Shaker Ahmed

Essays on Executive Characteristics, Risk-taking, and Compensation in the Banking Industry

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Tiivistelmä

Tämä väitöskirja koostuu neljästä esseestä, jotka tarkastelevat ylimmän johdon ominaisuuksien vaikutusta pankkien riskisyyteen ja johdon palkitsemiseen.

Väitöskirjan ensimmäisessä esseessä tutkitaan toimitusjohtajien maskuliinisuuden ja pankkien riskisyyden välistä yhteyttä. Tutkimustulokset osoittavat, että pankin toimitusjohtajan kasvonpiirteiden maskuliinisuus heijastuu positiivisesti pankin riskisyyteen ja erityisesti osakemarkkinoiden hinnanmuutoksiin perustuviin riskimittareihin. Toisessa esseessä tarkastellaan ulkonäön vaikutusta pankinjohtajien palkitsemiseen ja palkkioiden muodostumiseen. Empiiriset tulokset osoittavat, että ulkonäöllä on merkittävä positiivinen vaikutus pankkien toimitusjohtajien kokonaispalkkioon ja harkinnanvaraiseen suoritusperusteiseen palkitsemiseen. Keskimääräistä hyvännäköisempien pankinjohtajien kokonaispalkkio on noin 24 prosenttia korkeampi kuin johtajilla, jotka ovat kasvonpiirteiltään vähemmän viehättäviä.

Väitöskirjan kolmannessa esseessä tutkitaan pankkien riskisyyden ja ylimmän johdon iän välistä yhteyttä. Tutkimuksessa havaitaan, että toimitusjohtajan ja talousjohtajan iät vaikuttavat päinvastaisesti pankkien riskisyyteen. Iäkkäät toimitusjohtajat alentavat pankkien riskisyyttä, kun taas talousjohtajan iällä todetaan olevan positiivinen vaikutus pankkien riskinottoon. Talousjohtajan iän ja pankkien riskisyyden välinen positiivinen suhde on ainakin osittain selitettävissä eroilla pankkien pääomarakenteessa, sijoituspolitiikoissa ja johdon kannustinjärjestelmissä. Neljäs essee tarkastelee pankinjohtajien odotetun urahorisontin vaikutusta pankkien riskinottoon. Tutkimuksessa havaitaan, että toimitusjohtajan odotettavissa olevan urahorisontin pituus heijastuu pankkien luotonantopolitiikkaan ja vaikuttaa negatiivisesti pankkien riskisyyteen.

Asiasanat: Johdon ominaisuudet, pankkien riskisyys, johdon palkitseminen, toimitusjohtajat, talousjohtajat

Abstract

This dissertation is comprised of four essays that examine the effect of top executive characteristics on bank risk-taking and the formation of executive compensation.

The first essay uses the facial features of Chief Executive Officers (CEOs) to explore the association between CEO masculinity and bank risk-taking. The results demonstrate that banks led by CEOs with more masculine facial features are associated with more volatile stock returns and higher levels of idiosyncratic risk. The second essay studies the effect of facial attractiveness on the compensation of bank CEOs. The empirical findings documented in this essay demonstrate that CEO facial attractiveness is positively associated with the annual total compensation and the discretionary, performance-based components of compensation. The total compensation of above-average-looking bank CEOs is about 24 percent higher than the compensation of CEOs with below-average looks.

The third essay of the dissertation focuses on the influence of CEO and CFO (Chief Financial Officer) age on bank risk-taking. The results indicate that CEO age is negatively associated with the bank's insolvency risk and market-based measures of risk-taking. In stark contrast, banks with older CFOs exhibit higher levels of stock return volatility, systematic risk, idiosyncratic risk, and tail risk. The positive relationship between CFO age and bank risk-taking can be at least partially explained by differences in banks' investment policies, funding structure, and executive compensation incentives. Finally, the fourth essay investigates the influence of the CEO's expected career horizon on bank risk-taking. The results suggest that CEOs with shorter expected tenures reduce the level of risk-taking. The negative relation between expected CEO tenure and bank risk can be attributed to differences in bank lending policies and executive compensation incentives.

Keywords: Executive characteristics, bank risk-taking, executive compensation, CEOs, CFOs

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September 18, 2023

Shaker Ahmed

This work is dedicated to my wife,

Masuma Naorin.

Contents

Publications

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1 INTRODUCTION

The purpose of this doctoral dissertation is to examine whether bank executives' personal characteristics have any impact on bank risk-taking and the formation of their compensation. According to the upper echelons theory, executives' experiences, values, and cognitive styles affect their choices and preferences, consequently influencing their corporate decision-making (Hambrick and Mason, 1984). Consistent with this prediction, studies focusing on CEO characteristics such as overconfidence (Malmendier and Tate, 2005a, 2005b), early life experience (Malmendier et al., 2011), age (Serfling, 2014), gender (Palvia et al., 2015), facial attractiveness (Graham, Harvey and Puri, 2017), masculinity (Kamiya, Kim and Park, 2019) and narcissism (Buyl et al., 2019) have documented that executive characteristics are reflected in various firm-level decisions and outcomes.

Interestingly, the literature on executive characteristics is predominantly based on non-financial firms. However, given the difference between the banking and non-banking industry in terms of ownership structure, regulation, and business model, the results for non-financial firms cannot necessarily be generalized to banks (see, e.g., Adams and Mehran, 2003; Haan and Vlahu, 2016). Furthermore, aligning managerial incentives to those of the shareholders creates a unique agency problem for other stakeholders like depositors, borrowers, and regulators. Excessive compensation and over-reliance on equity-based incentives can lead to excessive risk-taking and even bank failures (e.g., Bai & Elyasiani, 2013; Bhagat & Bolton, 2014; DeYoung, Peng, & Yan, 2013). Compensation-induced risk-taking incentives might not only increase the riskiness of individual banks but can quickly spread across financial institutions and create negative externalities on the whole financial system (Iqbal and Vähämaa, 2019). In general, the rampant risk-taking by financial institutions before the global financial crisis of 2008 and the associated cost of bank failure to the economy during the crisis are vivid examples of this misaligned interest between different bank stakeholder groups and demonstrate the necessity of studying the effect of bank executives' characteristics on their risk-taking attitude and compensation structure.

The study of the behavioral aspects of banking executives, in addition to the common techno-economic factors, facilitates determining how executive characteristics can predict bank outcomes (see, e.g., Hambrick and Mason, 1984) and contributes to the niche study area of behavioral banking[1]. Moreover, the knowledge of the probable impact of bank executives' dispositions on bank outcomes and the formation of a managerial incentive structure helps banks find the most suitable candidates for the top positions and enables stakeholders like shareholders, regulators, and competitors to anticipate the changes in bank policies reflecting changes in the business environment.

This dissertation includes an introductory chapter and four interrelated essays on the characteristics of financial institutions' executives. The remainder of the introductory chapter is organized as follows: Section 2 describes the contribution of the dissertation in general, along with the contribution and limitations of each essay; Section 3 presents a brief discussion of the different aspects of the upper echelons theory explored in this thesis and the effect of CEO compensation on bank risk-taking; Section 4 provides summaries of the four essays.

[1] Prior studies exploring the link between CEO biases and firm outcomes are generally referred to as behavioral corporate finance literature (see, e.g., Baker, Ruback and Wurgler, 2006; Camerer and Malmendier, 2007, Malmendier and Tate, 2008). The use of term behavioral banking in this dissertation follows a similar logic.

2 CONTRIBUTION OF THE DISSERTATION

The four interrelated essays of this dissertation provide new evidence on the effect of executive characteristics on bank risk-taking and the formation of CEO compensation. The first essay focuses on the linkage between CEO masculinity and bank risk-taking. The paper finds a positive association between CEO facial masculinity and bank risk-taking. The second essay builds upon another look-based CEO trait to empirically examine the association between facial attractiveness and executive compensation. The results suggest the presence of a beauty premium in bank CEOs' discretionary, performance-based compensation.

The third essay investigates the relationship between executive age and bank risk-taking and documents that CEO and CFO aging have diametrically opposing impacts on bank risk-taking. The fourth paper is closely related to the third paper and shows how a shorter CEO decision horizon is associated with myopic behavior. While the third paper concentrates on the joint effect of the top two bank executives' career concern-driven risk-taking attitude over their life, the fourth paper addresses how CEOs' risk-taking motivation evolves based on their expected tenure in the office, regardless of other background characteristics.

In general, the dissertation contributes to banking literature by examining how executive characteristics affect bank risk-taking and compensation. The unique industry setup of the banking industry requires studying banks separately from non-financial firms. Furthermore, the focus on a single industry setup mitigates concerns about challenges related to the confounding effects of other CEO characteristics and structural differences across industries that may influence findings on executive characteristics driven firm risk-taking and the CEO compensation formation. The sample CEOs in the four studies comprising this dissertation are drawn from among top executives of large banks. The group is relatively homogenous, with similar demographic characteristics, educational backgrounds, and employment history (e.g., Nguyen, Hagendorff, & Eshraghi, 2015; King, Srivastav and Williams, 2016; Altunbas¸, Thornton and Uymaz, 2018)[2]. That makes the banking industry a convenient setting in which to explore hypotheses based on executive characteristics and to test them robustly.

