\ln \Xi_{k,t}\|C]}{Var[\ln \Lambda_{k,t}\|C]}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Panel A: Employee (log) total pay variance decomposition by hierarchy level | | | | | | | | |
| Hierarchy 1 (low) | 117,128 | 9% | 0.022 | 0.002 | 0.667 | 0.442 | -0.109 | 0.663 |
| Hierarchy 2 | 307,320 | 25% | 0.025 | 0.006 | 0.729 | 0.348 | -0.077 | 0.478 |
| Hierarchy 3 | 308,428 | 25% | 0.034 | 0.009 | 0.741 | 0.291 | -0.032 | 0.393 |
| Hierarchy 4 | 313,396 | 25% | 0.047 | 0.012 | 0.784 | 0.212 | 0.004 | 0.270 |
| Hierarchy 5 | 152,270 | 12% | 0.077 | 0.009 | 0.814 | 0.142 | 0.044 | 0.174 |
| Hierarchy 6 (high) | 44,507 | 4% | 0.090 | 0.003 | 0.872 | 0.126 | 0.002 | 0.145 |
| All | 1,243,049 | 100% | 0.041 | 0.041 | 0.776 | 0.239 | -0.015 | 0.308 |
| Panel B: Employee (log) total pay variance decomposition by bank division | | | | | | | | |
| Logistical Services | 288,284 | 23% | 0.035 | 0.008 | 0.664 | 0.342 | -0.006 | 0.514 |
| HQ Services | 371,616 | 30% | 0.043 | 0.013 | 0.727 | 0.245 | 0.028 | 0.338 |
| Retail Banking | 374,537 | 30% | 0.022 | 0.007 | 0.808 | 0.262 | -0.070 | 0.325 |
| Corp. Banking | 58,402 | 5% | 0.047 | 0.002 | 0.809 | 0.165 | 0.026 | 0.204 |
| Private Banking | 78,297 | 6% | 0.062 | 0.004 | 0.807 | 0.185 | 0.008 | 0.230 |
| Asset Mgmt. | 22,005 | 2% | 0.093 | 0.002 | 0.850 | 0.192 | -0.042 | 0.226 |
| Invest. Banking | 12,996 | 1% | 0.131 | 0.001 | 0.896 | 0.093 | 0.011 | 0.104 |
| Treasury/Markets | 36,912 | 3% | 0.155 | 0.005 | 0.879 | 0.076 | 0.045 | 0.086 |
| All | 1,243,049 | 100% | 0.041 | 0.041 | 0.776 | 0.239 | -0.015 | 0.308 |

**Table 4: Pre-Crisis Bonus Pay, Financial Constraints, and Labor Cost Reduction in the Crisis**

We report coefficient estimates of cross-sectional ordinary least squares regressions. One observation corresponds to a group $g$ of employees that work for the same bank, in the same division, and at the same hierarchy level and belong to the same age and tenure group. The dependent variable is the change of the mean total compensation of group $g$ between 2007 and 2008 $\Delta w_{g,2008} = (w_{g,2008} - w_{g,2007})/w_{g,2007}$ and regressed on the group's mean pre-crisis bonus share *Bonus Share*$_{g,2007}$. In Columns (3) to (6), we interact *Bonus Share*$_{g,2007}$ with three variables that capture the crisis shock to banks' financial constraints. $\Delta$*Short-term (ST) Debt Funding 2008* measures the percentage change in short-term debt liabilities from 2007 to 2008 whereas $\Delta$*Off-BS Activity 2008* and $\Delta$*Cash 2008* measure the percentage changes in off-balance sheet activity and in cash, respectively. In Columns (2) and (3), we include the controls *Loans/Assets*, *Deposits/Assets*, *(Book) Equity/Assets*, and *Log Assets*, which are all measured in 2007. All specifications include division × hierarchy × age × tenure fixed effects and either country or bank fixed effects as indicated. Robust standard errors are reported in parentheses and clustered by bank and by labor market (division × hierarchy × age × tenure). Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | $\Delta w = (w_{2008} - w_{2007})/w_{2007}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Bonus Share*$_{2007}$ | -0.264*** | -0.265*** | -0.271*** | -0.280*** | -0.273*** | -0.273*** |
| | (0.029) | (0.032) | (0.031) | (0.027) | (0.032) | (0.029) |
| $\Delta$ *ST Debt Funding 2008* | | | 0.005 | | | |
| | | | (0.068) | | | |
| *Bonus Share*$_{2007}$ × $\Delta$ *ST Debt Funding 2008* | | | 0.143*** | 0.239*** | | |
| | | | (0.033) | (0.044) | | |
| *Bonus Share*$_{2007}$ × $\Delta$ *Off-BS Activity 2008* | | | | | 0.071*** | |
| | | | | | (0.025) | |
| *Bonus Share*$_{2007}$ × $\Delta$ *Cash 2008* | | | | | | 0.106*** |
| | | | | | | (0.019) |
| Bank characteristics in 2007: | | | | | | |
| *Loans / Assets* | | -0.052 | -0.046 | | | |
| | | (0.046) | (0.050) | | | |
| *Deposits / Assets* | | 0.104 | 0.098 | | | |
| | | (0.074) | (0.070) | | | |
| *Equity / Assets* | | 0.275 | 0.139 | | | |
| | | (0.360) | (0.313) | | | |
| *Log Assets* | | -0.003 | -0.001 | | | |
| | | (0.007) | (0.006) | | | |
| Division × Hierarchy × Age × Tenure FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes | No | No | No |
| Bank FE | No | No | No | Yes | Yes | Yes |
| No. of observations | 7,218 | 6,127 | 6,127 | 6,127 | 5,639 | 6,127 |
| No. of banks | 66 | 44 | 44 | 44 | 40 | 44 |
| Adjusted $R^2$ | 0.27 | 0.27 | 0.28 | 0.39 | 0.38 | 0.38 |

