



Contents lists available at ScienceDirect

## Journal of Accounting and Economics

journal homepage: [www.journals.elsevier.com/journal-of-accounting-and-economics](http://www.journals.elsevier.com/journal-of-accounting-and-economics)

# Compensation regulation in banking: Executive director behavior and bank performance after the EU bonus cap<sup>☆</sup>

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## ARTICLE INFO

## Article history:

Received 22 November 2018

Received in revised form 21 December 2022

Accepted 23 December 2022

Available online 2 January 2023

## JEL classification:

G21

G32

G34

## Keywords:

Banks

Bonus cap

Executive compensation

Executive turnover

## ABSTRACT

The regulation that caps executives' variable compensation, as part of the Capital Requirements Directive IV of 2013, likely affected executive turnover, compensation design, and risk-taking in EU banking. The current study identifies significantly higher average turnover rates but also finds that they are driven by CEOs at poorly performing banks. Banks indemnified their executives by off-setting the bonus cap with higher fixed compensation. Although our evidence is only suggestive, we do not find any reduction in risk-taking at the bank level, one purported aim of the regulation.

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## 1. Introduction

In April 2013, the European Parliament capped the compensation share of bonus payments to banks' executive directors—henceforth, executives—in the European Union (EU). The declared goal of this regulation was to foster financial

<sup>☆</sup> The authors thank an anonymous referee and the editor, Robert Holthausen, for very clear and constructive feedback as well as John Bizjak, Lamont Black, Claudia Buch, Claire Célérier, Hans Degryse, Tim Eisert, Elena Gramano, Jens Hagendorff, Iftekhar Hasan, Harry Huizinga, Martina Jašová, Patrick Kampkötter, Johannes Kriebel, Elisa Luciano, Mike Mariathan, David Martinez-Miera, Antonios Mavroupos, Markus Merz, Felix Noth, Tommaso Oliviero, Steven Ongena, Jan Riepe, Kasper Roszbach, Miriam Schwartz-Ziv, Vahid Saadi, Abdolkarim Sadrieh, Farzad Saidi, Lena Tonzer, Anton van Boxtel, Michael Weber, Shuo Xia, Qizhou (Léo) Xiong, Yishay Yafeh, Yuhao Zhu, and seminar participants at the IWH, Otto-von-Guericke University Magdeburg, KU Leuven, Bank of Mexico, Collegio Carlo Alberto, University of Tübingen, University of Udine, Tilburg University, Finance Group at Humboldt University, the IWH Financial Markets & SAFE Winterschool (Riezlern), the CGDE Workshop (Dresden), the GOR AG FIFI Workshop (Marburg), the Executive Compensation Conference (Rotterdam), the FMA European Conference (Kristiansand), the SIEP Conference (Padova), the Banking Workshop (Münster), the Banca d'Italia-LTI Conference (Rome), the AFA Annual Meeting (Atlanta, poster), the Chicago Financial Institutions Conference, the RES Annual Meeting (Warwick), the ReBa Workshop Birmingham, and the MoFIR Workshop (Chicago, poster) for insightful discussions and comments. Truc Duong, Marie Hütter, and Felix Klischat provided excellent research assistance. The authors are grateful to the Systemic Risk Lab at SAFE for sharing data. This work was supported by the German Science Foundation (DFG, grant number 404779472). All errors are our own.

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stability. Observers predicted that this vote would alter the risk-taking attitudes of bank executives for good after the Great Recession of 2007–2008 (The Economist, 2013). But the effects of bonus caps are theoretically ambiguous. Whereas some studies show that they reduce risk-taking when banking regulation is weak or the bank is systemically relevant (Freixas and Rochet, 2013; Hakenes and Schnabel, 2014), others caution that less incentive pay reduces executives' effort and insures risk-averse managers, which may increase systemic risk (Carlson and Lazrak, 2010; Albuquerque et al., 2019).

The available empirical evidence is inconclusive too. Higher levels of pay in the financial industry and bonuses are critical to attract and retain highly skilled human capital (see Philippon and Reshef (2012) and Murphy (2013a,b), as well as recent survey evidence by Edmans et al. (2021)). High fixed compensation also causes higher operating leverage (Efung et al., 2022), which can increase volatility. In contrast, large variable and incentive-based compensation components in U.S. banks caused risk-shifting behavior after that industry's deregulation in 1999 (DeYoung et al., 2013). Pre-crisis compensation practices also contributed to risk-taking in non-U.S. banking markets (Efung et al., 2015). Such mixed empirical evidence highlights that corporate governance in banking is unique and depends also on country-specific regulation (Laeven and Levine, 2009; Anginer et al., 2018).

We provide evidence on how the 2013 Capital Requirements Directive (CRD) IV bonus cap regulation—henceforth, bonus cap—affected turnover dynamics and compensation practices at the executive level, as well as risk patterns at the bank level, in the EU. We assemble a novel sample of executives serving at major EU banks to investigate three implications of the bonus cap, which required that the maximum variable-to-fixed compensation ratio should not exceed 100% (or 200%, subject to shareholder approval). First, we study if bonus caps induced well-performing executives to leave the EU banking industry. Second, we ask whether and how banks adjusted the compensation of their executives. Third, we investigate if bank risk was significantly lower after the bonus cap.

The novel data collected for this study allows us to identify executives that were not compliant with the bonus cap as of 2013. Executives with higher maximum variable-to-fixed compensation ratios than permitted by the bonus cap constitute the treatment group. Executives with compliant contracts form the control group. By differentiating between plausibly forced and voluntary executive turnover in a difference-in-differences (DiD) framework, we establish that voluntary turnover is not significantly more likely for executives with higher treatment intensity. Likewise, better skilled and more experienced executives are not more likely to depart after the regulatory shock. Only treated executives at under-performing banks—in particular CEOs—leave the industry at a significantly higher rate following the bonus cap. Overall, we find no evidence that EU banks were unable to retain their best executives because of the bonus cap.

We then retrieve information on executives' *maximum achievable* rather than granted or *realized* variable compensation. These data allow us to measure a maximum variable-to-fixed compensation ratio, which gauges forward-looking incentives contained in the contracts of both CEO and non-CEO executives in EU banks. With this metric at hand, we establish that banks comply with the bonus cap in time by simultaneously increasing fixed and reducing variable compensation, in order to keep expected total compensation constant. Put differently, banks indemnified their executives, effectively neutralizing the regulatory shock to their expected total compensation.

Given these changes to compensation structures and the purported goal of the bonus cap to foster financial stability, we next analyze risk and return responses to the bonus cap at the bank level. Measures of credit risk (credit default swap (CDS) spreads), market risk (beta), and a proxy for systemic risk (SRISK%) increase after the bonus cap, also when we account for bank and country-by-year fixed effects. The return dimension of bank performance does not exhibit a statistically significant bonus cap response, nor does a second systemic risk proxy ( $\Delta\text{CoVaR}$ ). The three statistically significant risk responses have direct relevance for creditors (CDS spreads), shareholders (beta), the public, and policymakers (SRISK%). Our results imply that there is no evidence of any risk reduction at the bank level, which was one objective of the bonus cap regulation.

A challenge for any study of executive compensation is the endogenous nature of pay (Edmans et al., 2017). The bonus cap disrupted the contracting environment in which banks and their executives operate, but its exogeneity is unclear. Although treated and untreated executives exhibit different levels of observable traits in our sample, the parallel trends assumption is not violated. The differences across the two groups of executives appear to be time invariant. To account for level differences, we saturate the DiD specifications with fixed effects. We also ensure that our results are not driven by major confounding events or factors, such as the contemporaneous EU implementation of Basel III, banks' exposure to the European debt crisis, bailouts, or macroeconomic or regulatory shocks that are subsumed by country-by-year fixed effects. Our results also obtain when we specify top executives at large U.S. banks as a control group, who by definition are not directly affected by the bonus cap regulation in the EU.

Despite these extensive scrutiny checks, some important limitations remain noteworthy. First, our manually collected sample of the largest EU banks and their executives is small. Saturated fixed-effect regressions imply few degrees of freedom and we caution against an improperly narrow focus on point estimates. Second, the specification of country-by-year fixed effects accounts for confounding shocks, but it also limits the number of countries considered in the most conservative specification, such that our results might not generalize to the entire regulatory perimeter of the bonus cap. Third, whereas the collection of information about non-CEO executives offers an important extension, the bonus cap also applies to non-executive material risk takers whom we do not observe.

We therefore interpret the empirical results as suggestive evidence of relationships among executive compensation, managerial turnover, and bank performance associated with changes in regulatory compensation. Accordingly, we position this study relative to two main streams of research. The first focuses on the consequences of regulating bankers' compensation on both risk and executive labor markets. Cerasi et al. (2020) provide cross-country evidence that bank CEOs' pay

packages and turnover rates changed around the introduction of the Financial Stability Board (FSB) guidelines on compensation. In their investigation of U.K. banks' reactions (CEO compensation, turnover, and risk-taking) to regulations mandating deferred compensation and performance-based vesting, [Klymenova and Tuna \(2021\)](#) report that the new rules helped to reduce systemic risk but also may have impaired banks' ability to retain their CEOs. These results are relevant for predicting the effects of the EU-wide mandatory deferral of bonuses as part of the CRD III of 2010. We complement their investigation of CEOs employed in the U.K. financial system by assessing the CRD IV in 2013, in which regulators focused on bonus share instead of deferral rules. Empirical evidence on the effect of bonus caps is surprisingly scarce; we are only aware of laboratory-based experimental evidence provided by [Harris et al. \(2020\)](#).<sup>1</sup> They show that this type of cap is highly effective at limiting risk-taking if and only if the bonus is not conditional on achieving a performance target. This condition is rare in the banking industry, so we study the effects of capping bonus shares of CEOs and non-CEO executives at 45 major banks from 14 EU countries.

The second strand of the literature centers on the relationship between bank executive compensation, risk-taking, and financial stability. Following the Great Recession, several theoretical frameworks sought to link executive compensation, its regulation, and risk-taking in banks (e.g., [Thanassoulis, 2012](#); [Bolton et al., 2015](#); [Bénabou and Tirole, 2016](#)). On the empirical side, [Fahlenbrach and Stulz \(2011\)](#) show that banks with CEOs whose incentives were more tightly linked to shareholder wealth performed worse during the crisis. [Boyalian and Ruiz-Verdú \(2017\)](#) illustrate that equity incentives spurred default risk in highly levered banks. [Kolasinski and Yang \(2018\)](#) determine that financial institutions whose CEOs had a higher fraction of short-term incentives before the crisis exhibited higher exposure to subprime mortgages and higher distress. [Efung et al. \(2015\)](#) use payroll data from selected European countries to show that incentives in banks before the crisis were too high to be the result of an optimal trade-off between risk and return. Using data from 2006 to 2014, [Bennett et al. \(2021\)](#) report that banks link their compensation more to short-term metrics and do not appropriately adjust for leverage, providing a potential explanation for why banks took greater risks before the Great Recession. We add to these studies by testing if attempts in the EU banking sector to tame risk-taking due to incentive pay have been successful.

## 2. Institutional background on compensation regulation

In September 2009, the FSB published the Principles for Sound Compensation Practices to raise awareness that compensation systems are closely related to risk management and governance. Among other things, this initiative provides principles aligning compensation with prudent risk-taking goals. Payouts should be risk-adjusted, penalize bad performance at various levels of the institution, and reflect the time horizon of risks in adequate deferral schemes. The employee's role, position, and responsibility should be reflected by the mix of payouts in equity, equity-linked, and cash components.

The FSB principles sparked simultaneous developments of national and pan-European compensation regulations, giving rise to overlapping legislative timelines. The text of the EU CRD III was first published in July 2010. The final rules were laid down in the Directive 2010/76/EU, which was published in December 2010 and became effective as of January 2011. By then some national regulations aiming to comply with the anticipated CRD III were already enacted, for example the Remuneration Code in the U.K. and Germany's *Institutsvergütungsverordnung*. Both were enacted in late 2010 and had to be adjusted after the binding EU directive became effective as of January 2011 ([Financial Services Authority, 2010](#)).