Besides exploiting the unique industry setup, each essay expressly contributes to the small but growing body of behavioral banking literature. The first paper

[2] While the top executives of publicly traded U.S. firms generally are very homogenous in terms of their demographic characteristics and educational backgrounds, with the archetypical CEO being a white male in his mid-fifties, bank CEOs are even more predominantly white men who are in their late-fifties. Bank CEOs tend to be slightly older and lack gender and racial diversity compared to non-financial firm CEOs.

contributes to the scarce literature on how differences in masculinity among top executives potentially influence corporate risk-taking behavior. We find that stock market participants perceive banks led by CEOs with more masculine facial features to be riskier even though these banks are not associated with higher insolvency risk. This result necessitates further studying the policies taken by more masculine-looking CEOs to establish if there is a gap between the market's perception and actual CEO actions.

The second essay contributes to the literature in two distinct ways. First, prior studies mainly focus on the effect of CEO attractiveness in the formation of total compensation (see, e.g., Graham, Harvey, and Puri, 2017; Cook and Mobbs, 2022; Halford and Hsu, 2020; Li et al., 2021). Unlike prior literature, this study explores the effect of facial attractiveness on the different components of bank CEOs' compensation. Banking industry compensation structures for CEOs differ from those in non-financial firms as bonuses and other incentive compensation components account for a higher proportion of total compensation (e.g., Houston and James, 1995; Murphy, 2013). Given that discretionary components of CEO compensation involve more negotiation and are more susceptible to the influence of personal connections, communication skills, and CEO-director relationships (e.g., Bertrand & Mullainathan, 2001; Bebchuk & Fried, 2004; Keller, Molina, & Olney, 2020; Keller & Olney, 2021), we would expect the discretionary components of compensation to be more susceptible to CEO attractiveness than the base salary. Our empirical findings strongly indicate a beauty premium element to discretionary CEO compensation. Accordingly, this paper identifies the source of the beauty premium in CEO compensation.

Second, in contrast to the prior beauty-premium literature, we exploit state-of-the-art machine learning techniques to assess the facial attractiveness of bank CEOs. Our machine learning approach can be considered to yield an objective assessment of facial attractiveness by generalizing perceptions about what constitutes a beautiful face. The beauty assessments based on deep convolutional neural networks reflect both the biological traits of beauty, such as facial averageness, bilateral symmetries, and sexual dimorphism, as well as nonphysical attributes, such as a pleasant expression, youthful appearance, and good grooming (see, e.g., Rhodes, 2006 for a review). Consequently, machine-based image analysis should reduce noise and provide an objective consensus perception of facial attractiveness rather than reflecting the idiosyncrasies in respondents' subjective assessments of appearance as in survey-based designs. Overall, both the research design and the empirical findings of this paper enhance our understanding of CEO compensation formation in the banking industry.

The third essay contributes to the banking literature by examining the effect of executive age on bank riskiness. Specifically, this paper studies the joint impact of CEO and CFO age in bank risk-taking. A common assumption in CEO characteristics literature is that senior executives other than CEOs are unlikely to significantly influence investment and financial policies (Kini and Williams, 2012). However, CFOs' financial knowledge and involvement in the financial reporting process make them essential to firms' financial policies (Ge, Matsumoto, Zhang, 2011).

Similar to non-CEO executives' influence on firm policies and risk-taking, Berger, Imbierowicz, and Rauch (2016) find that non-CEO top executive officers significantly increase bank failures. The increased scrutiny and public interest in executives, particularly in CEOs' actions, probably allows CFOs to play a larger role in bank risk-taking. Therefore, considering the difference in CFOs' characteristics and contribution to financial decision-making, in this paper, we study how bank riskiness is associated with the CFO's and the CEO's ages. Our results demonstrate that the ages of CEOs and CFOs have a counterbalancing effect on bank risk-taking, highlighting the importance of considering both executive positions when investigating the riskiness of financial institutions.

The fourth paper examines how the CEO's decision horizon affects bank risk-taking. Policymakers point out managerial short-termism was a major contributor to the global financial crisis of 2007–2009. Firms incentivizing CEOs to behave more myopically were found to have more subprime exposure, a higher probability of financial distress, lower risk-adjusted stock returns during the crisis, and higher fines and settlements for subprime-related fraud (Kolasinski and Yang, 2018). Moreover, the harmful effects of myopic decisions by long-tenured CEOs persist even after they have departed the firm. Specifically, after the turnover of a long-tenured CEO, firms suffer from reduced operating performance and stock returns and have higher restructuring costs with longer recovery periods (Colak and Liljeblom, 2022). This paper focuses on the long-tenured CEOs' effect on bank risk-taking.

The findings proposed in this essay suggest that the expected CEO decision horizon positively impacts bank risk-taking. Specifically, CEOs with shorter expected tenures reduce bank risk-taking, whereas their counterparts with longer expected career horizons increase risk exposure. However, a CEO's expected tenure in office does not affect insolvency risk. Furthermore, the expected career horizon of CEOs of large banks has a more pronounced effect on the banks' total and systematic risk than that of smaller bank CEOs. The impact has decreased since the global financial crisis. We identify CEO pay-performance sensitivity and bank loan growth as potential policy channels for propagating the expected tenure-driven bank risk-taking. Overall, the results suggest that CEOs' anticipated tenure-induced myopic behavior has an important impact on bank risk-taking.

3 BACKGROUND

This section briefly describes the theoretical arguments based on the upper echelons theory and executive compensation and banking literature that bind the four essays in this dissertation.

3.1 The upper echelons theory

Top executives' strategic position in the firm means their decisions directly affect firm outcomes. In addition, their decisions set the context for the firm to hire, mobilize, and inspire others to make decisions that indirectly affect firm performance (Finkelstein, Hambrick, and Cannella, 2009). Executive actions can bring new life and direction to firms, and their inactions, missteps, or misdeeds can bring a successful firm to its knees. We see the reflection of the distinctive philosophy and values of Michael Bloomberg, John Pierpont Morgan Sr., and Warren Buffett in the formation and growth of their financial institutions Bloomberg L.P., J.P. Morgan and Co., and Berkshire Hathaway, respectively. In contrast, the failure of the top management to adequately address the risk level of the Lehman Brothers and Bear Sterns led to the demise of the two largest investment banks of our time during the global financial crisis of 2008.

Executive decisions are not always based on comprehensive knowledge of the unfolding situation. Top management often faces scenarios marked by high levels of uncertainty, multiple tradeoffs, and widespread implications. As a result, executives need to interpret the information they receive – often from various self-interested parties. Psychologists suggest that individuals depend on personal qualities such as experience, values, personalities, and other human characteristics in decision-making when faced with ambiguous and complex circumstances (Mischel, 1977). In other words, executives invest much of themselves into their firms' decisions.

Naturally, no two executives share similar experiences, capabilities, values, or personalities. Accordingly, executives differ in the awareness and interpretation of the strategic stimuli, beliefs about the causation, urgency, and expected impact of an event, as well as in personal aspiration levels (Hambrick and Mason, 1984). These dissimilarities in personal qualities lead to differences in their decision-making. Considering these factors, the upper echelons theory posits that top executives' human factors affect firm outcomes because their personal choices and preferences impact corporate decisions (Hambrick and Mason, 1984). Consequently, a comprehensive study of firm outcomes such as firm performance, value creation, and risk-taking needs to consider the biases and dispositions of top executives along with other deterministic firm-level characteristics. While an array of factors can influence executive cognition, values, and capabilities, the following sections discuss the personal characteristics covered in the four essays of this dissertation.

3.1.1 Demographic and other contextual executive characteristics

Observed demographic characteristics offer the most readily available information about executive characteristics, which have direct psychological analog or significant explanatory power for corporate decision-making (Malmendier, Tate, and Yan, 2011). Naturally, literature on the upper echelon has attracted much attention to the observable CEO background features such as age, gender, ethnicity, tenure, and educational attainment. Two essays in this dissertation utilize CEO background characteristics (age and tenure) to examine two different constructs of CEO traits identified in the prior literature impacting firm outcomes.

Age encompasses a diverse and dynamic collection of personal characteristics over an individual's life. An individual's personality and attitude to risk-taking evolve with age. Literature studying the relationship between CEO age and firm outcomes finds that executive age is negatively related to firm value, growth, operating performance, and corporate deal-making activities (e.g., Child, 1974; Cline and Yore, 2016; Li, Low, and Makhija, 2017). Furthermore, older CEOs pursue less risky investment policies such as less investment in research and development (R&D), more acquisition to diversify the firm's operations, and reduced use of leverage to curtail stock return volatility (Serfling, 2014). Peltomäki et al. (2021) document that the significant negative relationship between executive age and market-based firm risk level is limited to idiosyncratic risk and does not affect firm systematic risk, which indicates older CEOs prefer to reduce firm-specific risk-taking.