**Table 5: Risk Sharing across Bank Divisions**

We report coefficient estimates of panel regressions in the full sample of employee-year observations over the period 2003 to 2010. Employees' bonus shares are regressed on their banks' lending and trading income standardized by bank-wide employment and on the bank-level controls *Loans/Assets*, *Deposits/Assets*, *(Book) Equity/Assets*, and *Log Assets*. In Column (1), we include employee-year observations of all divisions in the regression sample. In Columns (2) to (5), the sample is restricted to employee-years from the functional areas Internal Services, Loan Business, Trading Business, and Wealth Management, respectively. All specifications control for bank × division × hierarchy fixed effects. Robust standard errors are clustered by bank and by labor market (division × hierarchy × age × tenure) and reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | *Bonus Share* | | | | |
|---|---|---|---|---|---|
| Divisions: | All D1-D8 | Internal Services D1+D2 | Loan Business D3+D4 | Trading Business D7+D8 | Wealth Mgmt. D5+D6 |
| | (1) | (2) | (3) | (4) | (5) |
| *Lending Income/Employees* | 0.026*** | 0.012** | 0.032*** | 0.091 | 0.062*** |
| | (0.006) | (0.005) | (0.005) | (0.088) | (0.007) |
| *Trading Income/Employees* | 0.020*** | 0.013*** | 0.013** | 0.300** | 0.039*** |
| | (0.005) | (0.004) | (0.005) | (0.142) | (0.006) |
| *Loans/Assets* | 0.066 | 0.042 | 0.051 | 0.316 | 0.008 |
| | (0.084) | (0.042) | (0.057) | (0.671) | (0.215) |
| *Deposits/Assets* | 0.071* | 0.084** | -0.006 | 0.514** | 0.082 |
| | (0.042) | (0.039) | (0.038) | (0.250) | (0.095) |
| *Equity/Assets* | -0.282 | -0.053 | -0.619* | -2.013 | -0.781 |
| | (0.321) | (0.215) | (0.365) | (3.352) | (0.900) |
| *Log Assets* | -0.028 | -0.029 | -0.045*** | -0.058 | -0.037 |
| | (0.022) | (0.020) | (0.011) | (0.179) | (0.068) |
| Bank × Division × Hierarchy FE | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 906,707 | 463,667 | 352,016 | 36,442 | 54,582 |
| No. of banks | 82 | 82 | 65 | 71 | 64 |
| Adjusted $R^2$ | 0.50 | 0.54 | 0.61 | 0.31 | 0.47 |

**Table 6: Risk Sharing across Bank Divisions outside the Crisis**

We report coefficient estimates of panel regressions in the subsample of employee-year observations with unique employee identifiers over the period 2003 to 2007. Employees' bonus shares are regressed on their banks' lending and trading income standardized by bank-wide employment. All specifications control for employee and for division × hierarchy × age × tenure × year fixed effects. In Columns (2) to (5), the sample is restricted to employee-years from the functional areas Internal Services, Loan Business, Trading Business, and Wealth Management, respectively. In Panel A, standard errors are clustered by bank as well as by labor market (division × hierarchy × age × tenure). In Panel B, standard errors are clustered by labor market alone. Standard errors are reported in parentheses and significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | *Bonus Share* | | | | |
|---|---|---|---|---|---|
| Divisions: | All D1-D8 | Internal Services D1+D2 | Loan Business D3+D4 | Trading Business D7+D8 | Wealth Mgmt. D5+D6 |
| | (1) | (2) | (3) | (4) | (5) |
| Panel A: Standard errors clustered by bank and by labor market | | | | | |
| *Lending Income/Employees* | 0.082*** | 0.070*** | 0.091 | 0.420** | 0.333** |
| | (0.014) | (0.013) | (0.058) | (0.187) | (0.104) |
| *Trading Income/Employees* | 0.078*** | 0.048 | 0.103 | 0.485*** | 0.084 |
| | (0.024) | (0.028) | (0.074) | (0.152) | (0.206) |
| Panel B: Standard errors clustered only by labor market | | | | | |
| *Lending Income/Employees* | 0.082*** | 0.070*** | 0.091** | 0.420*** | 0.333*** |
| | (0.009) | (0.009) | (0.043) | (0.115) | (0.101) |
| *Trading Income/Employees* | 0.078*** | 0.048*** | 0.103* | 0.485*** | 0.084 |
| | (0.010) | (0.006) | (0.057) | (0.101) | (0.120) |
| Employee FE | Yes | Yes | Yes | Yes | Yes |
| Division × Hierarchy × Age × Tenure × Year FE | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 122,486 | 51,291 | 58,460 | 4,102 | 3,457 |
| No. of banks | 12 | 12 | 11 | 11 | 7 |
| Adjusted $R^2$ | 0.90 | 0.79 | 0.89 | 0.89 | 0.79 |