The upshot for our study is that all ongoing and interacting legislative processes at the national and EU levels were initiated by the FSB remuneration principles of 2009. The national processes to revisit remuneration as part of a larger effort to enhance financial stability applied to all EU banking markets alike, ultimately leading to the enactment of the CRD III. The regulation prescribes minimum levels of deferral and equity grants for identified staff at significant institutions, designed to link bankers' incentives more closely with long-term bank performance and favor prudent risk-taking. At least 40% of variable compensation must be deferred for at least three years. Not less than half of variable compensation should be granted in a way that aligns the incentives with the long-term interests of the credit institution (e.g., by granting equity-linked compensation).

After being introduced in 2013, the rules on compensation in CRD IV became binding as of January 2014. The main goal was to limit bank risk-taking.<sup>2</sup> This regulation complements the original rules of the CRD III with the so-called banker bonus cap, which limits the ratio of variable-to-fixed compensation at 100%, or 200% if shareholders agree.<sup>3</sup> According to the [European Banking Authority \(2014\)](#), compensation items can be classified as fixed only if they are "permanent, i.e., maintained over a period tied to the specific role and organisational responsibilities for which they are granted; pre-determined, in terms of conditions and amount; non-discretionary, non-revocable and transparent to staff." The bonus cap applies to all so-called material risk takers, namely senior managers, internal supervisors, but also those lower-rank employees that can substantially alter the bank's risk profile with their choices (e.g., selected traders). It is binding for legal entities of EU banking groups, which includes non-EU subsidiaries. Regulating the variable-to-fixed compensation ratio leaves compensation levels

<sup>1</sup> [Abudy et al. \(2020\)](#) investigate a cap on *total* compensation in the Israeli finance industry and find that it helped to reduce rent extraction.

<sup>2</sup> Directive 2013/36/EU (65). National regulators had to ensure compliance with it by the end of 2014.

<sup>3</sup> The bonus cap can be increased by discounting up to 25% of the variable compensation that is deferred for at least five years (see EBA Guidelines, EBA/GL/2014/01, p. 3). We scrutinized all results reported below using alternative treatment definitions, such as a binary treatment indicator and a different treatment threshold. Results remain qualitatively intact and are available upon request.

untouched as such, but the costs to incentivize employees by offering potential variable compensation increase. Therefore, the bonus cap leads banks to internalize the potential costs of incentivization to a greater extent.

### 3. Theoretical priors on compensation regulation in banking

The governance mechanism of banks differs from that of non-financial firms (Shleifer and Vishny, 1997) for two main reasons: pervasive regulatory oversight and the presence of explicit and implicit government safety nets (e.g., deposit insurance and *too-big-to-fail* guarantees; see Adams and Mehran, 2003; John et al., 2010). Both aspects reflect the systemic relevance of bank stress, which can generate negative externalities for non-stressed banks, non-financial firms, and households (Acharya, 2009; Brunnermeier, 2009). Thus, the traditional agency problem among shareholders, creditors, and management is nested in a broader one between shareholders and the public, where the latter seek to avoid the externalities associated with financial and banking system instability (The Economist, 2010; Freixas and Rochet, 2013).

Shareholder-friendly bank governance arrangements in a low interest rate environment paired with overheated housing markets, a banking system that practiced the “originate to distribute” securitization model, and insufficient micro- and macroprudential oversight contributed to mounting imbalances in the financial system, which led to the Great Recession (Brunnermeier, 2009; Beltratti and Stulz, 2012; Anginer et al., 2018). The crisis illuminated how these governance practices in the presence of government safety nets and limited liability could produce high, socially undesirable levels of risk-taking (Eufinger and Gill, 2016). Consequently, the scope of bank regulation has been extended since the Great Recession. Microprudential requirements were tightened, novel macroprudential regulation was launched, and ensuring sound management processes and corporate governance gained importance, as recognized by FSB principles. Bankers' compensation packages came into sharp focus, which resonates with theories illustrating that compensation regulation can take a distinct disciplining role (John et al., 2000; Kolm et al., 2017). Whereas executive compensation contracts encompass many dimensions (e.g., level of pay, debt vs. equity incentives, maturity mix), most compensation regulation aims to reduce short-term incentives by constraining the structure of bank executives' payment packages. The focus on vesting periods under the 2010 CRD III was supplemented by an explicit bonus cap in the 2013 CRD IV, on which we focus.

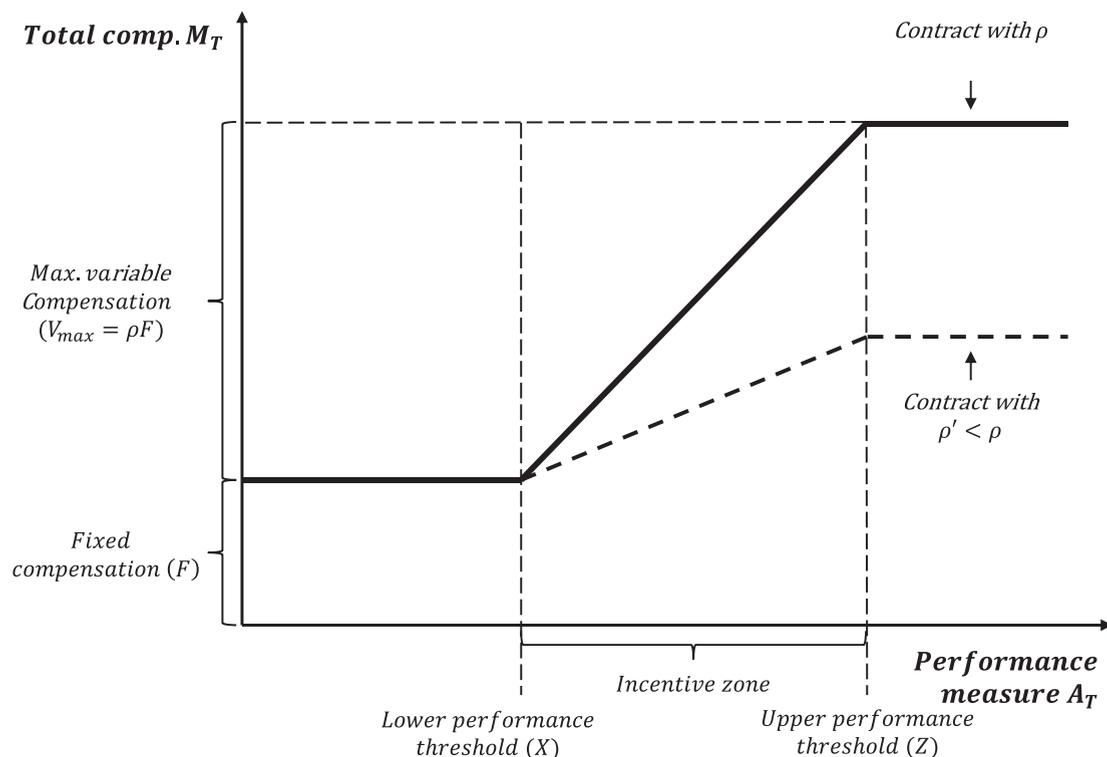
Kolm et al. (2017) show that a bonus cap can curb risk-shifting behavior by banks, thereby helping to restore the socially optimal level of risk-taking (see also Hakenes and Schnabel, 2014). However, they also find that bonus caps do not help to avoid that banks underinvest in risk-reducing investment and lending strategies. Thanassoulis and Tanaka (2018) study *too-big-to-fail* banks and focus on clawback rules as a tool to curb excessive risk-taking. Accounting for bank shareholders' endogenous reaction, they predict that these rules are effective when they are coupled with restrictions on pay-for-performance sensitivity, such as bonus caps. But they also caution that highly convex compensation schemes within a concentrated incentive region undermine the risk-reducing effect of the regulation. Albuquerque et al. (2019) demonstrate that bonus caps can even increase systemic risk as they reduce managerial effort if executive performance is evaluated relative to peers, which is commonplace among large EU banks. A cap on relative performance evaluation effectively reins in systemic risk according to Castiglionesi and Zhao (2021). Structural empirical tests of such mechanisms are beyond the scope of this paper. We focus on a question that is realistic to answer with reduced-form methods: What was the net change in bank riskiness around the introduction of the bonus cap?

Besides altering bank risk-taking, the bonus cap might have affected occupational choices of bank executives. The financial sector used to be an attractive occupation according to Philippon and Reshef (2012) and Célièrier and Vallée (2019) because skills can be better scaled relative to other sectors and yield higher returns to human capital. The bonus cap could alter the choices of skilled, highly mobile workers in the financial industry, in which country they want to work (Giet and Haufler, 2018). According to Oyer (2004), variable compensation can be more efficient than fixed pay to ensure that workers' participation constraint is met, even if the former partly rewards “luck.” The financial industry therefore provides a setting where variable compensation may primarily serve the function of retaining talent, rather than inducing optimal effort (see also Murphy, 2013b).

To understand the potential impact of the bonus cap on the participation constraint of bank executives, consider a stylized performance-based compensation plan in which variable compensation opportunities for executives are capped at a maximum level (Murphy, 2001; Bettis et al., 2018). Fig. 1 depicts the terminal payoff  $M_T$  as a function of performance  $A_T$  at time  $T$ . Within the incentive zone ( $X \leq A_T \leq Z$ ), executives participate in the bank's performance  $\Pi = A_T - X$  at a rate  $p$ . The maximum variable compensation achievable by the executive  $V_{\max}$  is a fraction of fixed compensation  $\rho F$ , where  $\rho$  represents the level of the cap ratio. At the end of a period, the compensation contract has the value:

$$M_T = F + \underbrace{(\rho F)/(Z - X)}_p \left[ \max \left\{ \underbrace{A_T - X}_{\Pi}, 0 \right\} - \max \{A_T - Z, 0\} \right]. \quad (1)$$

The bonus cap limits the value of the parameter  $\rho$  and we investigate *how* banks complied. Three ways to reduce  $\rho$  are to (1) decrease expected variable pay and maintain fixed pay, (2) increase fixed pay and maintain expected variable pay, or (3) rebalance so that executives are indifferent. These cases highlight empirically testable effects of the bonus cap in the EU on managerial mobility. If banks comply with regulation as in case 1 (2), we expect a surge (decrease) in voluntary turnover rates of executives. If banks indemnify their executives as in case 3, we expect no significant change in voluntary turnover rates.



**Fig. 1. Stylized performance-based compensation plan**

This figure shows the terminal payoff  $M_T$  of a stylized performance-based compensation plan as a function of a given measure of performance  $A_T$  at time  $T$ . The executive participates in the bank's performance  $\Pi = A_T - X$  at the participation rate  $p$  within the incentive zone ( $X \leq A_T \leq Z$ ).  $\rho$  is the ratio of the maximum variable compensation achievable by the executive ( $V_{\max}$ ) to fixed compensation ( $F$ ). This ratio is the quantity regulated by the bonus cap.

Several additional executive and bank traits are likely to matter. For example, highly skilled managers, who benefit more from performance-based compensation, may be more likely to leave than less skilled ones. A manager with general skills may be more prone to leave for another bank or sector if his/her human capital is portable (Weinberg, 2001). Banks also might decide not to indemnify managers, either because they do not want or cannot afford to retain them. We control for observable bank-level traits and use fixed effects to gauge unobservable turnover motives when testing if bank executives leave their positions around the introduction of the bonus cap more often, voluntarily or due to forced attrition, and how banks adjust executive compensation structures.

#### 4. Data

Whereas most studies focus on the turnover and performance of CEOs (e.g., Jenter and Kanaan, 2015), we consider the entire board of executive directors with managerial duties, whom we refer to as executives for short. We disregard supervisory directors and non-executive managers. For a panel of EU banks over the 2010–2016 period, we obtain information on executive boards and executives' characteristics from BoardEx. Accounting data come from Bureau van Dijk's Bankscope for 2010–2015 and Orbis Bank Focus for 2016. Stock market and CDS spread data are from Thomson Reuters Datastream. We construct a supplementary sample of executives from the largest 25 U.S. banks using compensation data from Standard and Poor's ExecuComp, as well as accounting and stock price data from CRSP-Compustat merged. We use two main systemic risk measures. The first is the expected capital shortfall adjusted for the size and the leverage of banks, SRISK% (Acharya et al., 2016; Brownlees and Engle, 2017), which we obtain from the V-Lab at New York University's Volatility Institute for the EU and the U.S. banking systems, to gauge the bank's expected capital shortfall conditional on a large drop in equity markets. The second measure is  $\Delta\text{CoVaR}$  (Adrian and Brunnermeier, 2016). These data are provided by the Systemic Risk Lab at the Center for Sustainable Architecture of Finance in Europe for EU and U.S. banks. We gather the sovereign debt exposure data from the EBA Transparency Exercise of 2011.