In contrast to their older counterparts, younger executives differ in their extent of risk aversion and make bolder investment and divestment decisions. Specifically, younger CEOs prefer acquiring other firms over *de novo* investments (Li, Low, and Makhija, 2017). Yim (2013) shows that neither a firm's acquisition inclination nor older CEOs' declining overconfidence with age can explain younger CEOs favoring acquisitions. Gibbons and Murphy (1992) argue that executives' career concern plays a dominant role in shaping age-based differences in corporate decision-making. Younger managers are yet to build their reputations as talented managers, and their employers lack information about their quality. Talented younger executives might undertake excessive risks to demonstrate their superior ability by managing those risky ventures (Prendergast and Stole, 1996). However, as executives grow older, they become more conservative because of their greater commitment to the firm's existing status quo. That change often manifests in their pursuing business policies that have worked for executives in the past (Bertrand and Mullainathan, 2003).

Another well-researched executive characteristic is tenure. One of the essays in the current thesis focuses on the myopic behavior of long-term CEOs. Pan, Wang, and Weisbach (2015) find that stock return volatility declines with CEO tenure. The rate of decline accelerates toward the end of the CEO's tenure. A shorter career horizon is also associated with lower market valuations (Antia, Pantzalis, and Park, 2010) and lower idiosyncratic risk (Antia, Pantzalis, and Park, 2021). The results indicate that safer policy choices by myopic CEOs reduce stock return volatility at the expense of firm value. In addition, auditors found to charge higher audit fees, suspecting departing CEOs are more likely to engage in earning management in their final years (Mitra et al., 2020). Similarly, consistent with the notion of entrenched long-term CEOs, the stock market reacts positively to the sudden death of a powerful CEO (Graham, Kim, and Leary, 2020).

CEOs with shorter decision horizons may prefer investments that produce relatively quicker returns instead of undertaking projects with long-term value creation (Antia, Pantzalis, and Park, 2010). The evolution in CEO power and compensation also contributes to this myopic behavior. Long-term CEOs enjoy greater managerial power as they gain control over their board over time and are likely to be appointed board chairs (Pan, Wang and Weisbach, 2016). Increased managerial power enables them to imprint their personal choices on firm policy (Korkeamäki, Liljeblom, and Pasternack, 2017). However, CEOs' inventive structure also reinforces the myopic behavior of departing CEOs. Owing to the longer vesting period of equity-based compensation, managerial incentives vest at an increasing rate over time, making compensation very sensitive to short-term performance in the final years. That situation intensifies the horizon problem whereby CEOs manipulate performance in their final years in office (Marinovic and Varas, 2019).

Apart from executive age and tenure, the essays in this dissertation consider additional CEO characteristics such as CEO gender, ethnicity, and educational attainment that can have confounding effects on the subject matter of the individual essays. For example, firms with female CEOs are associated with lower total and idiosyncratic risk and less risky firm policies (Peltomäki et al., 2021). A CEO's education level can serve as a proxy for the latent abilities of CEOs, which has been documented to influence various firm-level outcomes, including the level and structure of CEO compensation (e.g., King, Srivastav and Williams, 2016;

Gounopoulos, Loukopoulos and Loukopoulos, 2021; Chen, Torsin and Tsang, 2022; Urquhart and Zhang, 2022).

Considerable attention has been paid to the racial gap in executive pay. Anecdotal evidence signals systematic racial wage inequality across the corporate hierarchy (Bayer and Charles, 2018; Semyonov and Lewin-Epstein, 2009). Nevertheless, Hill, Upadhyay, and Beekun (2015) find ethnic minority CEOs receive higher compensation than their Caucasian peers. In a recent paper, Guo et al. (2021) do not find evidence that CEOs benefit from their ethnic minority status and conclude that there is no significant evidence to suggest that U.S. companies pay more to CEOs from ethnic minorities.

In general, background information indicates an executive's motivation, cognitive style, risk propensity, and other underlying traits that influence the executives' corporate decision-making. Given that background characteristics may capture one or several aspects of individual differences, they are more opaque indicators than purely psychological metrics of personal traits. However, Hambrick and Mason (1984) argue that, despite that shortcoming, any significant findings using background characteristics would put the upper echelons theory to a relatively stringent test.

3.1.2 Personal traits

Personality can be viewed as a relatively permanent characteristic of individual disposition. Conducting survey-based psychometric tests on senior executives, Graham, Harvey, and Puri (2013) demonstrate that CEOs are more optimistic and less risk-averse than the general population, including their second-in-command CFOs. Furthermore, research has indicated CEOs and CFOs can have diametrically opposite personalities (Kaplan and Sorensen, 2021). In terms of general ability, CEOs tend to score higher than CFOs. In addition, CEOs are more charismatic and strategically minded, whereas CFOs are analytical and detail-oriented.

A major challenge in executive personality-based research is the collection of individual personality traits and attitude data for senior executives (see, e.g., Finkelstein, Hambrick, and Cannella, 2009) [3]. However, like all other psychological and behavioral phenomena, biological processes both spur and constrain personality traits. Personality neuroscience, which takes the biological approaches to personality, provides a new landscape in personality research. One

[3] The traditional personality research mainly concentrates in "Big Five" personality dimensions — neuroticism, extraversion, openness, agreeableness, and conscientiousness (see, e.g., Haslam, Smillie and Song (2017) for a review).

personality trait that has received considerable attention in recent corporate finance literature is CEOs' attitudes to risk-seeking. Given that testosterone in males is correlated with extraversion, sociability, sensation seeking, dominance, and activity (Daitzman and Zuckerman, 1980; Zuckerman, 2005) and the development of the facial structure during adolescence, corporate finance studies normally postulate a positive relationship between CEO facial masculinity and firm risk-taking.

Measuring male CEOs' facial masculinity by their facial width-to-height ratio (fWHR), Kamiya, Kim, and Park (2019) find that CEO masculinity is associated with higher stock return volatility and financial leverage. In addition, masculine CEOs exhibit more acquisitive behavior – frequently engage in acquisitions and pay a higher takeover premium. There is also a greater probability that firms led by more masculine-looking CEOs will be subject to SEC enforcement actions in which the CEO is a named perpetrator (Jia, Lent, and Zeng, 2014).

A relevant question for these studies is whether executive masculinity is a proxy for CEO overconfidence or ability. Jia, Lent, and Zeng (2014) argued that CEO facial masculinity captures the risk-seeking dimension of executive characteristics and is not an alternative measure of overconfidence. Utilizing an alternative measure of CEO risk-seeking, Baghdadi, Podolski, and Veeraraghava (2022) also reached the same conclusion. Specifically, they find that compared to overconfidence or ability, risk-seeking tendencies of pilot CEOs have a considerably stronger effect on tax avoidance. Likewise, firms with pilot CEOs are associated with higher stock return volatility (Cain and McKeon, 2016) and better innovation outcomes (Sunder, Sunder, and Zhang, 2017). Overall, these studies confirm that executives' intrinsic motivation derived from their endowed risk-seeking traits significantly impacts firm policies.

3.1.3 Positive self-regard

Psychology literature establishes that executives are prone to overconfidence (Larwood and Whittaker, 1977). Executive overconfidence has been linked to a greater tendency to pursue costly acquisitions (Malmendier and Tate, 2008), offer smaller dividend payments (Deshmukh, Goel, and Howe, 2013), reduce utilization of external finance (Malmendier, Tate, and Yan, 2011), and a greater likelihood of financial misreporting (Schrand and Zechman, 2012). On the positive side, overconfident CEOs sanction greater investment in R&D and have more success with innovation (Hirshleifer, Low, and Teoh, 2012). In addition, overconfident CEOs from highly competitive industries have been found to foster more innovation (Galasso and Simcoe, 2011). In corporate deal-making, overconfident

CEOs are likely to target firms offering higher income diversification rather than low-risk levels, which is found to benefit their bondholders (Chen et al., 2022).

A common feature of executive overconfidence literature is using observable CEO actions, such as option holding and a higher level of firm investment, to construct a proxy for executives' exaggerated sense of confidence. Another strand of behavioral corporate finance literature studies the determinants or sources of executive overconfidence. Some of the channels found to affect CEO confidence include CEO relative age (Du, Gao, and Levi, 2012; Bai et al., 2019), formative early-life experiences (Malmendier, Tate, Yan, 2011), press portrayal (Malmendier and Tate, 2008), and physical attractiveness (Mobius and Rosenblat, 2006).

The second essay in this dissertation focuses on physical attractiveness, which has been linked with an increased level of executive confidence. In general, attractive-looking individuals are judged and treated more positively than unattractive people, even by those who know them (Langlois et al., 2000), and associated with positive stereotypes corresponding to superior leadership ability (e.g., Warner & Sugarman, 1986). Mobius and Rosenblat (2006) argue that attractive individuals project confidence when communicating or socializing with their employers, thereby giving a positive impression of their competence, which leads them to secure better remuneration than their less-confident peers. In their seminal study, Hamermesh and Biddle (1994) document that attractive-looking employees earn higher wages than less attractive individuals. Subsequent studies also find that the so-called beauty premium exists in the formation of CEO compensation (Graham, Harvey, and Puri, 2017).

3.2 CEO compensation

There are two competing theories on the formation of CEO compensation. According to the optimal contracting approach, executive compensation is determined based on the equilibrium in the competitive market for managerial talent and is designed to maximize shareholder value (e.g., Bebchuk, Fried, and Walker, 2002; Murphy, 2013). Nevertheless, Bebchuk and Fried (2004) argue that CEOs can apply structural and social-psychological mechanisms to influence the board's decision-making processes. Consequently, powerful self-interested CEOs might extract greater compensation than they would under an optimal principal-agent contract (Bebchuk and Fried, 2004).