**Table 7: Risk Sharing outside the Crisis after Loan Loss Realizations**

We report coefficient estimates of panel regressions in the subsample of employee-year observations with unique employee identifiers over the period 2003 to 2007. Employees' bonus shares are regressed on the annual change in loan loss provisions per employee. All specifications control for employee and for division × hierarchy × age × tenure × year fixed effects. In Columns (2) to (5), the sample is restricted to employee-years from the functional areas Internal Services, Loan Business, Trading Business, and Wealth Management, respectively. Robust standard errors are clustered by labor market (division × hierarchy × age × tenure) and reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | *Bonus Share* | | | | |
|---|---|---|---|---|---|
| Divisions: | All D1-D8 (1) | Internal Services D1+D2 (2) | Loan Business D3+D4 (3) | Trading Business D7+D8 (4) | Wealth Mgmt. D5+D6 (5) |
| $\Delta LLP/Employees$ | -0.082*** | -0.058*** | -0.105*** | -0.416** | -0.307*** |
| | (0.012) | (0.008) | (0.033) | (0.197) | (0.157) |
| Employee FE | Yes | Yes | Yes | Yes | Yes |
| Division × Hierarchy × Age × Tenure × Year FE | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 124,632 | 52,528 | 59,240 | 4,102 | 3,467 |
| No. of banks | 13 | 13 | 12 | 11 | 8 |
| Adjusted $R^2$ | 0.90 | 0.79 | 0.89 | 0.89 | 0.79 |

**Table 8: Pre-Crisis Compensation Differences across Banks**

We report coefficient estimates of cross-sectional ordinary least squares regressions. One observation corresponds to a group $g$ of employees that work for the same bank, in the same division, and at the same hierarchy level and belong to the same age and tenure group. The dependent variable is the (log) mean total compensation of group $g$ in 2007 and regressed on dummy variables that distinguish between banks with lax and tight funding constraints in 2008, i.e., banks with $\Delta$*Short-term (ST) Debt Funding 2008*, $\Delta$*Off-BS Activity 2008*, and $\Delta$*Cash 2008* above or below the median. In Columns (2), (4), and (6), we include the controls *Loans/Assets*, *Deposits/Assets*, *(Book) Equity/Assets*, and *Log Assets*, which are all measured in 2007. All specifications include division × hierarchy × age × tenure fixed effects. Robust standard errors are reported in parentheses and clustered by bank and by labor market (division × hierarchy × age × tenure). Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | Log $w_{2007}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Dummy:* $\Delta$ *ST Debt Funding 2008 > P50* | 0.008 | -0.007 | | | | |
| | (0.040) | (0.037) | | | | |
| *Dummy:* $\Delta$ *Off-BS Activity 2008 > P50* | | | -0.013 | -0.051 | | |
| | | | (0.041) | (0.043) | | |
| *Dummy:* $\Delta$ *Cash 2008 > P50* | | | | | -0.059 | -0.038 |
| | | | | | (0.042) | (0.043) |
| Bank characteristics in 2007: | | | | | | |
| *Loans / Assets* | | 0.022 | | -0.038 | | 0.012 |
| | | (0.096) | | (0.107) | | (0.102) |
| *Deposits / Assets* | | 0.100 | | 0.235 | | 0.133 |
| | | (0.123) | | (0.156) | | (0.124) |
| *Equity / Assets* | | 1.399** | | 1.670* | | 1.343** |
| | | (0.568) | | (0.986) | | (0.623) |
| *Log Assets* | | -0.017* | | -0.014 | | -0.015 |
| | | (0.009) | | (0.011) | | (0.010) |
| Division × Hierarchy × Age × Tenure FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 6,127 | 6,127 | 5,639 | 5,639 | 6,127 | 6,127 |
| No. of banks | 44 | 44 | 40 | 40 | 44 | 44 |
| Adjusted $R^2$ | 0.83 | 0.84 | 0.84 | 0.85 | 0.83 | 0.84 |