We manually collect information on the compensation structure at EU banks from publicly available remuneration reports in the years around the introduction of the bonus cap. These data comprise information on the share of fixed and variable compensation, on the share of stock-related grants, on the share of deferred grants, and on maximum variable compensation that can be achieved in the compensation plan ex ante. Hence, we capture the exact quantity regulated by the bonus cap: the *maximum* variable-to-fixed compensation ratio. The exact measurement of the quantity actually

regulated by the bonus cap permits more precise analyses compared with most databases, which only report granted or realized variable compensation.

The bonus cap was imposed on banks across all EU countries at the same time, therefore it is challenging to construct a counterfactual. We define bank executives with compensation packages that did not comply with the bonus cap as of 2013 as *treated* in our setting. Bank executives with compliant compensation packages as of 2013 constitute the control group. We define treatment on the basis of the 200% threshold, for which the vast majority of the sampled banks successfully applied (see Fig. 1 in European Banking Authority, 2015). This approach minimizes the number of false positives in the treatment group. Appendix Table A1 lists untreated and treated EU and U.S. banks.<sup>4</sup> Given that we cannot rule out that banks and executives self-select into certain compensation designs, we caution once more against a strict causal interpretation of the empirical results.

We provide the number of (un)treated executives to illustrate existing within-bank variation in compensation schemes. There are 24 treated executives serving on the boards of nine distinct banks. Treated and untreated executives are employed across a diverse set of banks. Treated executives concentrate in larger banks although some like BNP Paribas do not employ any, whereas the relatively small Aareal Bank does. Treated executives do not appear to strongly cluster along other important bank-level dimensions, such as business model, financial distress, or ownership structure.

The final sample contains 995 bank-executive-year observations from 45 banks. Table 1 summarizes the main executive- and bank-level variables for the treatment group and the control group for the periods before (2010–2013) and after (2014–2016) the introduction of the bonus cap. The data are winsorized at the 1st and 99th percentiles, and the variables are defined in the Appendix Table A2. Treated executives receive more fixed and performance-based pay, and serve at larger banks. The second-to-last column shows that changes in executive- and bank-level variables between 2010 and 2013 are generally not significantly different and exhibit parallel trends between the treatment and the control group before the introduction of the bonus cap.

Table 1 shows that bank-level variables exhibit relevant differences across the treatment and the control group before the introduction of the cap. Importantly, this fact does not invalidate the DiD given insignificant differences in the changes of these variables. However, level-differences may render the results sensitive to the functional form chosen for the dependent variable (Roberts and Whited, 2013). We specify below bank-level outcome variables of disparate functional forms—from log-transformed CDS spreads to Sharpe ratios and betas—, but still obtain a qualitatively fairly cohesive set of results. Therefore, we are less concerned that estimates are inconsistent, but caution again not to interpret point estimates causally.

The last column of Table 1 contains the results from univariate DiD tests between average changes of the main variables in the treatment and the control group around the introduction of the bonus cap. Treated executives exhibit a significant increase in their turnover rate. At the same time, the fixed compensation of treated executives significantly increases while the variable component contracts around the introduction of the EU cap. The combined pattern of compensation structure changes indicates that banks indemnify their executives for the bonus cap. In contrast, bank performance indicators exhibit no unconditionally significant DiD. Next, we revisit this prima facie evidence with a regression framework to account for observable and unobservable factors.

## 5. Main results

We present our findings regarding the effects of the bonus cap on bank executive turnover, then we detail our analysis of changes in executive compensation structure. Finally, we outline the results of our tests for bank performance responses.

### 5.1. Turnover rate

To study the consequences of the bonus cap for executives' mobility in labor markets, we adopt a DiD design, similar to Guo and Masulis (2015). We estimate a linear probability model to explain turnover of executive  $i$  at bank  $j$  in year  $t$ :

$$y_{ijt} = \beta_0 + \beta_1 \cdot \text{Treatment intensity}_i \times \text{Post}_t + \gamma \mathbf{x}_{it} + \theta \mathbf{z}_{jt(-1)} + \mathbf{1}\alpha_t + \mathbf{1}\alpha_j + \varepsilon_{ijt}. \quad (2)$$

The dependent variable  $y_{ijt}$  is an indicator equal to 1 if an executive leaves and to 0 otherwise. Given the potentially adverse impact of the bonus cap on EU banks' ability to retain their managers (Murphy, 2013b; Meekes and Ronchi, 2022), we are especially interested in executives who voluntarily left their banks either to take positions at other institutions or to retire early. By revealed preferences, if executives are worse (better) off after the cap, the number of voluntary turnovers should increase (decrease).

We exploit variation in compensation structure across treated executives and within banks. *Treatment intensity* <sub>$i$</sub>  equals 0 for the control group, whereas it is equal to the distance between  $\rho$  and 200% as of 2013 for treated executives. For example,

<sup>4</sup> A methodological alternative is a regression discontinuity design (RDD), in which the introduction of a sharp threshold may induce quasi-random variation in the treatment status of executives around the threshold. An RDD is infeasible in our setting because the sample is too small to restrict the analysis to executives with compensation packages right below or above the threshold.

**Table 1**  
Summary statistics.

	Untreated						Treated						Unconditional DiD	
	2010–2013			2014–2016			2010–2013			2014–2016			Pre-treatment	Changes around
	N	Average	S.E.	N	Average	S.E.	N	Average	S.E.	N	Average	S.E.	changes	treatment
<i>Executive characteristics:</i>														
Turnover	519	0.077	0.267	352	0.111	0.314	67	0.030	0.171	57	0.193	0.398	−0.135 (0.290)	0.129* (0.020)
Prof. experience	519	−0.035	1.438	352	0.010	1.666	67	0.618	1.564	57	0.628	1.706	−0.397 (0.494)	−0.036 (0.904)
Director age	519	54.620	8.441	352	56.648	7.999	67	52.910	5.570	57	55.368	5.951	−5.030 (0.101)	0.431 (0.780)
<i>Compensation structure:</i>														
Fixed comp. (thd. EUR)	519	890.312	619.718	352	972.998	666.709	67	1559.811	626.448	57	2439.960	939.985	115.608 (0.616)	797.463*** (0.000)
Var. comp. (thd. EUR)	519	269.369	634.373	352	317.445	578.629	67	2493.708	1798.012	57	1703.418	1678.042	−490.177 (0.138)	−838.366*** (0.000)
Max. var. comp. (thd. EUR)	402	851.435	1329.753	352	758.828	1001.971	62	6765.360	2846.159	57	4382.624	2446.419	5.859 (0.993)	−2290.128*** (0.000)
<i>Bank-level information:</i>														
Sharpe ratio	80	0.101	1.156	65	0.089	0.905	32	0.053	1.131	27	−0.256	0.701	0.077 (0.885)	−0.297 (0.352)
Log 5-year excess CDS spreads	70	1.175	0.757	54	1.327	0.834	27	1.113	0.601	22	1.382	0.639	0.187 (0.701)	0.117 (0.646)
SRISK%	94	27.155	25.712	70	20.201	22.891	32	23.920	18.048	27	22.750	19.427	−8.813 (0.567)	5.784 (0.414)
ΔCoVaR	74	27.431	10.466	59	16.266	5.739	32	29.575	9.881	27	17.127	5.330	7.896* (0.069)	−1.283 (0.633)
Beta	94	1.545	0.505	70	1.225	0.331	32	1.557	0.339	27	1.351	0.345	0.116 (0.651)	0.115 (0.366)
Total assets (bln. EUR)	129	514.825	548.696	100	480.104	574.713	32	1246.408	618.368	28	1055.140	622.431	−94.238 (0.768)	−156.547 (0.349)
Return-on-assets	129	−0.062	1.067	100	0.220	0.594	32	0.172	0.553	28	0.129	0.448	0.059 (0.916)	−0.325 (0.178)
Return-on-equity	129	−3.199	30.614	100	3.434	12.309	32	2.744	8.692	28	1.736	7.488	2.779 (0.805)	−7.641 (0.235)
Peripheral exposure	93	0.307	0.351	68	0.355	0.373	27	0.347	0.298	21	0.336	0.300	−0.118 (0.585)	−0.059 (0.611)

This table contains summary statistics for a sample of EU banks over 2010–2016. The second-last column reports difference-in-differences estimates over the pre-treatment period, between 2013 and 2010, for treated and untreated executives/banks. The last column reports difference-in-differences between 2014–2016 and 2010–2013 for treated and untreated executives/banks. The  $p$ -values (in parentheses) are computed from  $t$ -tests with standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

an executive with a maximum variable-to-fixed compensation  $\rho$  of 240% as of 2013 has a treatment intensity of 0.4. This approach improves the precision of empirical estimates.  $Post_t$  is an indicator variable, equal to 1 from 2014 onward.

Executive-level control variables  $\mathbf{x}_{it}$  comprise age, a CEO indicator, professional experience, a retirement age indicator (1 if the executive is older than 65 years), a female indicator, and tenure. Then  $\mathbf{z}_{jt(-1)}$  comprises bank-level control variables: size (natural logarithm of total assets), risk-adjusted performance as proxied by the lagged Sharpe ratio (hence the  $(-1)$  in the subscript of  $\mathbf{z}_{jt(-1)}$ ), the number of executives serving on the board, and an indicator for CEO turnover. To approximate the outside options of executives, at least indirectly, we follow Custódio et al. (2013) and use a principal component analysis of employment history information (see Internet Appendix Table IA1 for the computational details).

We specify year and bank fixed effects, denoted by  $\alpha_t$  and  $\alpha_j$ , to control for changes in aggregate conditions and unobservable, time-invariant bank traits. For ease of notation, we do not report direct terms of  $Treatment\ intensity_t$  in Equation (2). Note that  $Post_t$  is absorbed by year fixed effects, and standard errors are clustered at the bank level.

We use the specification in Equation (2) to examine executive turnover rates in EU banking around the introduction of the bonus cap and show the results from the DiD tests in Table 2. In columns 1 to 3, the dependent variable is an indicator variable equal to 1 for any turnover. Column 1 shows that the average turnover rate of treated executives is significantly higher in the post-bonus cap period than is that of non-treated executives.<sup>5</sup> To examine this result in more depth, we consider the turnover behavior of non-CEO executives (column 2), where we control for departing CEOs with an indicator variable, separately from that of CEOs (column 3) to ease the comparison with the existing CEO turnover literature. The point estimate of the change in

<sup>5</sup> We also account for well-known determinants of executive turnovers, which are more likely at smaller and worse performing banks and if executives are close to retirement age and have more professional experience. Point estimates for these covariates are generally insignificant.