Alongside the level of CEO compensation, pay structure significantly impacts firm risk-taking (Jensen and Murphy, 1990). In large, publicly traded firms, CEO compensation typically consists of a base salary, bonuses, equity-based compensations, and incentives. Partially due to tax laws and accounting rules, the annual base salaries of CEOs have remained relatively stagnant. Most of the variation in the level of CEO compensation, both over time and cross-sectionally, comes from the other, more discretionary compensation components like bonuses and different types of equity-based compensations (see, e.g., Murphy, 2013; Ahmed, Davydov and Vähämaa, 2022).

Fortin, Goldberg, and Roth (2010) find that banks paying a higher base salary to their CEOs take less risk as salary establishes a steady stream of cash flow, whereas equity-based compensation increases risk-taking as it aligns the upside potential of the executive's compensation with those of shareholders. Accordingly, using options encourages managers to take risks, and cash bonuses and restricted stock grants deter excessive risk-taking (Ryan and Wiggins, 2001). The increase of option-based compensation in the 1990s also increased the pay-performance sensitivity and the risk-taking incentive (i.e., delta and vega) embedded in these compensation packages. Conventional wisdom suggests that heightened risk-taking incentives contribute to excessive corporate risk-taking (DeYoung, Peng and Yan, 2013). As banks suffered huge losses during the 2008–09 financial crisis, public officials responded by increasing restrictions and monitoring financial executives' pay to eliminate incentive-induced risk-taking (Bebchuk, Cohen, and Spamann, 2010).

Naturally, since the crisis, the issue of bank risk-taking and CEO compensation has taken center stage. While Fahlenbrach and Stulz (2011) show that neither cash bonuses nor stock options are directly responsible for the global financial crisis or banks' performance during that period, Bhagat and Bolton (2014) find that an increased risk-taking incentive encourages risk-taking in banks. Covering the CEO compensation from the 1990s up until the financial crisis of 2008, Bai and Elyasiani (2013) report that more risk-sensitive compensation packages resulted in higher stock return volatility and riskier investment policies, such as increased non-traditional banking activities and reduced bank stability. Grove et al. (2011) also found that incentive compensation is positively associated with banks' financial performance but also deteriorating loan quality in the long term. Their results suggest that increased executive compensation boosts bank performance by increasing bank risk. Reaffirming this conclusion, Gande and Kalpathy (2017) report that banks with greater pre-crisis CEO risk-taking incentives required more emergency loan assistance during the crisis and needed longer to repay it.

Interestingly, CEO compensation does not have a linear impact on bank risk-taking. Research evidence indicates CEOs reduce bank risk-taking as their share of compensation in the top executive team increases and, consequently, implement more conservative investment policies (Bai and Elyasiani, 2013; Fortin, Goldberg, and Roth, 2010). There is also some weaker evidence that higher executive pay-performance sensitivity mitigates excessive risk-taking problems (Gande and Kalpathy, 2017). As the executives have a higher concentration of firm-specific wealth, they become exposed to a higher level of risk than a diversified outside investor and pursue safer strategies to reduce losses.

In addition to the cross-sectional differences in CEO pay, there are intertemporal differences in individual CEO pay, i.e., the variation in compensation over a CEO’s age or tenure. Yim (2013) shows that CEOs experience a large and permanent increment in their compensation following a successful acquisition, which encourages younger CEOs to pursue acquisitions (Yim, 2013). Andreou, Louca, and Petrou (2017) also find financial incentives explain the higher crash risk of firms with younger CEOs. The increase in compensation reflecting better firm performance earlier in a CEO’s career does not dissipate at the revelation of bad news in the later years. Hence, taking excessive risks or even hiding bad news pays off for younger CEOs.

Examining the increase in CEO compensation in the real estate investment trust (REIT) industry, Pennathur and Shelor (2002) document a negative relation between increased compensation and a CEO’s age. Older CEOs are also found to receive less incentive compensation (Harvey and Shrieves, 2001). Furthermore, Fosberg (2001) finds that older CEOs are more likely to be fired following underperformance than their younger counterparts. Such differences in CEO compensation packages and the possibility of being fired might lead to CEOs adopting different approaches to risk-taking over the course of their career. As a result, older or long-tenured CEOs have an inherent incentive to decrease performance volatility rather than pursue risky ventures with greater potential. In general, both compensation structure and growth play an important role in incentive-induced firm risk-taking.

3.3 Bank risk-taking

The ownership structure, opaque business model, and government regulation set banks apart from non-financial firms. Conventionally, banks operate with high leverage, which creates a call option-like payoff for the stockholder on the bank’s profitability. As a result, owners reap the benefits of excessive risk-taking when the outcome is positive, but their liability is limited to the contributed capital. The situation gives rise to a risk-shifting problem that motivates executives to take excessive risks at the expense of other stakeholders like creditors, depositors, and taxpayers. This risk-shifting problem gets even more complicated in the presence of deposit insurance. In addition, a *de facto* government guarantee to bail out "too-big-to-fail" banks encourages greater risk-taking (see, e.g., Haan and Vlahu, 2016).

Apart from the risk-shifting problem, banks also suffer from a lack of creditor disciplining. Banks primarily rely on deposits to fund their loans and investment activities. In non-financial firms, debtholders can monitor the firm and its management. However, the opaque business model, low concentration of individual credits from depositors, and high coordination cost make bank depositors less interested in monitoring banking activities (Shleifer and Vishny, 1997; Demirgüç-Kunt and Detragiache, 2002). Furthermore, Adams and Mehran (2003) report that U.S. institutional ownership in banks is significantly lower than in non-financial firms. As a result, banks lack the creditor disciplining seen among non-financial firms with large debtholders (Jensen and Meckling, 1976).

Another unique feature of the banking industry is the extent of government regulation. While some unique bank features encourage risk-taking, government regulations and supervision aim to quell excessive risk-taking. However, regulations such as capital requirements, activity restrictions, and deposit insurance cannot alone mitigate excessive risk-taking by executives. Especially, executive compensation-induced risk-taking incentives can further worsen bank stability in an environment where executive compensation is primarily aligned with shareholders' interests. The higher level of interest alignment means bank executives take more risk at the expense of other stakeholders. The rampant risk-taking by bank executives before 2008 is a vivid example of this phenomenon. Moreover, lower rates of CEO ownership in banks than in non-financial firms can adversely affect bank governance (Adams and Mehran, 2003). The unique bank features and the interplay between industry construct, executive compensation, and government supervision and monitoring make it harder to predict how executive characteristics can affect risk-taking in the banking industry.

The unpredictable nature of investment outcomes means the return can be positive or negative. In finance, the randomness of the investment return is considered the risk (Bessis, 2015, pp. 2). This dissertation uses four alternative market-based bank risk measures and an accounting-based proxy of bank stability to measure the variation in a bank's risk exposure over the years. Accounting-based risk measures are often criticized for being backward-looking because they use past financial performance data to predict the level of risk associated with a firm in the future (e.g., Agarwal and Taffler, 2008). Market-based measures address this issue as market prices are forward-looking and reflect the expectation of a firm's future cash flows. Hence, market-based risk measures indicate expected uncertainty in a firm's future performance.

The first measure of market-based risk is total risk, which captures the overall variability in bank stock returns. The total risk reflects the market's perception of the risks inherent in the bank's assets, liabilities, and off-balance-sheet positions. Furthermore, we use the two components of total risk—systematic risk and idiosyncratic risk—to investigate whether risk-taking associated with executive characteristics makes banks fundamentally riskier or only increases bank-specific risk exposure.

The above three risk measures estimate the uncertainty of stock returns for bank shareholders. Other stakeholders, such as regulators and executives, are more concerned about the loss of earnings or wealth derived from the adverse situation, that is, with uncertainty associated with negative outcomes alone. The rationale behind this thinking for regulators is to enhance the resilience of the financial industry, particularly under stressful conditions. On the other hand, bank executives are responsible for identifying, assessing, and controlling potential losses arising from adverse events. From their perspective, bank risk is its exposure to loss of earnings and its capacity to continue operating even when affected by factors beyond its control.

This dissertation employs tail risk based on Acharya et al.'s (2017) expected shortfall measure to account for the risk arising from unexpected adverse events. Specifically, tail risk estimates how much a bank is likely to lose in extreme adverse events or crises and is defined as the negative of the average of five percent worst daily returns over a fiscal year. The last measure of bank risk is the accounting-based Z-Score. The Z-Score predicts the probability that current losses exceed the capital is less than or equal to 1/ Z-Score[2] (Roy, 1952). An increase in the Z-Score implies a decrease in the probability of default, i.e., a greater distance to default.

4 SUMMARY OF THE ESSAYS

This section summarizes the four interrelated essays investigating the effect of top executive characteristics on bank risk-taking and the formation of executive compensation.