**Table 9: Pay Variation Explained by Employee Fixed Effects**

We report the $R^2$ and the adjusted $R^2$ of panel regressions in the subsample of employee-year observations with unique employee identifiers over the period 2003 to 2007. The dependent variable is the change of employees' annual total compensation $\Delta w_{k,t} = (w_{k,t} - w_{k,t-1})/w_{k,t-1}$ and regressed either on bank or on employee fixed effects. Columns (1) and (2) include division × hierarchy × age × tenure fixed effects, whereas Columns (3) to (6) include division × hierarchy × age × tenure × year fixed effects. Columns (5) and (6) additionally control for bank × year fixed effects.

| Dependent variable: | $\Delta w_t = (w_t - w_{t-1})/w_{t-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | Comparison 1 | | Comparison 2 | | Comparison 3 | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $R^2$ | 0.15 | 0.46 | 0.24 | 0.56 | 0.29 | 0.59 |
| Adjusted $R^2$ | 0.14 | 0.09 | 0.23 | 0.23 | 0.28 | 0.29 |
| Bank FE | Yes | No | Yes | No | No | No |
| Employee FE | No | Yes | No | Yes | No | Yes |
| Division × Hierarchy × Age × Tenure FE | Yes | Yes | No | No | No | No |
| Division × Hierarchy × Age × Tenure × Year FE | No | No | Yes | Yes | Yes | Yes |
| Bank × Year FE | No | No | No | No | Yes | Yes |
| No. of observations | 103,738 | 103,738 | 103,310 | 103,310 | 103,310 | 103,310 |
| No. of banks | 31 | 31 | 31 | 31 | 31 | 31 |

INTERNET APPENDIX

# Bank Bonus Pay as a Risk Sharing Contract

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October 26, 2021

# Internet Appendix A: Detailed Calculations for Table 3

To estimate the variance decomposition in Table 3, we proceed in three steps. First, we correct total employee compensation $w$ for variation explained by several employee characteristics. These characteristics are marked by the set of interacted fixed effects $C = \{Age \times Tenure \times Division \times Hierarchy \times Year\ FE\}$ and control for variation in employees' participation constraints. Second, based on the residual compensation $w|C$, we calculate $\ln w|C$, $\ln \Lambda|C$, and $\ln \Xi|C$, as defined in Section 6.1. Finally, we calculate the (log) pay variance and the percentage variance contribution of the different components reported in Columns (3), (5), (6), and (7) of Table 3.

At the first step, we follow the literature and estimate a multiplicative model for total compensation $w$:

$$w = \exp(C) \cdot \epsilon \tag{1}$$

The residual compensation $w|C$ conditional on $C$ is then predicted as $\hat{\epsilon} = \frac{w}{\hat{w}}$, where $\hat{w}$ denotes the employee's compensation predicted by Eq. (1). Defining $\epsilon = \exp(u)$, we can rewrite Eq. (1) as $w = \exp(C + u)$ and define $\hat{w}$ as

$$\mathbb{E}[w|C] = \exp(C) \cdot \mathbb{E}[\exp(u)]. \tag{2}$$

To estimate $\hat{C}$ in Eq. (2), we fit the log-linear model

$$\ln w = C + u. \tag{3}$$

Assuming that $u \sim N(0, \sigma^2)$, $\mathbb{E}[\exp(u)]$ in Eq. (2) can be estimated as $\exp(0.5\hat{\sigma}^2)$, where $\hat{\sigma}^2$ is an unbiased estimator of the regression error term in Eq. (3).[1] For a given employee-year $(k, t)$, the

[1] Alternatively, Duan (1983) shows that, based on the weaker assumption of independent and identically distributed $u$, $\mathbb{E}[\exp(u)]$ can be estimated as $N^{-1}\Sigma_j \exp(\hat{u})$. The estimation of the variance components yields identical estimates under the assumption of normally and iid. distributed errors.

residual compensation $w_{k,t}|C$ conditional on $C$ is predicted as

$$\hat{\epsilon}_{k,t} = \frac{w_{k,t}}{\hat{w}_{k,t}} = \frac{w_{k,t}}{\exp(\hat{C}_{k,t}) \cdot \exp(0.5\hat{\sigma}^2)}. \tag{4}$$

At the second step, we calculate $\ln \Xi_{k,t}|C = \ln \overline{\hat{\epsilon}_{b(k),t}}$ and $\ln \Lambda_{k,t}|C = \ln \hat{\epsilon}_{k,t} - \ln \overline{\hat{\epsilon}_{b(k),t}}$, where $\overline{\hat{\epsilon}_{b(k),t}}$ is the average (residual) compensation paid by employee $k$'s bank in year $t$. Finally, the variance components reported in Table 3 follow by direct calculation.

Reference:

Duan, N. (1983): A Nonparametric Retransformation Method. *Journal of the American Statistical Association* 78, 605-610.