**Table 2**  
Executive turnover.

Dependent variable:	Turnover			Turnover (poor perf.)		
	All	Ex-CEOs	CEOs only	All	Ex-CEOs	CEOs only
	(1)	(2)	(3)	(4)	(5)	(6)
Treat. int.	-0.027 (-0.99)	-0.027 (-0.85)		0.014 (0.93)	0.009 (0.41)	
Post × Treat. int.	0.054** (2.27)	0.034 (1.36)	0.116** (2.50)	0.039* (1.95)	0.025 (1.16)	0.088** (2.25)
Sharpe ratio (lag)	-0.020 (-0.96)	-0.043 (-1.48)	0.005 (0.32)	-0.030* (-1.86)	-0.058** (-2.61)	0.017 (1.05)
# Executives	-0.066*** (-3.89)	-0.071*** (-4.38)	-0.051* (-1.81)	-0.043** (-2.52)	-0.051** (-2.62)	-0.031 (-1.21)
Bank size	-0.046 (-0.34)	0.125 (0.71)	-0.536** (-2.33)	-0.350** (-2.25)	-0.268 (-1.28)	-0.568** (-2.17)
Age	-0.001 (-0.39)	-0.000 (-0.11)	0.011 (1.51)	-0.001 (-0.62)	-0.001 (-0.45)	-0.000 (-0.03)
Retirement age	0.105* (2.03)	0.055 (0.99)	0.027 (0.37)	0.056* (2.00)	0.043 (1.06)	0.028 (0.42)
Female	-0.081* (-1.72)	-0.092 (-1.70)	0.116 (0.74)	-0.043 (-0.89)	-0.055 (-0.88)	0.007 (0.04)
Tenure	0.006 (1.38)	0.005 (1.22)	0.037** (2.39)	0.005 (1.57)	0.004 (0.82)	0.028 (1.63)
Prof. experience	0.006 (0.71)	0.000 (0.02)	0.014 (0.31)	0.005 (0.72)	-0.004 (-0.42)	0.028 (0.58)
CEO	-0.050** (-2.19)			-0.031* (-1.70)		
CEO turnover		-0.044 (-0.36)			-0.036 (-0.30)	
Bank and executive controls	X	X	X	X	X	X
Year fixed effects	X	X	X	X	X	X
Bank fixed effects	X	X	X	X	X	X
# Executives	130	106	35	130	106	35
# CEOs	36	0	35	36	0	35
# Banks	32	27	29	32	27	29
Mean(y)	0.109	0.125	0.060	0.080	0.091	0.046
S.D.(y)	0.312	0.331	0.238	0.272	0.288	0.211
R <sup>2</sup>	0.221	0.233	0.438	0.188	0.196	0.418
N	561	408	151	561	408	151

This table reports estimates from difference-in-differences regressions (linear probability models) for turnover of executives around the introduction of the bonus cap of 2013, analyzing separately all executives, non-CEO executives, and CEOs. The sample covers executives of EU banks between 2010 and 2016. In columns 1 to 3, the dependent variable is *Turnover*, an indicator variable equal to 1 if the executive leaves the board of the bank in a given year. In columns 4 to 6, the dependent variable is *Turnover (poor perf.)*, an indicator variable equal to 1 if the executive leaves the board of the bank and the bank's ROE is below the median in the previous year. Treated executives are those whose maximum variable-to-fixed compensation ratio exceeds 200% as of 2013. *Treatment intensity* is (1) equal to 0 for executives in the control group and (2) equal to the distance between  $\rho$  (maximum variable-to-fixed compensation) and 200% as of 2013 for treated executives. *Post* is an indicator variable equal to 1 from 2014 onward. All specifications include bank and executive control variables (bank size, lagged Sharpe ratio, number of executives serving on the board, age, a retirement age indicator, tenure, a female indicator, and professional experience). In columns 2 and 5, we also control for CEO turnover. The sample in columns 2 and 5 includes only non-CEO executives. The sample in columns 3 and 6 includes only CEOs. Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

the turnover rate of non-CEO executives is insignificant. This result indicates that the significant effect for the full sample hinges on departing CEOs.<sup>6</sup>

The true nature of turnover is ultimately unobservable; we do not know if turnovers are due to executives' or employers' choices. But turnover at well-performing banks is arguably more likely to originate from executives' choices and therefore offers a plausible approximation of voluntary turnovers. Conversely, turnover at poorly performing banks is consistent with executives being forced to leave.<sup>7</sup> In columns 4 to 6, we use as dependent variable an indicator equal to 1 only for executive turnover events at banks with below-median performance—as measured by the bank's return on equity (ROE) relative to the

<sup>6</sup> Specifying bank fixed effects implies that the estimation hinges on the presence of CEO attrition. We observe 9 CEO turnover events over a sample of 35 CEOs from 29 banks. Seven banks employ more than one CEO during the sample period. The turnover results are qualitatively similar without bank fixed effects and are available upon request.

<sup>7</sup> Identifying forced and voluntary turnovers through news searches, as Jenter and Kanaan (2015) do, is infeasible due to the sparse media coverage of non-CEOs. We follow the intuition of Jenter and Lewellen (2021) and analyze turnover rates at different performance levels. A limitation of this approach is to "misclassify" voluntary turnovers at poorly performing banks and forced turnovers at well-performing ones, which applies to all tests using *Turnover (poor performance)* as dependent variable as well.

**Table 3**  
Executive turnover, managerial skills, and bank performance.

Dependent variable:	Turnover			Turnover
	(1)	(2)	(3)	(poor perf.)
Post × Treat. int. × High exp.	0.050 (0.86)			
Post × Treat. int. × Top total pay		−0.050 (−1.57)		
Post × Treat. int. × Top var. pay			−0.035 (−1.04)	
Post × Treat. int. × Sharpe ratio (lag)				−0.043 (−0.95)
Bank and executive controls	X	X	X	X
Year fixed effects	X	X	X	X
Bank fixed effects	X	X	X	X
# Executives	130	122	122	130
# CEOs	36	34	34	36
# Banks	32	30	30	32
Mean(y)	0.109	0.117	0.117	0.086
S.D.(y)	0.312	0.322	0.322	0.280
R <sup>2</sup>	0.231	0.233	0.229	0.248
Observations	561	521	521	561

This table reports estimates from difference-in-differences regressions (linear probability models) for executive turnover, conditional on their skills and bank performance around the introduction of the bonus cap of 2013. The sample covers executives of EU banks between 2010 and 2016. The dependent variable in columns 1 to 3 is *Turnover*, an indicator variable equal to 1 if the executive leaves the board of the bank in a given year. In column 4, the dependent variable is *Turnover (poor perf.)*, an indicator variable equal to 1 if the executive leaves the board of the bank and the bank's ROE is below the median in the previous year. Treated executives are those whose maximum variable-to-fixed compensation ratio exceeds 200% as of 2013. *Treatment intensity* is (1) equal to 0 for executives in the control group and (2) equal to the distance between  $\rho$  (maximum variable-to-fixed compensation) and 200% as of 2013 for treated executives. *Post* is an indicator variable equal to 1 from 2014 onward. The specification in column 1 includes a triple interaction term with *High exp.*, an indicator variable equal to 1 if *Professional experience* is above its median for a given executive. The specification in column 2 includes a triple interaction term with *Top total pay*, an indicator variable equal to 1 if the executive is the highest paid (or the second highest paid) within the board in terms of total compensation (for boards with at least five executives). The specification in column 3 includes a triple interaction term with *Top var. pay*, an indicator variable computed in the same way but based on variable compensation. The specification in column 4 includes a triple interaction term with *Sharpe ratio (lag)*. Double interactions and direct terms are omitted to conserve on space, but are available upon request. All specifications include bank and executive control variables (bank size, lagged Sharpe ratio, number of executives serving on the board, age, a retirement age indicator, tenure, a female indicator, professional experience, and a CEO indicator). Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

other banks' in the previous year—and to 0 otherwise.<sup>8</sup> Our estimates suggest that the frequency of turnover events at below-median performing banks increases significantly for treated executives. This result is mostly driven by performance-induced turnover events involving CEOs. Consistent with the evidence that non-CEO executive turnover is relatively less sensitive to performance, this result suggests that firm performance gauges productivity well only for CEOs (Fee and Hadlock, 2004).<sup>9</sup>

But the increase in the turnover rate during bad treated bank-years does not suffice to conclude that most attrition is forced. Some underperforming banks may have been unable to retain their best executives (especially CEOs) after the bonus cap introduction. If the most talented executives are called on to deal with the toughest restructuring cases, this human capital pool has more degrees of freedom to decide to leave, in case of unsatisfactory turnaround missions. We therefore augment our empirical strategy with explicit proxies for the quality of executives in Table 3 to tease out possible differential changes in turnovers that reflect forced versus voluntary departures, conditional on observable executive traits. The proxies for executives' skill gauge the attractiveness of their outside option and thus the ease of leaving their current position. In column 1, we add a triple interaction with the indicator variable *High experience*, which equals 1 if the professional experience measure exceeds the median (Custódio et al., 2013). In columns 2 and 3, we assume that the best executives are also the highest paid in the bank and measure skills by compensation in the pre-bonus cap period. The indicator variable *Top total pay* in column 2 equals 1 if the executive receives the highest (or second highest) total compensation on the board (for boards with at least five executives). The indicator variable in column 3 is computed identically but refers to variable compensation (*Top var. pay*). No statistically significant pattern across different degrees of professional experience or compensation levels emerges, reinforcing the idea that executives' voluntary turnovers are not more likely after the introduction of the bonus cap.

Then, provided that the bonus cap produces a shift toward a safer compensation structure, executives' total compensation may become less exposed to poor performance. Banks may use forced turnovers as a substitute form of discipline for weak

<sup>8</sup> Executive performance is often evaluated relative to peers, and key performance indicators are often linked to short-term metrics like ROE, which depends on leverage (Engel et al., 2003). Using return on assets (ROA) yields similar results that are available upon request.

<sup>9</sup> Specific national regulations could confound the estimation of bonus cap effects on the characteristics of incoming directors, such as heterogeneous approaches to regulating the share of female board members across EU countries (Jourová, 2016). Therefore, we also specified country-by-year fixed effects in the turnover regressions. The qualitatively identical results are available upon request.

**Table 4**  
Executive compensation structure.

Dependent variable:	Max. var.	Var.	Fixed	Max. var.	Expected	Expected
	to fixed	comp.	comp.	comp.	pay, pre prob.	pay, post prob.
	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treat. int.	-0.896*** (-6.78)	-527.269** (-2.22)	343.651*** (3.14)	-858.713*** (-4.06)	-5.470 (-0.03)	-304.492 (-0.99)
Bank size	0.700** (2.22)	-115.650 (-0.36)	-259.387 (-0.84)	354.250 (0.68)	64.062 (0.13)	251.167 (0.54)
ROE	-0.000 (-0.06)	4.719* (1.71)	3.191** (2.21)	4.714*** (2.94)	5.722*** (3.29)	6.669*** (3.98)
# Executives	0.004 (0.11)	25.007 (0.79)	20.398 (0.83)	47.943 (0.76)	38.919 (0.77)	39.924 (0.82)
Age	-0.102* (-1.75)	74.447 (1.37)	91.284 (1.33)	33.089 (0.39)	100.336 (1.07)	134.355 (1.26)
Tenure	-0.005 (-0.30)	-141.572 (-1.17)	-115.269 (-1.20)	-391.656 (-1.29)	-264.005 (-1.16)	-248.837 (-1.07)
Professional experience	0.294 (1.52)	-7.432 (-0.06)	-37.130 (-0.23)	406.274* (1.80)	125.726 (0.34)	-246.264 (-0.71)
CEO	-0.148 (-0.54)	441.345 (1.66)	493.584** (2.66)	1305.946* (1.92)	1196.544** (2.37)	1109.611** (2.57)
Year fixed effects	X	X	X	X	X	X
Bank fixed effects	X	X	X	X	X	X
Executive fixed effects	X	X	X	X	X	X
# Executives	185	200	200	185	158	163
# CEOs	51	52	52	51	44	46
# Banks	44	45	45	44	37	39
Mean(y)	1.126	521.452	1058.330	1525.059	1718.688	1729.927
S.D.(y)	1.207	1047.108	758.716	2431.648	1733.656	1691.123
R <sup>2</sup>	0.871	0.764	0.822	0.893	0.898	0.874
N	855	989	989	853	722	737

This table reports estimates from difference-in-differences regressions for the compensation structure of executives around the introduction of the bonus cap of 2013. The sample covers executives of EU banks over the years between 2010 and 2016. The dependent variables are *Maximum variable compensation to fixed* (column 1), *Variable compensation* (column 2), *Fixed compensation* (column 3), *Maximum variable compensation-to-fixed* (column 4), *Expected pay based on pre-probabilities* (column 5), and *Expected pay based on post-probabilities* (column 6). Treated executives are those whose maximum variable-to-fixed compensation ratio exceeds 200% as of 2013. *Treatment intensity* is (1) equal to 0 for executives in the control group and (2) equal to the distance between  $\rho$  (maximum variable-to-fixed compensation) and 200% as of 2013 for treated executives. *CEO* is an indicator variable equal to 1 if an executive serves as the CEO. *Post* is an indicator variable equal to 1 from 2014 onward. All specifications include bank and executive control variables (bank size, current-year ROE, number of executives serving on the board, age, tenure, professional experience, and a CEO indicator). Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

performance. Such a change in governance practice would lead to the observed higher turnover rate at treated banks with poor performance. If so, we would expect a positive differential effect on the performance sensitivity of turnover events in the presence of below-median bank performance. Column 4 of Table 3 contains the results of a triple DiD regression that analyzes the role of risk-adjusted performance for such turnover events. We do not find evidence of a significant relationship between turnover sensitivity and risk-adjusted performance.