4.1 CEO facial masculinity and bank risk-taking

This paper studies the influence of the facial features of CEOs to examine the association between CEO masculinity and bank risk-taking. Biological and psychological literature indicates that facial masculinity measured by a high facial width-to-height ratio (fWHR) is linked to high testosterone levels among males as well as masculine behavioral traits such as increased risk tolerance, aggression, and sensation seeking (e.g., Anderl et al., 2016; Apicella et al., 2008; Campbell et al., 2010; Carré and McCormick, 2008; Carré, McCormick and Mondloch, 2009; Haselhuhn and Wong, 2012; Lefevre et al., 2013; Ormiston, Wong and Haselhuhn, 2017). Furthermore, the upper echelons theory (Hambrick and Mason, 1984) and prior empirical studies indicate that the characteristics, personality, and personal preferences of top executives might influence corporate decision-making and outcomes (see, e.g., Cronqvist, Makhija, and Yonker, 2012; Graham, Harvey and Puri, 2013; Malmendier, Tate and Yan, 2011). Given that individual characteristics affect firm-level outcomes, this paper investigates whether the personal differences in masculinity among CEOs are imprinted on their banks' level of risk-taking.

The article's hypothesis builds upon biological and psychological research on the linkages between facial masculinity, masculine behavioral traits, and testosterone. Biological studies have documented that facial morphology and bone structure are directly related to adolescent testosterone levels (see, e.g., Lindberg et al., 2005; Nie, 2005; Vanderschueren and Bouillon, 1995; Verdonck et al., 1999). In general, this literature indicates that facial masculinity among men primarily results from craniofacial bone growth during the pubertal stage, which, in turn, is regulated by testosterone administration. Furthermore, studies by Penton-Voak and Chen (2004), Pound, Penton-Voak, and Surridge (2009), and Lefevre et al. (2013) suggest that facial masculinity is positively associated with circulating and reactive levels of testosterone.

The steroid hormone testosterone, on the other hand, has been linked to a wide variety of masculine behavioral traits such as aggression, hostility, sensation seeking, competitiveness, and risk tolerance (see, e.g., Apicella et al., 2008; Archer, 2006; Mehta, Jones and Josephs, 2008; Pound et al., 2009; Roberti, 2004).

Collectively, previous studies demonstrate that facial masculinity and masculine behavioral traits are both linked to testosterone levels. Although the neuroendocrinological mechanisms through which testosterone affects human behavior are still not precisely known, prior research leads to the conjecture that differences in facial masculinity across individuals can help to predict differences in behavior.

The general underlying premise of our study is that differences in facial width-to-height ratios across individual bank CEOs reflect differences in masculinity. Specifically, we expect to find a positive relationship between CEO facial masculinity and bank risk-taking. We test our hypothesis using data on publicly traded large U.S. banks included in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices over the period 2006–2014. The primary variable of interest, fWHR is calculated as bizygomatic width (i.e., the distance between the cheekbones) divided by upper-face height (i.e., the distance between the upper lip and the midpoint of the inner ends of eyebrows). Three alternative measures of bank risk-taking used in the empirical analysis are: (i) stock return volatility, (ii) idiosyncratic risk, and (iii) *Z*-score. The results documented in this essay demonstrate that banks led by CEOs with more masculine facial features have more volatile stock returns and higher levels of idiosyncratic risk. However, we do not find any evidence that CEO facial masculinity is associated with lower level of bank stability.

4.2 Facial attractiveness and CEO compensation: Evidence from the banking industry

This paper studies the link between CEO facial attractiveness and the formation of their compensation. Anecdotal evidence indicates that the physical attractiveness of individuals influences various social outcomes such as initial impressions (Feingold, 1992; Jackson, Hunter and Hodge, 1995), romantic appeal and dating choices (Carmalt et al., 2008; Meltzer et al., 2014), peer judgment and treatment (Langlois et al., 2000), the success and popularity of politicians and athletes (Hamermesh, 2006; Berggren, Jordahl and Poutvaara, 2010; Williams, Park and Wieling, 2010; Brewer and Howarth, 2012), and even student evaluations of university professors (Hamermesh and Parker, 2005; Oghazi, 2016; Jobu Babin et al., 2020).

Beauty is also known to affect job-related outcomes, and attractive individuals may be rewarded for their good looks in the labor market (see, e.g., Chiu and Babcock, 2002; Hosoda, Stone-Romero and Coats, 2003; Luxen and van de Vijver, 2006).

In their seminal study, Hamermesh and Biddle (1994) document how attractive-looking employees earn higher wages than less attractive individuals. This so-called *beauty premium* is economically meaningful as the wages of above-average-looking employees exceed the wages of less attractive individuals by around 10-15 percent. The existence of the beauty premium has been documented in various experimental studies as well as in many different labor market settings and among different social and occupational groups (see, e.g., Biddle and Hamermesh, 1998; Harper, 2000; Mobius and Rosenblat, 2006; Andreoni and Petrie, 2008; Fletcher, 2009; Johnston, 2010; Borland and Leigh, 2014; Deryugina and Shurchkov, 2015; Doorley and Sierminska, 2015; Parrett, 2015; Scholz and Sicinski, 2015).

Given that beauty is a favorable and enduring labor market attribute that persists even after controlling for individuals' other personal characteristics such as age, gender, weight, education, intelligence, personality, and family background (e.g., Hamermesh, 2011; Scholz and Sicinski, 2015), we posit that facial attractiveness is positively associated with the compensation of bank CEOs. Unlike prior literature predominantly concentrating on the presence of beauty premium in total CEO compensation, this paper examines if the extent of beauty premium varies across different components of compensation.

In addition to the level and structure of CEO compensation, we also examine the effect of facial attractiveness on the sensitivity of compensation to changes in stock prices and stock return volatility. Ex-ante, depending on the preferences of the CEO, the relation between facial attractiveness and CEO compensation sensitivities can be positive or negative. Attractive-looking CEOs may be able to extract compensation arrangements that emphasize discretionary pay components that are less dependent on the firm's stock market performance. However, if attractiveness is related to self-confidence, as suggested by Langlois et al. (2000) and Mobius and Rosenblat (2006), attractive CEOs could negotiate compensation packages featuring high pay-performance and risk-taking incentives. Accordingly, questions of how CEO facial attractiveness influences pay performance and pay-risk sensitivities are ultimately addressed empirically.

In our empirical analysis, we use data on the S&P 1500 banks spanning 2005–2020. We collect facial images of 272 individual bank CEOs and utilize a deep convolutional neural network developed by He et al. (2016) to assess the facial attractiveness of those CEOs on a scale of 1 to 5. Following the prior executive compensation literature (e.g., Core, Holthausen, and Larcker, 1999; Ang, Lauterback, and Schreiber, 2002; Coles, Daniel, and Naveen, 2006; Bugeja, Matolcsy, and Spiropoulos, 2012; Rekker, Benson, and Faff, 2014; Gande and Kalpathy, 2017; Cerasi et al., 2020), we measure CEO compensation with annual total compensation, base salary, and the discretionary components of compensation, CEO's pay-performance sensitivity and pay-risk sensitivity.

Our empirical findings provide strong evidence of a beauty premium in bank CEO compensation. Specifically, we document that facial attractiveness is positively associated with bank CEOs' total compensation and their discretionary, performance-based compensation components while it is largely unrelated to the annual base salary. Moreover, the magnitude of the documented beauty premium in bank CEO compensation is economically significant. Our results suggest that a one standard deviation increase in the CEO facial attractiveness measure increases total compensation by almost 9 percent ($395,000) after controlling for various CEO-specific and bank-specific attributes that are known to affect executive compensation. Moreover, the total compensation of above-average-looking bank CEOs is about 24 percent ($1.06 million) higher than the compensation of CEOs with below-average looks, and the above-average-looking CEOs have about 55 percent greater sum of bonuses, stock grants, and option grants than their less attractive peers. Nevertheless, our findings also indicate that bank CEOs' pay performance and pay-risk sensitivities are unaffected by facial attractiveness.

Additional robustness tests demonstrate that the strength of board monitoring or managerial power does not influence the positive association between facial attractiveness and CEO compensation. We also show that the beauty premium in the compensation of bank CEOs cannot be explained by demographic attributes such as age, gender, or ethnicity, nor by differences in bank size and business models. Collectively, our results offer strong support for the beauty premium hypothesis in the executive labor market. The beauty premium persists at the top executive level, and bank CEOs are as susceptible to attractiveness gaps in their compensation as average employees. Intriguingly, the documented size of the beauty premium among bank CEOs is very similar to that in the general labor market (e.g., Hamermesh and Biddle, 1994; Scholz and Sicinski, 2015).

4.3 Executive age and bank risk-taking

This paper investigates how the ages of the CEO and CFO affect bank risk-taking. Psychology literature suggests that aging affects people's tolerance of risk (see, e.g., Mather et al., 2012; Mata et al., 2011). In addition, studies scrutinizing individuals' investment strategies find that older people hold less risky stocks and investment portfolios (Brooks et al., 2018; Korniotis and Kumar, 2011; McInish, 1982; Morin and Suarez, 1983; Palsson, 1996). Corporate finance literature supports these findings in reporting age-related differences in corporate policies, firm performance, and riskiness (see e.g., Cline and Yore, 2016; Serfling, 2014; Yim, 2013). Given that executive age predicts firm risk-taking for non-financial firms, we examine whether this relationship exists in the highly regulated banking industry.