# Internet Appendix B: Data Description for Figure 5

These analyses are based on the LIAB Cross-Sectional Model 2 (LIAB QM2) of the German Federal Employment Agency (DOI: 10.5164/IAB.LIABQM29319.de.en.v1, see also Ruf et al., 2021).[2] This data set is a linked employer-employee data set which links information on establishments from the IAB Establishment Panel, the largest German annual establishment survey, with information on individuals employed at those establishments from the social security data of the Federal Employment Agency. In detail, the data set includes the survey data of all establishments surveyed in the IAB Establishment Panel between 1993 and 2019 and additionally, all employees working in these establishments for at least one day on June 30 of a given survey year.

For the identification of cross-divisional job positions (logistical and headquarter services) we use information on the current occupational group in the individual data set which is based on the 3-digit job classification KldB 2010 (equivalent to the ISCO-08 (International Standard Classification of Occupations 2008)). In detail, we identify the following job positions, which closely correspond to our functional area "Internal services": information technology; IT systems

[2]The data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

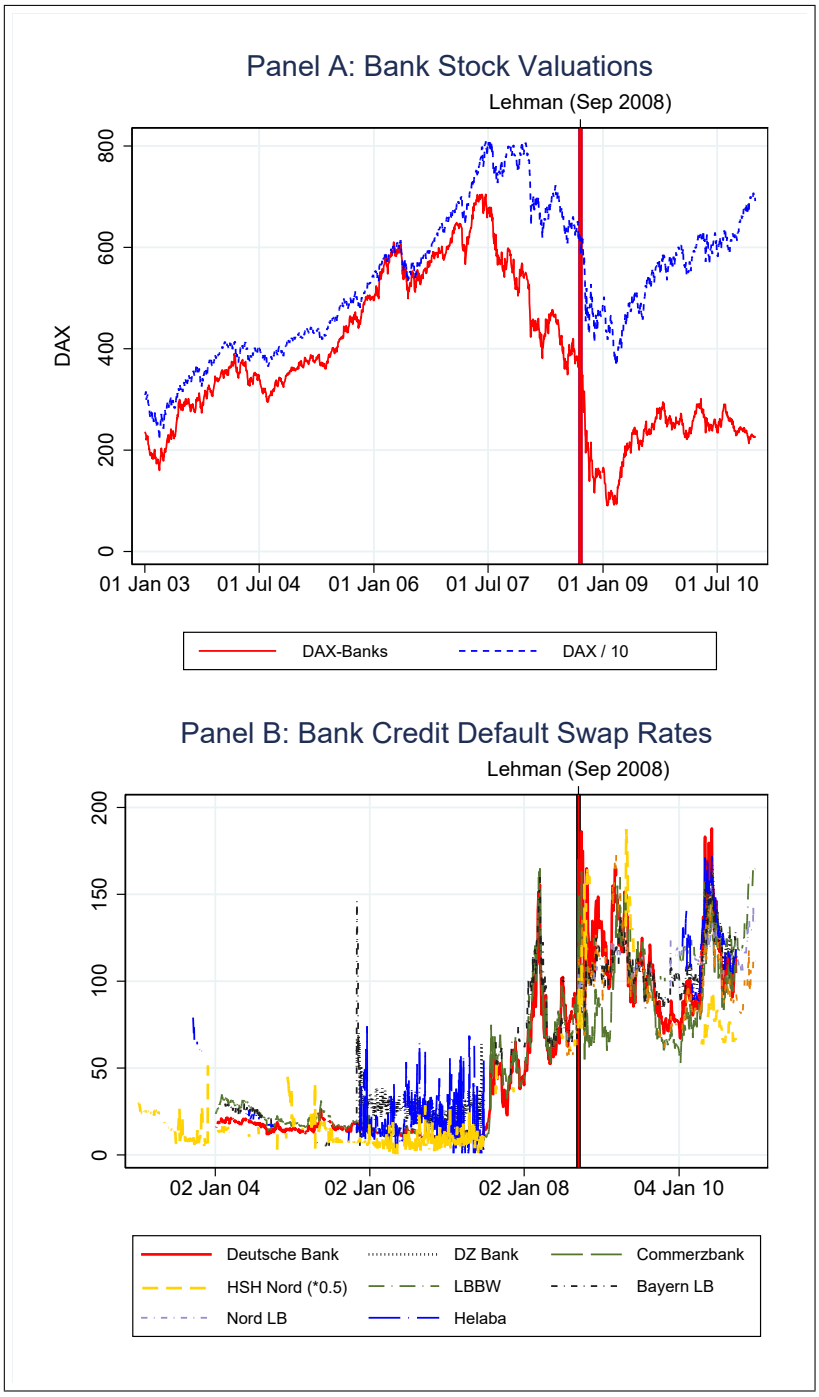
analysis; IT application; IT network engineering and IT administration; software development and programming; purchasing and sales; corporate organization/management and corporate strategy; office and secretarial office occupations; human resources; managerial and financial accounting and auditing; taxation; general administrative/cross-divisional occupations.