Overall, we find no evidence that banks fail to retain their executives following the bonus cap. Whereas the average attrition of all executives increases after the regulatory shock, this surge is driven by treated CEOs at under-performing banks.<sup>10</sup>

## 5.2. Compensation structure

The preceding section documents that CEOs at poorly performing banks exhibit higher turnover rates under the bonus cap, whereas non-CEO executives at well-performing banks are not more likely to leave. Are the dynamics of compensation structure adjustment around the bonus cap consistent with turnover patterns too?

We estimate Equation (2) using the maximum variable-to-fixed compensation ratio, variable compensation, fixed compensation, maximum variable compensation, and expected compensation as dependent variables. The executive-level controls comprise age, tenure, professional experience, and a CEO indicator. Bank-level controls comprise size, current-

<sup>10</sup> We also collect data on career trajectories after a turnover from news stories and professional networking websites to explore subsequent employers of bank executives who leave. We identify 101 turnover events among treated banks, of which only a quarter are departures for another executive position (Internet Appendix Table IA2).

year ROE, and the number of executives serving on the board. Each specification controls for bank and executive characteristics, as well as for year, bank, and executive fixed effects.<sup>11</sup>

Table 4 contains the estimation results. Column 1 focuses on the quantity directly regulated by the bonus cap: the maximum variable-to-fixed compensation ratio. We observe a large and statistically significant decrease for the treated group. The parameter estimate of almost  $-1$  implies that variable and fixed compensation components were on average adjusted in such a way to comply with the new regulation, holding expected total compensation approximately constant. This adjustment was accomplished through a significant, economically substantial reduction of executives' variable compensation grant levels after the reform (column 2). The point estimate implies that the average executive received roughly 500,000 euro less in variable compensation after the introduction of the bonus cap compared with executives who complied already as of 2013. Treated executives received on average 350,000 euro more in fixed compensation following the bonus cap (column 3). In contrast, maximum variable compensation exhibits a large and statistically significant decrease (column 4). Decomposing the result on the maximum variable-to-fixed compensation ratio in column 1 suggests that banks responded to the regulatory shock by indemnifying their executives, as in case 3 from Section 3.

In columns 5 and 6 we test if banks complied in a way that left executives' expected pay unchanged around the introduction of the bonus cap. We approximate the probability to earn variable compensation by the ratio of variable grants over maximum variable grants per director. We refer to this measure as the goal achievement rate. Expected pay is computed as the sum of fixed pay and the maximum variable pay times the goal achievement rate. In column 5, the goal achievement rate is computed over the pre-bonus cap period. To gauge possible changes in managerial effort induced by the bonus cap, column 6 computes the goal achievement rate over the pre- and post-bonus cap periods. Treated executives do not exhibit any statistically significant change in expected pay. Thus, banks seem to offer contract adjustments that do not make managers worse off around the introduction of the bonus cap. Put differently, banks indemnified their executives and adjust contracts so that their expected compensation remains unchanged.

To corroborate the validity of our DiD tests, the left column in Fig. 2 plots different measures of compensation (maximum variable-to-fixed compensation ratio, fixed compensation, and expected pay) around the introduction of the bonus cap for treated and control groups. The evolution of these measures for treated and untreated executives is consistent with the parallel trend assumption, because they only diverge as of 2014.<sup>12</sup> The contraction of the ratio of maximum variable-to-fixed pay is mirrored by the hike in fixed grants as of 2014, depicted in the second graph of the first column. Expected pay does not respond significantly, which is consistent with the indemnification narrative.

We also discuss in Section IA.1 of the Internet Appendix if these results on compensation structure hinge on CEOs, given that this group of executives also drives the result of more frequent departures. Internet Appendix Table IA3 demonstrates that this is not the case. In Section IA.2 of the Internet Appendix, we further discuss potential effects of the bonus cap on pay-for-performance sensitivity. Overall, Internet Appendix Figure IA.2 and Table IA4 show that pay-for-performance sensitivity does generally not change significantly around the introduction of the bonus cap.

Going back to Fig. 1, the overall evidence suggests several effects of the EU cap: (1) an increase of the lower bound of pay (fixed salary), (2) a decrease of the upper bound of pay (fixed salary plus maximum variable compensation), and (3) an insignificant change of the slope of the schedule within the incentive zone. Together, these findings point to a compressed incentive region after the EU cap. More managers may reach targeted performance levels more easily, which may reduce their incentives to exert effort.

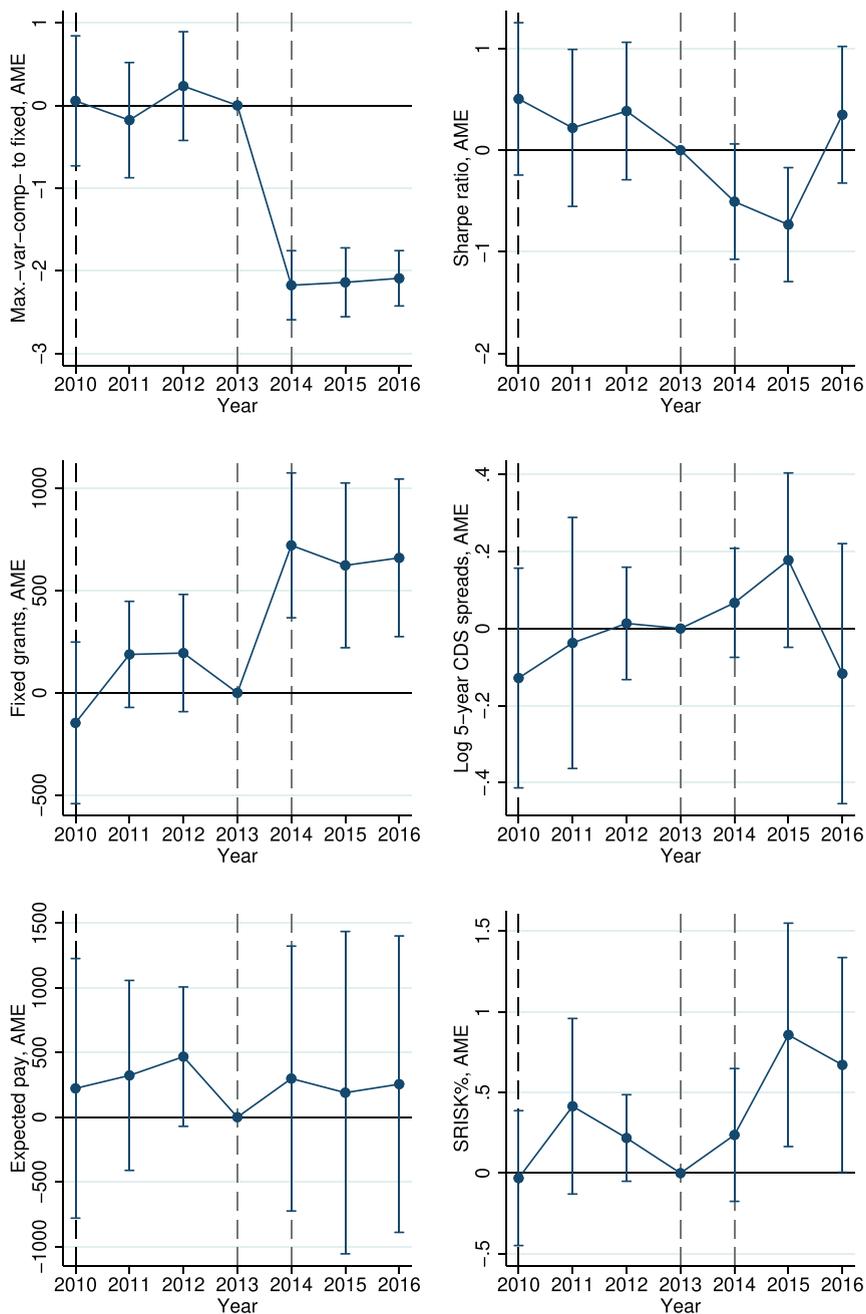
### 5.3. Bank performance

Banks are highly interconnected institutions, in which the different objectives of multiple interest groups interact and possibly conflict. The bonus cap, by changing the executives' compensation structure, alters the agency relationship between bank management and these interest groups. Key stakeholders are equity owners and creditors, who hold direct claims on the asset value of the bank, but have different payoff functions. Shareholders are residual claimants who are more keen on risk-taking relative to the creditors who hold senior claims. The seniority differences of claims can generate agency conflicts between owners and creditors, especially if the bank is approaching distress. Therefore, we examine bank-specific performance measures related to equity and debt claims around the introduction of the EU cap.

In addition to this conventional agency conflict, explicit and implicit public guarantees on banks' debt imply potential negative externalities beyond the individual banking firm (see Section 3). Therefore, we also consider systemic risk responses to the bonus cap to gauge implications for the financial stability of the banking system, in which the public has an interest. But despite the importance that policymakers assign to safeguarding financial stability (European Central Bank, 2009), systemic risk remains an elusive theoretical concept (Allen and Carletti, 2013) that is difficult to measure empirically or forecast in a consistent way (Benoit et al., 2017; Loeffler and Raupach, 2018; Banulescu-Radu et al., 2021). Most scholars agree on a range of mutually non-exclusive drivers of systemic crises, such as common exposures of banks to overvalued assets that are subject to sudden corrections, subsequent liquidity freezes, and fire sales that cause financial market breakdowns. Gridlock in financial markets fuels the contagion of insolvency risk through observable and unobservable financial networks among banks

<sup>11</sup> Our results are robust to the exclusion of executive fixed effects and available upon request.

<sup>12</sup> Internet Appendix Figure IA.1 provides the same test for other executive and bank variables.



**Fig. 2. Compensation structure, bank performance, and the introduction of the bonus cap**

This figure shows the evolution of selected executive- and bank-level variables around the introduction of the bonus cap. We show the average marginal effect (AME) of the bonus cap on executive traits in the left column (maximum variable-to-fixed pay ratio, fixed grants, and expected pay) and for bank performance in the right column (Sharpe ratio, CDS spreads, and SRISK%), year-by-year. These values are obtained by estimating the coefficients  $\beta_t$  from the following specification:

$$y_{(ij)t} = \sum_t \beta_t \cdot Treated_{(ij)} \times \mathbf{1}_{\{Year=t\}} + \alpha_j + \alpha_t + \varepsilon_{jt}.$$

$Treated_{(ij)}$  is equal to 1 if the executive has a non-compliant compensation plan for person-level specifications or if the bank  $j$  has at least one executive whose compensation structure is non-compliant with the bonus cap as of 2013 (maximum variable-to-fixed compensation ratio > 200%), and 0 otherwise. The specification includes bank ( $\alpha_j$ ) and year ( $\alpha_t$ ) fixed effects. The sample comprises EU banks over 2010–2016, using 2013 as the reference year. The dashed vertical lines denote the points in time at which the bonus cap was introduced (2013) and at which it became binding (2014). Vertical bars indicate 90% confidence intervals.