To investigate the relationship between executive age and bank risk-taking, we use the data on large U.S. banks belonging to the S&P 1500 index over the sample period 2006-2018. We look into the bank insolvency risk and four market-based risk measures. As market-based risk measures, we use total volatility and its two components – systematic risk and idiosyncratic risk. The fourth risk measure is the tail risk, which estimates how much a bank is likely to lose following extremely adverse events or crises. Our empirical results demonstrate that bank risk-taking is influenced by executive age. Specifically, we document that CEO age is negatively associated with bank insolvency risk and the market-based risk measures after controlling for bank size, financial performance, asset growth, funding and income structures, and other bank-specific characteristics. These findings are broadly consistent with the prior empirical evidence for non-financial firms documented by Serfling (2014), Andreou et al. (2017), and Peltomäki et al. (2021). However, in stark contrast, we find that banks led by older CFOs are associated with higher stock return volatility, systematic risk, idiosyncratic risk, and tail risk.

The results suggest that the personal characteristics of CEOs and CFOs may have very different or even counterbalancing influences on bank risk-taking, which can relate to their different roles and responsibilities. Specifically, while the CEO has more responsibility for the longer-term strategic decisions and business performance, the CFO is more involved in shorter-term operational decisions related to the bank's funding structure, financial management, and risk exposure.

Further analysis suggests that the differences in bank riskiness can, at least to some extent, be attributed to differences in banks' investment policies, funding structure, and executive compensation incentives. Specifically, we document that banks with older CFOs are associated with more risky lending policies, higher reliance on non-deposit funding, and higher executive compensation sensitivity to changes in the bank's stock price. These tests provide further evidence to conclude that older CEOs constrain bank risk-taking, while banks with older CFOs are associated with higher levels of risk.

4.4 CEO myopia and bank risk-taking

A CEO with a short decision horizon often displays temporal myopia by focusing more on short-term results that benefit them personally over strategies impacting long-term firm growth (Eisenhardt 1989; Gibbons and Murphy 1992). As executive decision horizons are limited to executives' expected tenure, CEOs with a longer tenure or very close to retirement age become more myopic (Antia, Pantzalis, and Park, 2010, 2021). Myopic CEOs might opt out of risky ventures and favor less risky investment opportunities to smooth the firm's riskiness for the remainder of their expected tenure. This paper investigates the extent of the relationship between the expected CEO career horizon and firm risk-taking in the context of the banking industry.

Typically, a firm's lifespan is longer than its CEO's tenure. Accordingly, CEOs have a far shorter decision horizon than the firm they work for. As a result, self-indulgent CEOs pursue corporate policies that favor their intertemporal preferences but are suboptimal from the shareholder perspective. This mismatch of decision horizons between executives and their employers is a key source of agency problems (Jensen and Smith, 1985). While a short expected tenure is not optimal for implementing long-term strategies, long-serving CEOs' commitment to the organizational status quo increases as their tenure extends and decreases their willingness to adapt or respond adequately to dynamic environments (Hambrick, Geletkanycz and Fredrickson, 1993). As a result, the horizon problem is intensified by the increase in the length of a CEO's tenure.

Using data on large U.S. banks included in the S&P 1500 index over the sample period 2005–2020, this paper investigates the relationship between CEO decision horizon and bank risk-taking. After controlling for a number of bank-specific factors and board characteristics known to affect bank risk exposure, the paper identifies a positive relationship between the CEO's expected career horizon and bank risk-taking. Specifically, we find that the level of risk reduction from older or long-tenured CEOs is higher than their younger or newly appointed counterparts' contribution to risk-taking. Results from additional tests to address endogeneity concerns using propensity score matching and the instrumental variable (IV) regression of Lewbel (2012) also confirm our main findings that longer expected tenure increases risk-taking among bank executives.

Further analysis shows that the magnitude and pattern of age and tenure-driven myopic behavior affect bank risk differently. While CEO age affects both bank-specific idiosyncratic and systematic risk, tenure-driven risk-taking is limited to idiosyncratic risk. In addition, the expected career horizon of large bank CEOs has a more pronounced effect on banks' total and systematic risk than that of smaller banks CEOs. The risk-taking associated with the expected career horizon has decreased since the global financial crisis. We also find that CEOs' pay-performance sensitivity and bank loan growth contribute to risk-taking associated with expected tenure. Overall, our findings suggest that CEOs' expected tenure-induced myopic behavior has an important impact on bank risk-taking.

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CEO facial masculinity and bank risk-taking☆

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ABSTRACT

This paper uses Chief Executive Officer (CEO) facial features to examine the association between CEO masculinity and bank risk-taking. Given that high facial width-to-height ratio has been linked to high testosterone levels and masculine behavioral traits such as increased risk tolerance, aggression, and sensation seeking, we postulate a positive relationship between CEO facial masculinity and bank risk-taking. Consistent with this prediction, we document that banks led by CEOs with more masculine facial features are associated with more volatile stock returns and higher levels of idiosyncratic risk.

1. Introduction

This paper uses Chief Executive Officer (CEO) facial features to examine the association between CEO masculinity and bank risk-taking. Abundant evidence documented in the biological and psychological literature indicates that facial masculinity as reflected by high facial width-to-height ratio (fWHR) is linked to high testosterone levels among males and masculine behavioral traits such as increased risk tolerance, aggression, and sensation seeking (e.g., Anderl et al., 2016; Apicella et al., 2008; Campbell et al., 2010; Carré & McCormick, 2008; Carré, McCormick, & Mondloch, 2009; Haselhuhn & Wong, 2012; Lefevre, Lewis, Perrett, & Penke, 2013; Ormiston, Wong, & Haselhuhn, 2017). Given the documented linkage between facial masculinity and various attributes that reflect individuals' risk preferences, we hypothesize a positive relationship between CEO facial masculinity and bank risk-taking.

We draw on the upper echelons theory of Hambrick and Mason (1984) and prior empirical studies which indicate that the characteristics, personality, and personal preferences of the top executives may influence firm-level decisions and outcomes (see e.g., Cronqvist, Makhija, & Yonker, 2012; Graham, Harvey, & Puri, 2013; Malmendier, Tate, & Yan, 2011). Previously, the relation between CEO facial masculinity and corporate outcomes has been examined in Wong, Ormiston, and Haselhuhn (2011), Jia, van Lent, and Zeng (2014), and Kamiya, Kim, and Park (2018).[1] Wong et al. (2011) document that CEO fWHR is positively associated with firm profitability, while Jia et al. (2014) find a positive association between CEO fWHR and the incidence of financial misreporting. Most closely related to our study, Kamiya et al. (2018) investigate the relation between CEO fWHR and firm-level riskiness using data on the S&P 1500 non-financial firms. Their findings indicate that the firms of more masculine CEOs have higher stock return volatility, higher financial leverage, and are more likely to conduct acquisitions.

We complement the work of Kamiya et al. (2018) by examining whether CEO facial masculinity is related to bank risk-taking. Banks are fundamentally different from non-financial firms in terms of their business models, exposure to regulations and supervision, societal importance, and risk-taking incentives. Moreover, the banking industry is often viewed as male-dominated, and in the aftermath of the global financial crisis, financial institutions have been criticized for their masculinity-driven culture and rampant risk-taking (e.g., Maclean,

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[1] In a related study, Lu and Teo (2018) examine whether the fWHR of hedge fund managers is associated with fund performance. Their findings indicate that hedge fund managers with high fWHR take on greater risks, have a greater preference for lottery-like stocks, and are more reluctant to sell loser stocks.

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2016). Thus, we consider the banking industry to provide an expedient setting to examine the linkage between CEO facial masculinity and firm-level riskiness.

Our hypothesis builds upon the biological and psychological research on the linkages between facial masculinity, masculine behavioral traits, and testosterone. Biological studies have documented that facial morphology and bone structure are directly related to testosterone exposure in adolescence (see e.g., Lindberg et al., 2005; Nie, 2005; Vanderschueren & Bouillon, 1995; Verdonck, Gaethofs, Carels, & de Zegher, 1999). In general, this literature indicates that facial masculinity within men is largely an outcome of craniofacial bone growth during the pubertal stage which, in turn, is regulated by testosterone administration. Furthermore, studies by Penton-Voak and Chen (2004), Pound, Penton-Voak, and Surridge (2009), and Lefevre et al. (2013) suggest that facial masculinity is positively associated with circulating and reactive levels of testosterone.

The steroid hormone testosterone, on the other hand, has been linked to a wide variety of masculine behavioral traits such as aggression, hostility, sensation seeking, competitiveness, and risk tolerance (see e.g., Apicella et al., 2008; Archer, 2006; Mehta, Jones, & Josephs, 2008; Pound et al., 2009; Roberti, 2004). Collectively, previous studies demonstrate that facial masculinity and masculine behavioral traits are both linked to testosterone levels. Although the neuroendocrinological mechanisms through which testosterone affects human behavior are still not exactly known, prior research leads to the conjecture that differences in facial masculinity across individuals can help to predict differences in behavior.