The identification of the financial services sector vs. the non-financial-services sector is based on the 3-digit Classification of Economic Activities, Edition 2003 of the Federal Statistical Office (equivalent to the NACE classification). Wage information comprises the employee's average gross daily wage in Euros. It is calculated from the fixed-period earnings reported by the employer and the duration of the (unsplit) original notification period in calendar days. We restrict the data set to full-time employees liable to social security in the years 2003 to 2013, i.e. we drop, for instance, unemployed individuals, interns, apprentices, low-income workers, and employees in partial retirement. We can identify 57,938 full-time employee-years in internal service positions within the financial services sector, and 3,294,007 employee-years in internal service positions outside the financial services sector.

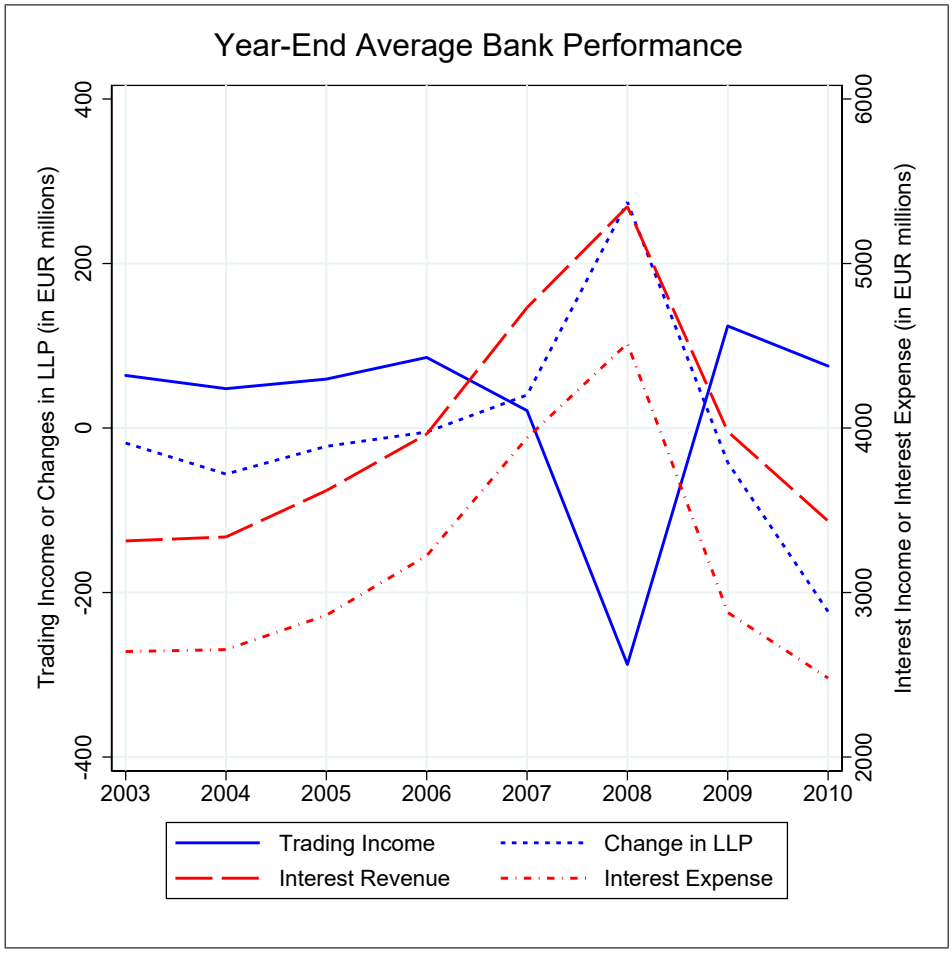
Reference:

Ruf, Kevin; Schmidtlein, Lisa; Seth, Stefan; Stüber, Heiko; Umkehrer, Matthias; Graf, Tobias; Grießemer, Stephan; Kaimer, Steffen; Köhler, Markus; Lehnert, Claudia; Oertel, Martina; Schneider, Andreas (2021): "Linked-Employer-Employee-Data of the IAB (LIAB): LIAB cross-sectional model 2 1993-2019, version 1". Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). DOI: 10.5164/IAB.LIABQM29319.de.en.v1

# Internet Appendix C: Additional Figures and Tables




Appendix Figure I: Panel A shows the evolution of the stock index for listed German banks (DAX-Banks) relative to the index of all German Stocks (DAX) (scaled by $10^{-1}$). Panel B reports the spreads of credit default swaps (in basis points) for the eight German banks with five-year single-name CDS contracts. The spread for HSH Nord is scaled by a factor of 0.5.