**Table 5**  
Bank performance.

Dependent variable:	Sharpe ratio (in %)	Log 5-year excess CDS spread	SRISK%	$\Delta$ CoVaR	Beta
	(1)	(2)	(3)	(4)	(5)
Post $\times$ Treat. int.	-0.108 (-0.82)	0.310*** (3.84)	0.689*** (2.79)	-1.435 (-1.02)	0.142** (2.39)
Bank fixed effects	X	X	X	X	X
Country-year fixed effects	X	X	X	X	X
# Banks	30	17	30	23	30
Mean(y)	0.025	0.997	2.321	23.099	1.433
S.D.(y)	1.048	0.738	2.505	10.025	0.413
R <sup>2</sup>	0.788	0.974	0.977	0.901	0.835
N	189	111	189	143	189

This table reports estimates from difference-in-differences regressions for different bank performance metrics around the introduction of the bonus cap in 2013. The sample covers EU banks between 2010 and 2016. The dependent variables are *Sharpe ratio* (column 1), *Log 5-year excess CDS spreads* (column 2), *SRISK%* (column 3),  $\Delta$ CoVaR (column 4), and *Beta* (column 5). *Treatment intensity* is the average treatment intensity of executives within a bank as of 2014 (based on those executives for whom *Post  $\times$  Treated* = 1, where *Treated* is the executive-level binary treatment indicator). *Post* is an indicator variable equal to 1 from 2014 onward. Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

(Glasserman and Young, 2016; Bosma et al., 2019), some of which are considered too big, too connected, too many, or otherwise too important to fail, triggering government intervention (Acharya and Yorulmazer, 2007; Brown and Dinc, 2009; Farhi and Tirole, 2012; Freixas and Rochet, 2013). Given this ambiguity regarding the sources of systemic financial crises, we remain agnostic and use several proxies.

To measure the relationships between the bonus cap and bank performance indicators, we specify Equation (2) at the bank level, because we do not observe individual executives' performance in terms of return or risk-taking. *Treatment intensity<sub>j</sub>* at the bank level equals the average intensity across executives serving on a bank's board, as of the enforcement of the EU cap. Thus, it refers to the same executives that are in the post-treatment sample in executive-level regressions. An important difference of these bank-level analyses relative to executive-level regressions involves the potential for bias due to confounding regulatory events. The latter isolate responses, in the form of changes to turnover and compensation towards the bonus cap by exploiting variation within banks and across executives. Any regulation affecting entire banks identically would not contaminate executive-level responses. But bank-level exposure to other relevant regulations imposed around the same time poses a challenge to isolate the bonus cap effect on bank performance if it correlates with *Treatment intensity<sub>j</sub>*.

We tackle this challenge by saturating bank-level specifications with country-by-year instead of year fixed effects, in addition to bank-specific fixed effects. Thereby, we purge all variation in bank performance that is attributable either to confounding national legislation, such as heterogeneous deposit insurance schemes and bailout practices, and the regulation of gender quotas on boards per country (Jourová, 2016).<sup>13</sup> We disregard control variables because they are arguably endogenous to bank return and risk, thus qualifying as "bad controls" (Angrist and Pischke, 2009).

The unconditional pre- and post-treatment summary statistics reported in Table 1 indicate that the parallel trends assumption is not violated when we compare cross-sectional average changes of the variables of interest before the bonus cap was introduced (2010–2013). To further inspect the parallel trend assumption over time, we depict estimated average marginal effects (AMEs) of the bonus cap on three main bank-level outcome variables by interacting a binary treatment indicator with year-specific indicators. The plotted AMEs in the right column of Fig. 2 reveal the non-violation of the parallel trends assumption during the pre-treatment period. Neither the risk-adjusted return proxy (Sharpe ratio), nor the idiosyncratic (CDS spreads) and systemic risk (SRISK%) measures exhibit significant differences across bank treatment status in the pre-cap years. The Sharpe ratio and SRISK% respond significantly in at least one post-treatment year, pointing to a temporary deterioration of returns and systemic risk hikes. Yet the benefit of an intuitive visualization as in Fig. 2 implies important costs. First, obtaining sufficiently precise point estimates of differences across numerous strata in this small sample is challenging due to low statistical power. Second, the binary treatment indicator used to depict the AMEs gauges bank-specific exposure to the bonus cap less precisely than the intensity measure specified in the executive-level regressions so far. Third, we do not account for unobserved confounding shocks by means of country-by-year fixed effects.

We refine this preliminary evidence and conduct another DiD analysis in Table 5. The Sharpe ratio of treated banks, shown in column 1, does not respond significantly to the policy shock. This result suggests that the reform did not alter shareholders' position in the bank, once we augment the bank-level specifications with country-by-year fixed effects. The bonus cap appears to exert no additional impact on shareholder performance above and beyond any variation in country-specific business cycles or regulatory environments, like deposit insurance schemes or bank bailout practices.

<sup>13</sup> Hence, we cannot fit performance regressions for single-bank countries (see Appendix Table A1). Specifications with bank- and year-fixed effects yield qualitatively identical results. Confounding regulations in executive-level analyses leave the results unaffected and are available upon request.

**Table 6**  
U.S. executives/banks as the control group.

Panel A: Director-level outcomes					
Dependent variable:	Turnover	Turnover (poor perf.)	Fixed comp.	Var. comp.	
	(1)	(2)	(3)	(4)	
Post × Treat. int.	0.049** (2.32)	0.041* (2.02)	220.760*** (2.88)	-841.659*** (-6.49)	
Bank and executive controls	X	X	X	X	
Year fixed effects	X	X	X	X	
Bank fixed effects	X	X	X	X	
Executive fixed effects		X	X	X	
# Executives	276	276	231	231	
# CEOs	41	41	41	41	
# Banks	34	34	33	33	
Mean(y)	0.118	0.076	1226.256	3525.117	
S.D.(y)	0.323	0.265	907.352	3327.529	
R <sup>2</sup>	0.069	0.081	0.756	0.895	
N	1042	1042	1055	1055	
Panel B: Bank-level outcomes					
Dependent variable:	Sharpe ratio (in %)	Log 5-year excess CDS spread	SRISK%	ΔCoVaR	Beta
	(1)	(2)	(3)	(4)	(5)
Post × Treat. int.	0.035 (0.72)	0.169*** (7.40)	0.512*** (3.91)	-0.476 (-0.69)	0.093*** (3.86)
Bank fixed effects	X	X	X	X	X
Country-year fixed effects	X	X	X	X	X
# Banks	32	16	32	30	32
Mean(y)	0.731	3.213	2.528	23.703	1.131
S.D.(y)	1.225	1.434	4.202	9.029	0.319
R <sup>2</sup>	0.605	0.978	0.936	0.788	0.877
N	218	110	218	206	218

This table reports estimates from difference-in-differences regressions around the introduction of the bonus cap in 2013. The sample period is 2010–2016. The dependent variables are executive-level outcomes in Panel A and bank-level outcomes in Panel B. The treatment sample covers executives of EU banks fulfilling the conditions laid out below. The control sample covers the top executives from the largest 25 U.S. banks as of 2013. Treated executives are those EU banks' executives whose maximum variable-to-fixed compensation ratio exceeds 200% as of 2013. In Panel A *Treatment intensity* is equal to 0 for executives in the control group and equal to the distance between  $\rho$  (maximum variable-to-fixed compensation) and 200% as of 2013 for treated executives. In Panel B, *Treatment intensity* is the average treatment intensity of executives within a bank as of 2014 (based on those executives for whom  $Post \times Treated = 1$ , where *Treated* is the executive-level binary treatment indicator). *Post* is an indicator variable equal to 1 from 2014 onward. All specifications correspond to the most saturated ones in Table 2, Table 4, and Table 5. Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

The implications differ from a creditor perspective. We use spreads on CDSs written on banks' five-year bonds—the most liquid contract of the CDS market (e.g. Kim et al., 2013)—, to measure credit risk over the corresponding horizon. We specify banks' excess CDS spreads relative to their corresponding sovereign CDS spread as the dependent variable in column 2 to capture idiosyncratic credit risk. Treated banks' credit risk increased after the regulatory shocks, compared with untreated peers.

Next, we specify proxies for systemic and market risk. In column 3, SRISK% measures the bank's fraction of capital shortfall, conditional on a large drop of the European financial market value adjusted for the size and leverage of the bank (Acharya et al., 2016; Brownlees and Engle, 2017). This systemic risk indicator increased significantly after the policy shock. However, different systemic risk measures can give conflicting or even misleading signals (Loeffler and Raupach, 2018), so inference regarding systemic risk is sensitive to the chosen metric. In column 4, we therefore specify ΔCoVaR as the dependent variable, which equals the end-of-year difference between the value-at-risk of the financial system when a bank is distressed versus when it exhibits median performance (Adrian and Brunnermeier, 2016). Whereas SRISK% captures the consequences of a system meltdown for an individual bank, ΔCoVaR measures the contribution of an individual bank to aggregate systemic risk. Treated banks do not exhibit statistically different ΔCoVaR after the introduction of the bonus cap. In sum, banks' vulnerability in terms of critical undercapitalization in very adverse market scenarios increased, but the contribution of the average bank to the entire system's value-at-risk did not change in response to the bonus cap. Finally, treated banks exhibit a statistically significant increase in their market risk, as gauged by beta in column 5.

Together, these results document increases in idiosyncratic credit risk, SRISK% as one dimension of systemic risk, and non-diversifiable market risk around the introduction of the bonus cap. For most other bank performance metrics, we do not find

any statistically significant response (see Internet Appendix Table IA.5). In sum, we do not find evidence of a risk reduction, which was a major objective of the bonus cap regulation in the EU.

## 6. Robustness and limitations

### 6.1. U.S. executives as an alternative control group

A key challenge in our empirical analysis is potential selection bias. Highly skilled executives are more likely to work in large banks and receive high-powered incentives and are thus more likely treated. Therefore, we specified covariates to gauge managers' skills and risk appetite, as well as banks' abilities to retain human capital and perform standard diagnostic tests. Still, we cannot rule out the possibility that the treatment assignment is to some extent non-random in the DiD design.

To address the lack of a clear counterfactual for the EU-wide introduction of a bankers' bonus cap, we define an alternative control group. We sample top executives from the largest U.S. banks to complement the baseline choice of untreated EU bankers, which enriches our analysis in two main ways. First, U.S. banks' executives are not directly affected by the bonus cap introduced in the EU. Second, this alternative control group allows us to compare the EU banks in which treated executives are employed to U.S. institutions that are similar in terms of size and business model. The compensation packages of treated EU executives should be more similar to top executives' pay at large U.S. banks than they are to pay at untreated EU banks. The difference in CEO pay between U.S. and non-U.S. CEOs is moderate when comparing firms with similar characteristics across countries (Fernandes et al., 2013). The U.S. control group also alleviates concerns about executives' self-selection into the treatment.

Following Boyallian and Ruiz-Verdú (2017), we identify U.S. banks in ExecuComp, rank them by asset size as of 2013, and focus on the largest 25. ExecuComp generally reports on the five most paid executives for each firm, whom we all include in the control sample. We collect data on their turnover events, compensation packages, and bank-level variables. A limitation of this alternative control group is that ExecuComp provides awarded or realized variable compensation, but no maximum variable compensation. Therefore, we prefer to use EU banks' untreated executives in the baseline analysis.

Table 6 shows estimates from DiD specifications using this alternative control sample. In Panel A, we analyze executive turnover rates and compensation around the introduction of the bonus cap. We observe a general increase in the turnover rate of treated executives in the post-bonus cap period, driven by turnover events taking place after periods of poor bank performance. This result reinforces our finding that the bonus cap did not lead to a surge in voluntary turnovers. We also find again a positive and significant increase in fixed compensation (column 3) and a significant decline in variable compensation (column 4). Thus, EU treated executives appear to have been indemnified relative to their peers at U.S. banks around the introduction of the bonus cap.

In Panel B, we re-estimate DiD specifications for bank performance, using the same dependent variables. All key results described in Section 5.3 are confirmed. Risk-adjusted equity performance does not change significantly for treated banks around the bonus cap introduction, whereas their idiosyncratic credit risk rises significantly. Also SRISK% exhibits again a statistically significant increase after the policy shock, whereas the differential effect of  $\Delta\text{CoVaR}$  remains indistinguishable from zero. Market risk responses also remain significantly positive. The sign and magnitude of coefficients obtained previously in Table 5 and those using U.S. banks as the control group in Table 6 are similar.