The general underlying premise in our study is that differences in facial width-to-height ratios across individual bank CEOs reflect differences in masculinity. Given that masculinity and testosterone levels are known to affect the risk preferences and tolerance of individuals, it is of interest to examine whether personal differences in masculinity among CEOs are imprinted on the level of risk-taking of their banks. If facial masculinity predicts individuals' risk preferences and these preferences, in turn, are reflected in corporate outcomes as suggested by the upper echelons theory, we should observe a positive relationship between CEO facial masculinity and bank risk-taking.

By examining this hypothesis, we contribute to the scarce literature on how individual differences in masculinity among top executives may potentially influence corporate behaviour. Consistent with our research hypothesis, we document a positive association between CEO facial masculinity and bank risk-taking. Thus, our results suggest that individual differences in masculinity not only influence personal financial risk-taking behavior but may also have important implications for firm-level risk-taking. In general, these findings can be considered to add further knowledge to our understanding of how personal differences among executives may be reflected in corporate decisions and outcomes.

2. Data and variables

2.1. Data

In our empirical analysis, we used data on publicly traded U.S. banks included in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices over the period 2006–2014. We first collected the names, ages, and genders of the CEOs of firms with primary Standard Industrial Classification (SIC) codes between 6000 and 6300 from ExecuComp.[2] After excluding female CEOs, we manually collected facial pictures of the CEOs using Google Image Search.[3] We collected at least two pictures of each CEO and chose the picture that is of best quality for measuring fWHR.[4] In addition to CEO pictures and demographics, we collected financial data for the banks from Bankscope and stock price data from Thomson Reuters Datastream. The final sample used in our analysis consisted of 134 individual CEOs, 104 banks, and 618 firm-year observations.

2.2. CEO facial masculinity

Following Wong et al. (2011), Jia et al. (2014), and Kamiya et al. (2018), we used CEO facial width-to-height ratio as our main proxy for CEO masculinity. The fWHR is calculated as bizygomatic width (i.e., the distance between the cheekbones) divided by upper-face height (i.e., the distance between the upper lip and the midpoint of the inner ends of eyebrows). We utilize Face++ facial recognition software to extract facial dimensions from CEO pictures.

In addition to fWHR, we used expected testosterone levels of bank CEOs as an alternative proxy for CEO masculinity. Studies by Hodges-Simeon, Sobraske, Samore, Gurven, and Gaulin (2016), Welker, Bird, and Arnocky (2016), and Hodges-Simeon et al. (2018) suggest that age moderates the relationship between individual's testosterone level and fWHR. On the other hand, clinical studies have documented that testosterone levels of men decrease with age (see e.g., Feldman et al., 2002; Harman, Metter, Tobin, Pearson, & Blackman, 2001). Because aging potentially decreases testosterone levels and because testosterone mediates the relationship between fWHR and masculine behavioral traits such as risk-taking, we constructed an alternative proxy for CEO masculinity based on CEO facial width-to-height ratio and age. For this purpose, we utilized the clinical data on baseline and reactive testosterone levels provided in Lefevre et al. (2013). Specifically, using clinical data on baseline and reactive testosterone levels of males, we estimated the following seemingly unrelated regression (SUR) system:

$$\sqrt{Testosterone_i} = \alpha + \beta_1 fWHR_i + \beta_2 \log(Age_i) + \varepsilon_i, \quad (1)$$

where *Testosterone* is either the baseline or the reactive level of testosterone in individual *i*'s blood, *fWHR* is the facial width-to-height ratio, and *Age* denotes the individual's age in years. After estimating the coefficients α, β_1, and β_2 in Eq. (1), we utilized these coefficient estimates together with the facial width-to-height ratios and ages of the bank CEOs to predict their expected testosterone levels.[5]

2.3. Bank risk-taking

We used three alternative measures of bank risk-taking: (i) stock return volatility, (ii) idiosyncratic risk, and (iii) *Z*-score. Stock return volatility and idiosyncratic risk are market-based measures of risk, while *Z*-score is an accounting-based risk measure estimated from balance sheet variables.

Stock return volatility was measured as the annualized standard deviation of daily stock returns over a calendar year. Stock return volatility captures the overall riskiness of a bank and it can be considered

[2] SIC codes are a system used by U.S. government agencies and departments for classifying industries by a four-digit code. Firms with SIC codes between 6000 and 6300 are depository institutions, non-depository credit institutions, and security and commodity brokers, dealers, exchanges, and services. Following the prior banking literature, we define these financial institutions as banks.

[3] The facial width-to-height ratio is a valid measure of masculinity only for men. Biological studies indicate that facial masculinity within men is largely an outcome of craniofacial bone growth during the pubertal stage which, in turn, is regulated by testosterone administration. Due to the confounding effects of other hormonal factors, testosterone is less directly related to facial morphology of women (e.g., Lefevre et al., 2013). Consequently, the common practice in the fWHR literature is to exclude women from the sample.

[4] We defined the quality based on the neutrality of head pose in terms of pitch, roll, and yaw angles. We utilize Face++ facial recognition software to obtain pitch, roll, and yaw angles for each picture.

[5] Specifically, we calculated the expected testosterone levels of bank CEOs based on the facial width-to-height ratios and ages of the CEOs as follows: $\sqrt{Testosterone_i} = 14.53 + 2.64 \times fWHR_i - 3.21 \times \log(Age_i)$.

Table 1
Descriptive statistics.

Variables	Mean	Median	Min	Max	Std. dev.	No. of obs.
CEO masculinity:						
fWHR	2.143	2.133	2.487	1.753	0.151	618
Testosterone	7.232	7.211	8.743	5.155	0.585	618
Bank risk-taking:						
Volatility (%)	38.111	27.698	156.622	10.049	26.197	618
Idiosyncratic risk (%)	28.630	20.751	138.667	8.684	21.540	618
Z-score (%)	39.675	26.989	277.718	−1.625	42.901	552
Control variables:						
Size (in millions)	155,889.2	15,748.6	2,573,126.0	1301.4	437,695.1	618
Capital ratio (%)	15.226	14.485	63.000	8.000	4.544	618
Profitability (%)	0.857	0.921	14.873	−6.576	1.554	618
Loan growth (%)	7.029	4.939	102.754	−77.319	17.453	618
Loans to assets (%)	59.441	64.284	95.904	1.309	18.177	618
CEO turnover	0.340	0.000	0.000	1.000	0.474	618

Note. The CEO facial masculinity variables are CEO facial width-to-height ratio (*fWHR*) and expected CEO testosterone level (*Testosterone*). *Volatility* is measured as the annualized standard deviation of daily stock returns over a calendar year. *Idiosyncratic risk* is calculated as the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year. *Z-score* is measured as the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. The control variables are defined as follows: (i) *Size* is the natural logarithm of total assets, (ii) *Capital ratio* is calculated as the ratio of Tier 1 and Tier 2 equity capital to risk-weighted assets and off-balance sheet risks under the Basel capital requirements, (iii) *Profitability* is proxied by the return on assets calculated as net income divided by total assets, (iv) *Loan growth* is the annual growth rate of net loans, (v) *Loans to assets* is the ratio of total loans to total assets, and (vi) *CEO Turnover* is a dummy variable that equals one for banks that experienced CEO turnovers during the sample period.

to reflect market perceptions about the risks inherent in the bank's business strategies, management, assets, liabilities, and off-balance-sheet positions. We calculated idiosyncratic risk as the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year. Idiosyncratic risk is a market-based measure of bank-specific riskiness that is unrelated to systematic market developments and uncertainty. While higher stock return volatility reflects greater total risk of a bank, higher idiosyncratic risk reflects higher bank-specific risk. In general, the two market-based risk measures used in our analysis reflect the perceptions of stock market participants regarding the riskiness of a bank.

Z-score was measured as the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. We estimated the Z-scores only for banks for which at least five years of data were available. The Z-score is a proxy for bank stability with lower values indicating higher insolvency risk of the bank. Essentially, the Z-score measures a bank's distance to default based on the amount of equity capital, return on assets, and the variability of return on assets. In contrast to our two market-based risk measures, Z-score provides a backward-looking representation of the firm's riskiness.

2.4. Control variables

Following the prior banking literature, we employed a number of control variables in our regressions to account for the potentially confounding effects of institution-specific factors on bank risk-taking. Specifically, we controlled for bank size, capital ratio, financial performance, growth, and asset structure in our regressions and we also included binary variables to account for CEO turnovers and the systematic increase in bank riskiness during the financial crisis of 2008–2009.[6] These control variables are defined as follows: (i) bank size is the natural logarithm of total assets, (ii) capital ratio is calculated as the ratio of Tier 1 and Tier 2 equity capital to risk-weighted assets and off-balance sheet risks under the Basel capital requirements,[7] (iii) profitability is proxied by the return on assets (ROA) calculated as net income divided by total assets, (iv) growth is the annual growth rate of net loans, (v) asset structure is proxied by the ratio of total loans to total assets, (vi) CEO turnover is a dummy variable equal to one for banks that experienced CEO turnovers during the sample period, and (vii) financial crisis is a dummy variable that equals one in 2008 and 2009.