Appendix Figure II: We show the evolution of banks' different income sources (in million Euros) averaged across banks in Austria, Germany, and Switzerland. The sample is restricted to banks with data throughout all years 2003 to 2010.

## Appendix Table I: Employee Skills Evaluated by the Pay Consultancy

We report examples for the cognitive skills and abilities of bank employees evaluated by the pay consultancy. The pay consultancy uses these information to sort employees into homogeneous groups, i.e. into six career positions in the employment hierarchy.

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Problem-Solving Skills:

| | |
|---|---|
| Level 1 | Recognizes routine problems and applies existing, clearly specified procedures to solve them. |
| Level 2 | Recognizes problems and all related issues in simple situations; develops possible solutions; evaluates each using standard procedures and makes an informed decision. |
| Level 3 | Identifies key issues and patterns from conflicting / incomplete information; sees problems in a higher-level context and finds new, less obvious solutions. |
| Level 4 | Recognizes patterns and relationships in a timely manner; grasps underlying consequences beyond the acute problem; develops new and innovative solutions to very complex problems. |
| Level 5 | Anticipates problems and challenges and proposes innovative solutions consistent with business goals; serves as a point of contact for solving unique or very complex business problems involving servicing own or others' customers. |

General Skills and Capabilities:

| | |
|---|---|
| Level 1 | Can apply basic knowledge/skills to own activity. |
| Level 2 | Applies knowledge/skills to a variety of daily activities; recognizes specific technical problems. |
| Level 3 | Applies knowledge/skills to a variety of daily and specialized activities. |
| Level 4 | Applies knowledge/skills by working through complex problems and/or while coordinating work that may go beyond own expert knowledge; shares expert knowledge with colleagues and other areas. |
| Level 5 | Acts as a source of advice to others regarding a wide range of knowledge / skills within own discipline and beyond. |

etc.

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## Appendix Table II: Robustness of Variance Decomposition

We decompose the (log) pay variance into its incentive pay and its risk sharing component after correcting total annual compensation $w_{k,t}$ for variation explained by different sets $C$ of conditioning fixed effects. Numbers are reported when employees across all bank divisions and hierarchical affiliations are considered together. The variance decomposition reported in Panel E is identical to the one reported in Table 3 of the paper. See Internet Appendix A for details of the calculation of the variance decomposition.

| Observations | (Log) Pay Variance | Percentage Variance Contribution | | | Ratio |
|---|---|---|---|---|---|
| | | Incentive Component | Risk Sharing Component | Covariance Component | |
| Number | $Var[\ln w_{k,t}\,\vert C]$ | $\frac{Var[\ln \Lambda_{k,t}\vert C]}{Var[\ln w_{k,t}\vert C]}$ | $\frac{Var[\ln \Xi_{k,t}\vert C]}{Var[\ln w_{k,t}\vert C]}$ | $\frac{2Cov[\ln \Lambda\vert C\,,\ln \Xi\vert C]}{Var[\ln w_{k,t}\vert C]}$ | $\frac{Var[\ln \Xi_{k,t}\vert C]}{Var[\ln \Lambda_{k,t}\vert C]}$ |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Conditioning set $C = \{\}$ | | | | | |
| 1,261,693 | 0.189 | 0.771 | 0.278 | -0.049 | 0.361 |
| Panel B: Conditioning set $C = \{$*Year FE*$\}$ | | | | | |
| 1,261,693 | 0.183 | 0.794 | 0.256 | -0.051 | 0.323 |
| Panel C: Conditioning set $C = \{$*Age* $\times$ *Tenure* $\times$ *Division* $\times$ *Hierarchy FE*$\}$ | | | | | |
| 1,243,566 | 0.047 | 0.719 | 0.298 | -0.017 | 0.414 |
| Panel D: Conditioning set $C = \{$*Age* $\times$ *Tenure* $\times$ *Division* $\times$ *Hierarchy FE* ; *Year FE*$\}$ | | | | | |
| 1,243,566 | 0.045 | 0.749 | 0.266 | -0.015 | 0.354 |
| Panel E: Conditioning set $C = \{$*Age* $\times$ *Tenure* $\times$ *Division* $\times$ *Hierarchy* $\times$ *Year FE*$\}$ | | | | | |
| 1,243,049 | 0.041 | 0.776 | 0.239 | -0.015 | 0.308 |