### 6.2. Confounding events and UK sample bias

It is important to acknowledge that the bank-level results are less direct than those at the executive level. This limitation creates a second challenge, namely potentially confounding regulation events after the Great Recession. Many regulatory changes were introduced before the bonus cap, which alleviates some concerns. But the adjustments to these reforms also might have occurred over an extended period of time, thus overlapping and interacting with the bonus cap. In addition to such observable differences, unobservable country effects may be at work, such as in terms of non-synchronous business cycles, banking system distress, or diverging government bailout practices across EU countries after 2014. To account for possible unobserved confounding factors, we specify country-by-year fixed effects, as a first line of defense, in the bank-level tests.

But these may not suffice to rule out spurious effects due to other (regulatory) shocks. As a second line of defense, we therefore conduct falsification tests for selected events. One such event involves the 2013 Capital Requirements Regulation (CRR).<sup>14</sup> Together with the CRD IV, which contains the bonus cap, it implemented Basel III in the EU.<sup>15</sup> Specifically, the CRR reformed capital and liquidity requirements, which could confound our estimates of the effects of the bonus cap on bank performance and risk. Although effective as of 2014, the CRR's capital and liquidity requirements were subject to a phase-in period that ended only in 2019. For example, with regard to capital requirements before 2016 the phase-in focused solely on

<sup>14</sup> Regulation (EU) No. 575/2013 was enacted in 2013, but applies from 2014 onward, like the bonus cap. The CRR mainly addresses disclosure requirements for remuneration policies (see Art. 450).

<sup>15</sup> The CRD IV also introduced systemic risk buffers, which could affect bank riskiness. However, these buffers have not been activated in those EU economies that host most of the banks in our sample (Germany, France, U.K., Italy, Spain) as of 2020. See [https://www.esrb.europa.eu/national\\_policy/systemic/html/index.en.html](https://www.esrb.europa.eu/national_policy/systemic/html/index.en.html).

increasing the quality of regulatory capital (e.g., higher fraction of Tier 1 capital) and only required level increases after 2016, mainly through a new so-called conservation buffer.<sup>16</sup> In contrast, the EU bonus was fully implemented in 2014, without a phase-in process. Because of these discrepancies in the schedule of implementation, it is unlikely that our bank-level results are blurred by the EU implementation of the new Basel III requirements. Spurious effects still could arise if banks' exposures to the bonus cap correlated with changes in capital and liquidity requirements introduced at the same time. Therefore, we scrutinize the main results when controlling for changes in the level and composition of regulatory capital and liquidity. In the Appendix Table A3, we formally control for changes in Tier 1 capital levels, in the composition of regulatory capital, and in liquid assets, which could have been induced by the CRR.<sup>17</sup> These robustness tests do not alter the main findings.

Regulatory reforms aside, the European debt crisis hit banks to different degrees. Different exposures to sovereign debt may confound the effect of the bonus cap on bank-level outcomes. We replace *Treatment intensity* with bank-level exposure to the sovereign debt of stressed EU members (Greece, Ireland, Italy, Portugal, and Spain). We obtain bank sovereign debt holdings from the EBA Transparency Exercise of 2011, which was the first time this information was disclosed to the public. If the baseline analysis merely captures the lingering effects of the European debt crisis, we should observe the same patterns in bank performance and risk-taking in this specification. Appendix Table A4 reports estimates of this falsification test for bank-level performance measures. No clear pattern emerges, which supports our interpretation to associate the baseline responses with the bonus cap, although the reduced sample size (15 banks vs. 30 banks in Table 5) reduces the power of these tests.

Some banks in the sample (e.g., MPS, Dexia) were bailed out by national governments. These interventions could bias our analysis of the bonus cap, because bailouts were granted conditional on restricting bank managers' compensation. In Internet Appendix Table IA.6, we replicate the analysis of Table 5 without banks bailed out since the Great Recession.<sup>18</sup> The qualitative findings are generally robust to this adjustment. In sum, our main results remain consistent when we account for major confounding events.<sup>19</sup>

Because U.K. banks dominate the treatment group, our tests may capture spurious effects, such as a more investment banking-oriented business model or the more prevalent bonus culture at U.K. banks. In Internet Appendix Table IA.7, we exclude U.K. banks both from the treatment and control groups. The results remain virtually identical, with the exception of a negative significant change in expected compensation.

### 6.3. Limitations

The manually collected data and the empirical design are subject to limitations that warrant attention. First, both the executive and bank-level analyses hinge on relatively small samples, posing a general challenge to precise point estimations of coefficients. Our approach to saturate models at both levels of analyses with many fixed effects further increases the burden on the data to draw inferences. Whereas the overall tendencies of the effects are surprisingly robust across a wide range of scrutiny checks, we caution against putting too much emphasis on point estimates.

Second, the use of country-by-year fixed effects in bank-level analyses implies that we can only sample seven EU countries with more than one bank, whereas the maximum number of countries used for the analyses conducted at the executive level is 14. Although the qualitative robustness of empirical results obtained after excluding the U.K., home to most banks in the sample, bodes well for some general associations, we acknowledge that the regulatory perimeter of the bonus cap is larger than these countries.

Third, the collected compensation data refer to top executives in management boards. However, non-board executives and middle management, such as traders, might be subject to the bonus cap too if they qualify as material risk-takers. The compensation of non-executive material risk-takers is not reported publicly at an individual level though, so we cannot gauge the effect of changed incentives on managerial labor markets below the management board level, as is done, for example by Meekes and Ronchi (2022) for the banking industry in the Netherlands.

Fourth, approximations of banks' business choices that may drive risk taking, such as lending and funding decisions, do not change significantly after the bonus cap.<sup>20</sup> The unavailability of detailed data on relevant risk-taking choices within banks, for example changes to internal risk-controlling processes, the re-design of risk limits, or granular loan and investment choices, render it hard to identify empirically the reasons for significantly positive risk responses to the bonus cap.

Bearing these limitations in mind, the overarching empirical indications regarding the effects of the bonus cap on executive turnover, compensation structure, and bank performance yield robust results overall, with fairly few contradictions. Continued research efforts to collect and analyze compensation information for all material risk-takers in banking, thereby helping to identify how bonus caps shape risk-taking, are needed.

<sup>16</sup> Minimum total regulatory capital relative to risk-weighted assets stays at 8%, under Basel II, up to 2016. See [https://www.bis.org/bcbs/basel3/basel3\\_phase\\_in\\_arrangements.pdf](https://www.bis.org/bcbs/basel3/basel3_phase_in_arrangements.pdf).

<sup>17</sup> The CRR regulates liquidity with the so-called liquidity coverage, which is only sparsely reported in Bankscope before 2014. Thus, we use the ratio of liquid assets to short-term funding.

<sup>18</sup> The data are obtained from Table B.I of Carbó-Valverde et al. (2020), Table A3 of Bosma et al. (2019), and the state aid search engine of the European Commission.

<sup>19</sup> Unreported tests also demonstrate the irrelevance of the Single Supervisory Mechanism in 2013-14 or differences between global systematically important banks according to the FSB and small banks.

<sup>20</sup> The results from a series of reduced-form tests are available upon request.

## 7. Conclusion

Bankers' compensation has been subject to significant regulatory activity following the Great Recession, mainly aimed at enhancing financial stability. But the banking sector is characterized by higher returns to skill than other industries as well as a highly mobile workforce. Any regulation of compensation practices in banking thus can have important consequences for the managerial labor market, for example by reducing banks' abilities to retain their most skilled managers. Likewise, the consequences of compensation regulation for managerial risk-taking behavior are not obvious.

We examine changes of executive compensation structure, occupational choices by bank executives, and risk-taking in the banking sector in response to the introduction of the bonus cap in the EU in 2013. The bonus cap limits the maximum variable-to-fixed compensation ratio of executives in EU banks. We use a DiD approach to compare executives whose compensation structure in 2013 did not comply with the bonus cap against a control group of executives with compensation packages compliant with the regulation as of 2013.

At the executive level, the introduction of the bonus cap associates with an increase in average turnover rates of executives. This effect is driven by CEOs who departed from poorly performing banks. We do not find evidence that highly skilled executives generally depart the EU banking sector. The empirical results further indicate that banks comply with the regulation by offering their executives higher fixed and lower maximum variable compensation, such that their expected total compensation remained constant. Put differently, banks indemnified executives against the introduction of the bonus cap.

At the bank level, we do not find evidence of a decline in risk-taking around the introduction of the bonus cap. Selected empirical proxies for risk-taking even increased, whereas others as well as (risk-adjusted) returns did not respond significantly to the regulatory shock. This evidence holds across a wide range of robustness checks, which account for confounding policy shocks and alternative control groups.

Whereas our testing framework does not allow for causal statements, the empirical results suggest consistently that concerns about the bonus cap jeopardizing EU banks' ability to retain skilled managers may have been overstated. At the same time, we do not find any empirical support that the bonus cap regulation reduced risk in the EU banking sector, one of the purported policy objectives of EU regulators.

## Appendix. "Compensation Regulation in Banking: Executive Director Behavior and Bank Performance after the EU Bonus Cap "

**Table A.1**  
List of banks.

	Banks without treated executives	Country	Treat. exec.-years	Untr. exec.-years
1.	AAREAL BANK AG	DE	4	20
2.	BARCLAYS PLC	GB	12	0
3.	BBVA - BANCO BILBAO VIZCAYA ARGENTARIA SA	ES	11	0
4.	DEUTSCHE BANK AG	DE	26	6
5.	HSBC HLDGS PLC	GB	14	7
6.	LLOYDS BANKING GROUP PLC	GB	15	0
7.	ROYAL BANK OF SCOTLAND GROUP PLC	GB	10	0
8.	STANDARD CHARTERED PLC	GB	18	0
9.	UNICREDIT SPA	IT	7	0
	Banks without treated executives	Country	Treat. exec.-years	Untr. exec.-years
1.	ABN AMRO GROUP NV	NL	0	43
2.	BANCA MPS	IT	0	13
3.	BANCA POPOLARE DELL'EMILIA ROMAGNA SCARL	IT	0	34
4.	BANCA POPOLARE DI MILANO SCARL	IT	0	20
5.	BANCO COMERCIAL PORTUGUES SA	PT	0	30
6.	BANCO SABADELL SA	ES	0	17
7.	BANCO SANTANDER SA	ES	0	29
8.	BANK OF CYPRUS GROUP	CY	0	12
9.	BANK OF IRELAND	IE	0	12
10.	BANKIA SA	ES	0	8
11.	BANKINTER SA	ES	0	15
12.	BNP PARIBAS	FR	0	9
13.	BAYERNLB AG	DE	0	36
14.	CAIXABANK SA	ES	0	2
15.	COMMERZBANK AG	DE	0	54
16.	CREDIT AGRICOLE SA	FR	0	6
17.	COOPERATIEVE RABOBANK UA	NL	0	37

(continued on next page)

Table A.1 (continued)

	Banks without treated executives	Country	Treat. exec.-years	Untr. exec.-years
18.	DANSKE BANK AS	DK	0	2
19.	DEUTSCHE POSTBANK AG	DE	0	28
20.	DEXIA SA	BE	0	4
21.	DZ BANK AG	DE	0	47
22.	ERSTE GROUP BANK AG	AT	0	31
23.	GRUPPO BANCA CARIGE SPA	IT	0	21
24.	GROUPE BPCE SA	FR	0	22
25.	HELABA LANDESBANK HESSEN THUERINGEN	DE	0	31
26.	ING GROEP NV	NL	0	20
27.	INTESA SANPAOLO SPA	IT	0	51
28.	KBC GROUP NV	BE	0	18
29.	KFW GROUP	DE	0	27
30.	LANDESBANK BERLIN AG	DE	0	30
31.	LANDESBANK BADEN WUERTEMBERG AG	DE	0	31
32.	MEDIOBANCA SPA	IT	0	24
33.	SKANDINAVISKA ENSKILDA BANKEN AB	SE	0	7
34.	SOCIETE GENERALE SA	FR	0	7
35.	SVENSKA HANDELSBANKEN AB	SE	0	6
36.	UNIONE DI BANCHE ITALIANE SCPA	IT	0	61
	US banks in the alternative control group	Country	Treat. exec.-years	Untr. exec.-years
1.	AMERICAN EXPRESS CO	US	0	37
2.	AMERIPRISE FINANCIAL INC	US	0	34
3.	BANK OF AMERICA CORP	US	0	37
4.	BANK OF NEW YORK MELLON CORP	US	0	38
5.	CAPITAL ONE FINANCIAL CORP	US	0	34
6.	CITIGROUP INC	US	0	36
7.	COMERICA INC	US	0	37
8.	E TRADE FINANCIAL CORP	US	0	39
9.	FIFTH THIRD BANCORP	US	0	42
10.	FIRST NIAGARA FINANCIAL GRP	US	0	32
11.	FIRST REPUBLIC BANK	US	0	29
12.	GOLDMAN SACHS GROUP INC	US	0	36
13.	HUDSON CITY BANCORP INC	US	0	28
14.	HUNTINGTON BANCSHARES	US	0	42
15.	JP MORGAN CHASE & CO	US	0	37
16.	KEYCORP	US	0	35
17.	MORGAN STANLEY	US	0	34
18.	NEW YORK COMMUNITY BANCORP INC	US	0	35
19.	NORTHERN TRUST CORP	US	0	38
20.	PNC FINANCIAL SERVICES GROUP INC	US	0	39
21.	SCHWAB (CHARLES) CORP	US	0	38
22.	STATE STREET CORP	US	0	34
23.	SUNTRUST BANKS INC	US	0	35
24.	US BANCORP	US	0	36
25.	WELLS FARGO & CO	US	0	43

This table reports the maximum number of 45 banks, for which we collected compensation data and that are used, for example, in Table 4. We also report the 25 largest US banks used as an alternative control group. For each bank we show the home country as well as the treated and untreated executive-years based on the 200% threshold.

Table A.2

Definition of variables.

Variable	Databases	Definition
<i>Executive characteristics:</i>		
Turnover	BoardEx [ExecuComp]	Dummy variable that equals 1 if an executive leaves the board and 0 otherwise. We collected data on 2016 turnovers manually by checking banks' websites and news reports. [Executive turnover is set to 1 in the year after an executive has last been reported in ExecuComp, and 0 otherwise.]
Turnover (poor performance)	BoardEx, Bankscope and Orbis Bankfocus [ExecuComp and CCM]	Dummy variable equal to <i>Turnover</i> if the ROE of the respective bank is below the median of banks sampled in the previous year and 0 otherwise.

Table A.2 (continued)

Variable	Databases	Definition
CEO	Manually collected [ExecuComp]	Dummy variable that equals 1 if an executive is the CEO of the bank and 0 otherwise. We collected this information manually because the BoardEx database does not indicate the CEO in a board. [ExecuComp provides a CEO indicator.]
Professional experience	BoardEx	A variable derived from BoardEx data on executives' employment history using a principle component analysis like Custódio et al. (2013). Relevant information includes number of executive directorships, number of industries, number of firms, number of positions, and number of supervisory directorships.
Age	BoardEx [ExecuComp]	The age of the executive measured in years.
Retirement age	BoardEx [ExecuComp]	Dummy variable that equals 1 if an executive is older than 65 years of age and 0 otherwise.
Tenure	BoardEx [ExecuComp]	The number of years that an executive has served as an executive for the bank.
Female	BoardEx [ExecuComp]	Dummy variable that equals 1 if an executive is female and 0 otherwise.
High experience	BoardEx	Dummy variable that equals 1 if <i>Professional experience</i> is above its median for a given executive and 0 otherwise.
<i>Compensation structure:</i>		
Fixed compensation	Manually collected [ExecuComp]	Sum of fixed compensation grants in a year (i.e., salary, pensions, other fixed compensation, and fixed allowances). If banks do not report these subcategories, we take the aggregate value of fixed compensation. [For tests using the US control group fixed compensation is the one described above for EU executives and the sum of salary (salary), other components (othcomp), and pension contributions (pension_chg) for US executives.]
Variable compensation	Manually collected [ExecuComp]	Sum of variable grants in a year (i.e., grants that relate to bank performance of up to the reporting year). [For tests using the US control group, variable compensation is defined as the one described above for EU executives and the sum of bonus (bonus), option grants (option_awards_fv), and stock grants (stock_awards_fv) for US executives.]
Maximum variable compensation	Manually collected	Maximum value of variable compensation that can be achieved within the reporting year.
Maximum variable compensation to fixed	Manually collected	Ratio of maximum variable compensation to fixed compensation; the bonus cap applies to this ratio.
Expected pay	Manually collected	Expected pay is the sum of fixed pay plus the product of a probability measure and the maximum variable pay an executive could receive. The probabilities are calculated at the board-level. They are either based on pre-treatment realized probabilities ( <i>Expected pay, pre prob.</i> ) or on probabilities that are realized over the entire pre- and post-treatment period ( <i>Expected pay, post prob.</i> ). In the former case, realized probabilities equal the average of achieved variable compensation over maximum variable compensation—the goal achievement rate—before the bonus cap was introduced (2010–2013). In the latter case, the probability equals the average goal achievement rate over 2010–2013 (2014–2016) for pre-(post-) cap period.
Top total pay	Manually collected	Dummy variable that equals 1 if the executive is the highest paid (or the second highest paid) within the board in terms of total compensation (for boards with at least five executives) and 0 otherwise.
Top variable pay	Manually collected	Dummy variable computed in the same way as <i>Top total pay</i> but based on variable compensation.
Treatment intensity	Manually collected	Variable that equals 0 for executives in the control group. It is equal to the distance between $\rho$ (maximum variable-to-fixed compensation) and 200% as of 2013 for treated executives. Treated executives are those whose maximum variable-to-fixed compensation ratio exceeds 200% as of 2013.
Post	–	Dummy variable that equals 1 from 2014 onward and 0 otherwise.
<i>Bank-level information:</i>		
Bank size	Bankscope and Orbis Bank Focus [CCM]	Natural logarithm of total assets.
ROA	Bankscope and Orbis Bank Focus [CCM]	Return on assets.
ROE	Bankscope and Orbis Bank Focus [CCM]	Return on equity.
Sharpe ratio	Datastream [CCM]	Ratio of stock return over stock volatility.
Log 5-year excess CDS spread	Datastream	Log of 5-year CDS excess spread. The excess spread is the difference of the CDS spread of the bank and the CDS spread of the corresponding sovereign CDS spread (average over the last quarter of the year).
SRISK%	NYU V-Lab	Fraction of the entire financial sector's capital shortfall that the bank would incur in the event of a crisis.
$\Delta$ CoVaR	Systemic Risk Lab at SAFE	Following Adrian and Brunnermeier (2016), $\Delta$ CoVaR of bank $i$ is defined as the difference of the CoVaR of the financial system with respect to bank $i$ and

(continued on next page)

Table A.2 (continued)

Variable	Databases	Definition
Beta	NYU V-Lab	the Value-at-Risk (VaR <sub>i</sub> ) of the financial system. The CoVaR of the financial system with respect to bank <i>i</i> is the VaR of the financial system, conditional on bank <i>i</i> being in distress.
# Executives	BoardEx	Market beta of the bank based on the MSCI World Index. Number of executives serving on the board. We take the gross number of observations per year on a board and subtract the sum of the turnovers of the respective year.
CEO turnover	BoardEx [ExecuComp]	Dummy variable that equals 1 if the CEO leaves the board and 0 otherwise. We collected data on 2016 turnovers manually by checking banks' websites and news reports. We also manually collected who the CEO is because BoardEx does not indicate the CEO in a board. [ExecuComp provides a CEO indicator.]
Tier 1	Bankscope and Orbis Bank Focus	Tier 1 capital over risk-weighted assets.
Regulatory capital mix	Bankscope and Orbis Bank Focus	Tier 1 capital over total regulatory capital.
Liquidity	Bankscope and Orbis Bank Focus	Liquid assets over short-term funding.
Peripheral exposure	EBA	Ratio of bank's aggregate sovereign debt exposure to peripheral countries (Portugal, Ireland, Italy, Portugal, and Spain) over a bank's total sovereign debt exposure based on the 2011 EBA Transparency Exercise.

This table reports definitions of variables used in the main analysis as well as in the appendices of the paper. For variables used in tests relying on the U.S. control group (see Table 6), additional information on the database and the variable definition is given [in brackets].

Table A.3

Bank performance, capital requirements, and liquidity regulation.

Dependent variable:	Sharpe ratio (in %)	Log 5-year excess CDS spread	SRISK%	ΔCoVaR	Beta
	(1)	(2)	(3)	(4)	(5)
Post × Treat. int.	-0.184 (-1.32)	0.309*** (3.15)	0.702*** (2.76)	-1.101 (-0.74)	0.152** (2.51)
Δ Tier 1	-0.050 (-1.37)	-0.018 (-0.82)	0.010 (0.38)	-0.208 (-1.13)	0.016 (0.98)
Δ Regulatory capital mix	-0.007 (-0.64)	0.007 (1.68)	-0.001 (-0.08)	-0.039 (-0.82)	-0.003 (-0.80)
Δ Liquidity	0.003 (0.34)	-0.001 (-0.81)	0.000 (0.05)	0.083 (1.44)	-0.000 (-0.19)
Bank fixed effects	X	X	X	X	X
Country-year fixed effects	X	X	X	X	X
# Banks	30	17	30	23	30
Mean(y)	0.008	1.020	2.493	23.157	1.458
S.D.(y)	1.031	0.739	2.544	10.121	0.413
R <sup>2</sup>	0.784	0.977	0.976	0.913	0.832
N	173	106	173	138	173

This table reports estimates from difference-in-differences regressions for bank performance around the introduction of the bonus cap in 2013. The sample covers EU banks between 2010 and 2016. The dependent variables are *Sharpe ratio* (column 1), *Log 5-year excess CDS spreads* (column 2), *SRISK%* (column 3), *ΔCoVaR* (column 4), and *Beta* (column 5). *Treatment intensity* is the average treatment intensity of executives within a bank as of 2014 (based on those executives for whom *Post* × *Treated* = 1, where *Treated* is the executive-level binary treatment indicator). *Post* is an indicator variable equal to 1 from 2014 onward. *Δ Tier 1* is the change in the bank's Tier 1 capital over total risk-weighted assets. *Δ Regulatory capital mix* is the change in the bank's Tier 1 capital over total regulatory capital. *Δ Liquidity* is the change in the bank's ratio of liquid assets over deposits and short-term funding. Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

**Table A.4**  
Bank performance (falsification test).

Dependent variable:	Sharpe ratio (in %)	Log 5-year excess CDS spread	SRISK%	$\Delta$ CoVaR	Beta
	(1)	(2)	(3)	(4)	(5)
Post $\times$ Periph. Exposure	-0.022 (-0.04)	1.056 (1.12)	0.955 (0.66)	-6.521 (-0.82)	-0.223 (-0.75)
Bank fixed effects	X	X	X	X	X
Country-year fixed effects	X	X	X	X	X
# Banks	15	12	15	14	15
Mean(y)	-0.095	0.992	3.941	24.457	1.532
S.D.(y)	0.960	0.760	2.500	9.615	0.358
R <sup>2</sup>	0.784	0.972	0.961	0.903	0.883
N	98	81	98	93	98

This table reports estimates from difference-in-differences regressions for bank performance around the introduction of the bonus cap in 2013, replacing the bank's *Treatment intensity* used in Table 5 with *Peripheral exposure*, i.e., the bank's exposure to the sovereign debt of peripheral countries (Greece, Ireland, Italy, Portugal, and Spain) relative to its total sovereign debt holdings. The sample covers EU banks between 2010 and 2016. The dependent variables are *Sharpe ratio* (column 1), *Log 5-year excess CDS spreads* (column 2), *SRISK%* (column 3),  $\Delta$ *CoVaR* (column 4), and *Beta* (column 5). *Post* is an indicator variable equal to 1 from 2014 onward. Included fixed effects are indicated below. The *t*-statistics (in parentheses) are computed from standard errors clustered by bank. Significance at the 10%, 5%, and 1% levels is indicated by \*, \*\*, and \*\*\*, respectively. Refer to Appendix Table A2 for variable definitions.

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