## Appendix Table III: Mincer Regressions by Employee Group

We re-estimate the Mincer regression in Table 2, Column (6) for different employee groups separately: Column (1) includes observations from all divisions; in Columns (2) to (5), the sample is restricted to observations from Internal Services, Loan Business, Trading Business, and Wealth Management, respectively. In Column (6), we consider junior employees (lowest three hierarchy levels). Division fixed effects and year fixed effects for 2003 to 2006 are estimated but not reported to preserve space. Robust standard errors are clustered by bank and reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | *Bonus Share* | | | | | |
|---|---|---|---|---|---|---|
| Divisions: | All D1-D8 | Internal Services D1+D2 | Loan Business D3+D4 | Trading Business D7+D8 | Wealth Mgmt. D5+D6 | Junior Employees D1-D8 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Age / 10* | 0.031*** | 0.013*** | 0.012* | 0.208*** | 0.088*** | -0.002 |
| | (0.006) | (0.004) | (0.007) | (0.056) | (0.026) | (0.004) |
| (*Age* / 10)$^2$ | -0.005*** | -0.002*** | -0.002** | -0.033*** | -0.014*** | -0.000 |
| | (0.001) | (0.001) | (0.001) | (0.007) | (0.003) | (0.001) |
| *Tenure* / 10 | 0.034*** | 0.029*** | 0.021*** | 0.118*** | 0.131*** | 0.018*** |
| | (0.010) | (0.008) | (0.007) | (0.027) | (0.020) | (0.005) |
| (*Tenure* / 10)$^2$ | -0.008*** | -0.006*** | -0.005*** | -0.031*** | -0.031*** | -0.004*** |
| | (0.002) | (0.002) | (0.001) | (0.007) | (0.005) | (0.001) |
| Hierarchy FE relative to level 1: | | | | | | |
| *Hierarchy 2* | 0.007 | 0.016* | 0.004 | -0.045 | -0.033 | 0.010*** |
| | (0.005) | (0.008) | (0.004) | (0.028) | (0.050) | (0.004) |
| *Hierarchy 3* | 0.022*** | 0.030*** | 0.022*** | 0.038 | 0.057 | 0.029*** |
| | (0.008) | (0.011) | (0.006) | (0.024) | (0.037) | (0.006) |
| *Hierarchy 4* | 0.079*** | 0.080*** | 0.083*** | 0.176*** | 0.145*** | |
| | (0.014) | (0.016) | (0.012) | (0.023) | (0.033) | |
| *Hierarchy 5* | 0.199*** | 0.172*** | 0.180*** | 0.367*** | 0.319*** | |
| | (0.028) | (0.028) | (0.028) | (0.030) | (0.041) | |
| *Hierarchy 6* | 0.399*** | 0.322*** | 0.298*** | 0.736*** | 0.618*** | |
| | (0.044) | (0.040) | (0.028) | (0.069) | (0.061) | |
| Year FE relative to 2007: | | | | | | |
| *2008 Year FE* | -0.037*** | -0.028*** | -0.030*** | -0.212*** | -0.103*** | -0.014** |
| | (0.007) | (0.008) | (0.008) | (0.050) | (0.023) | (0.006) |
| *2009 Year FE* | -0.032*** | -0.020** | -0.031*** | -0.167** | -0.138*** | -0.011* |
| | (0.007) | (0.008) | (0.008) | (0.073) | (0.040) | (0.006) |
| *2010 Year FE* | -0.044*** | -0.043*** | -0.019** | -0.200*** | -0.076* | -0.018*** |
| | (0.013) | (0.009) | (0.008) | (0.069) | (0.041) | (0.006) |
| Year (2003-2006) FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Division FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of observations | 1,045,416 | 560,969 | 373,313 | 38,928 | 72,186 | 628,919 |
| No. of banks | 248 | 239 | 139 | 135 | 163 | 241 |
| Adjusted $R^2$ | 0.42 | 0.49 | 0.55 | 0.3 | 0.47 | 0.32 |

**Appendix Table IV: Importance of Employee Fixed Effects across Banks**

We report coefficient estimates of cross-sectional ordinary least squares regressions. One observation corresponds to one bank. The dependent variable is the bank-level share of variation in annual wage changes $R^2(\textit{Employee FE})_b$ that is explained by employee fixed effects. To calculate $R^2(\textit{Employee FE})_b$, we regress $\Delta w$ on employee fixed effects for each bank separately and store the $R^2$ value. We then regress $R^2(\textit{Employee FE})_b$ of bank $b$ on dummy variables that distinguish between banks with lax and tight funding constraints in 2008, i.e., banks with $\Delta$*Short-term (ST) Debt Funding 2008*$_b$, $\Delta$*Off-BS Activity 2008*$_b$, and $\Delta$*Cash 2008*$_b$ above or below the median. Standard errors are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively.

| Dependent variable: | $R^2$(*Employee FE*) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| *Dummy:* $\Delta$ *ST Debt Funding 2008 > P50* | -0.045 | | |
| | (0.082) | | |
| *Dummy:* $\Delta$ *Off-BS Activity 2008 > P50* | | -0.012 | |
| | | (0.091) | |
| *Dummy:* $\Delta$ *Cash 2008 > P50* | | | -0.090 |
| | | | (0.082) |
| No. of banks / observations | 17 | 15 | 17 |
| $R^2$ | 0.02 | 0.00 | 0.07 |
| Adjusted $R^2$ | -0.05 | -0.08 | 0.01 |