3. Results

3.1. Descriptive statistics, correlations, and univariate tests

Table 1 reports descriptive statistics for the variables used in our empirical analysis. The mean CEO fWHR in our sample is 2.143 with a standard deviation of 0.151. The descriptive statistics indicate that the sample banks are very heterogeneous in terms of the risk measures and bank-specific control variables. Bivariate correlations between the variables are reported in Table 2. As can be noted from the table, the facial width-to-height ratios and expected testosterone levels of bank CEOs are strongly positively correlated with each other ($r = 0.78$, $p < 0.01$). Moreover, the CEO facial masculinity variables are significantly positively correlated with the three alternative measures of bank risk-taking with correlation coefficients of around 0.10 ($p < 0.10$).

As a preliminary test of our research hypothesis, we perform *t*-tests to examine differences between banks led by CEOs with less and more masculine facial features. We divide our sample into subgroups based on the median fWHR and the median expected testosterone level. Table 3 reports the results of the *t*-tests. Consistent with our hypothesis, the *t*-tests indicate that banks led by CEOs with higher fWHR and higher expected testosterone levels have more volatile stock returns and higher idiosyncratic risk. However, the mean differences in bank *Z*-scores between the different subgroups are statistically insignificant.

[6] With our control variables, we are able to explain more than 60% of the variation in stock return volatility and idiosyncratic risk and over 20% of the variation in *Z*-score.

[7] The Basel Committee on Bank Supervision is an international committee of banking supervisory authorities which provides banking regulation recommendations and international standards on capital requirements and assessment of risks. These Basel capital requirements are designed to ensure that banks have enough equity capital to meet their obligations and absorb potential losses from lending, investment, and trading activities. Tier 1 equity capital represents the core capital of a bank and consists of common stock, retained earnings, and perpetual preferred stock. Tier 2 equity capital represents the supplementary capital reserves of a bank such as loan-loss reserves, limited life preferred stock, and subordinated debt.

Table 2
Correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) fWHR										
(2) Testosterone	0.777***									
(3) Volatility	0.075*	0.081*								
(4) Idiosyncratic risk	0.104**	0.082*	0.972***							
(5) *Z*-score	0.109**	0.127***	−0.228***	−0.251***						
(6) Size	−0.185***	−0.168***	0.023	−0.039	−0.234***					
(7) Capital ratio	−0.004	0.032	−0.019	−0.048	0.020	−0.041				
(8) Profitability	−0.093**	−0.036	−0.555***	−0.610***	0.209***	0.035	0.113***			
(9) Loan growth	0.021	0.044	−0.271***	−0.273***	0.155***	0.044	−0.075*	0.278***		
(10) Loans to assets	0.080*	−0.104**	0.040	0.094**	−0.107**	−0.374***	−0.378***	−0.083*	−0.009	
(11) CEO turnover	−0.036	−0.034	0.109**	0.107**	−0.340***	0.346***	−0.083*	−0.135***	−0.139***	−0.082*

Note. The CEO facial masculinity variables are CEO facial width-to-height ratio (*fWHR*) and expected CEO testosterone level (*Testosterone*). *Volatility* is measured as the annualized standard deviation of daily stock returns over a calendar year. *Idiosyncratic risk* is calculated as the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year. *Z-score* is measured as the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. The control variables are defined as follows: (i) *Size* is the natural logarithm of total assets, (ii) *Capital ratio* is calculated as the ratio of Tier 1 and Tier 2 equity capital to risk-weighted assets and off-balance sheet risks under the Basel capital requirements, (iii) *Profitability* is proxied by the return on assets calculated as net income divided by total assets, (iv) *Loan growth* is the annual growth rate of net loans, (v) *Loans to assets* is the ratio of total loans to total assets, and (vi) *CEO turnover* is a dummy variable that equals one for banks that experienced CEO turnovers during the sample period.

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Table 3
Univariate tests.

Panel A: Banks with low fWHR CEOs vs. banks with high fWHR CEOs

Variables	Low fWHR	No. of obs	High fWHR	No. of obs	Difference	*t*-Stat
CEO masculinity:						
fWHR	2.010	67	2.268	67	0.258***	17.48
Testosterone	6.875	307	7.584	311	0.709***	8.48
Bank risk-taking:						
Volatility	3.424	307	3.506	311	0.081*	2.05
Idiosyncratic risk	3.111	307	3.230	311	0.119**	2.50
Z-score	3.252	268	3.185	284	−0.066	−0.33

Panel B: Banks with low testosterone CEOs vs. banks with high testosterone CEOs

Variables	Low testosterone	No. of obs	High testosterone	No. of obs	Difference	*t*-Stat
CEO masculinity:						
fWHR	2.015	56	2.228	78	0.213***	10.88
Testosterone	6.767	309	7.697	309	0.931***	15.21
Bank risk-taking:						
Volatility	3.418	309	3.513	309	0.094**	2.76
Idiosyncratic risk	3.123	309	3.219	309	0.096**	2.31
Z-score	3.170	268	3.262	284	0.092	0.48

Note. The table reports the results of *t*-tests for the null hypothesis that there is no difference in the means between subgroups constructed based on the median CEO fWHR and the median CEO testosterone level. *fWHR* is the facial width-to-height ratio and *Testosterone* is the expected testosterone level. *Volatility* is the logarithm of the annualized standard deviation of daily stock returns over a calendar year. *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year. *Z-score* is the logarithm of the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. All variables are winsorized at the 1st and 99th percentiles.

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

3.2. Regression results

We examine the association between CEO facial masculinity and bank risk-taking by estimating alternative versions of the following regression specification[8]:

$$\log(Bank\ risk_{j,t}) = \alpha + \beta_1 Facial\ masculinity_{j,t} + \beta_2 Size_{j,t} + \beta_3 Capital\ ratio_{j,t} + \beta_4 Profitability_{j,t} + \beta_5 Loan\ growth_{j,t} + \beta_6 Loans\ to\ assets_{j,t} + \beta_7 CEO\ turnover_{j,t} + \beta_8 Financial\ crisis_{j,t} + \varepsilon_{j,t} \quad (2)$$

[8] All of the alternative regression specifications are testing the same research hypothesis; CEO facial masculinity is positively associated with bank risk-taking.

Table 4
CEO facial width-to-height ratio and bank risk-taking.

	Volatility		Idiosyncratic risk		Z-score	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	2.714***	3.047***	2.411***	2.816***	5.401***	5.590***
	(8.89)	(12.84)	(6.99)	(10.43)	(17.20)	(22.30)
<u>CEO masculinity:</u>						
fWHR	0.177*		0.215**		0.097	
	(1.90)		(2.01)		(0.82)	
High fWHR		0.072**		0.089**		0.035
		(2.16)		(2.43)		(0.85)
<u>Control variables:</u>						
Size	−0.017	−0.015	−0.034**	−0.031**	−0.032***	−0.032**
	(−1.36)	(−1.23)	(−2.15)	(−2.07)	(−2.67)	(−2.59)
Capital ratio	0.030***	0.030***	0.031***	0.030***	−0.010	−0.010*
	(3.91)	(3.97)	(3.82)	(3.89)	(−1.66)	(−1.67)
Profitability	−0.123***	−0.123***	−0.146***	−0.146***	0.041***	0.042***
	(−7.24)	(−7.39)	(−7.60)	(−7.79)	(3.09)	(3.10)
Loan growth	−0.002**	−0.002**	−0.002	−0.002	0.001	0.001
	(−2.50)	(−2.50)	(−1.59)	(−1.61)	(1.55)	(1.54)
Loans to assets	0.000	0.000	0.002	0.002	−0.003**	−0.004**
	(0.24)	(0.12)	(1.50)	(1.36)	(−2.35)	(−2.39)
CEO turnover	0.052	0.054	0.061	0.064	−0.142***	−0.141***
	(1.23)	(1.29)	(1.20)	(1.26)	(−3.67)	(−3.65)
Financial crisis	0.986***	0.986***	0.948***	0.947***	−0.019	−0.019
	(32.34)	(32.03)	(26.94)	(26.76)	(−0.96)	(−0.95)
No. of obs.	618	618	618	618	552	552
Adjusted R^2	0.65	0.66	0.68	0.68	0.24	0.25
F-stat.	243.34***	235.37***	171.21***	166.28***	5.12***	5.27***

The dependent variables are defined as follows: *Volatility* is the logarithm of the annualized standard deviation of daily stock returns over a calendar year, *Idiosyncratic risk* is calculated as the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year, and *Z-score* is measured as the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. *fWHR* is the facial width-to-height ratio and *High fWHR* is a dummy variable that equals one if *fWHR* is above the sample median. The control variables are defined as follows: (i) *Size* is the natural logarithm of total assets, (ii) *Capital ratio* is calculated as the ratio of Tier 1 and Tier 2 equity capital to risk-weighted assets and off-balance sheet risks under the Basel capital requirements, (iii) *Profitability* is proxied by the return on assets calculated as net income divided by total assets, (iv) *Loan growth* is the annual growth rate of net loans, (v) *Loans to assets* is the ratio of total loans to total assets, (vi) *CEO turnover* is a dummy variable that equals one for banks that experienced CEO turnover during the sample period, and (vii) *Financial crisis* is a dummy variable that equals one in 2008 and 2009. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm.

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

where $Bank\ risk_{j,t}$ is one of three bank risk-taking variables (*Volatility*, *Idiosyncratic risk*, or *Z-score*) for bank *j* at time *t*, and $Facial\ masculinity_{j,t}$ is either the facial width-to-height ratio (*fWHR*) or the expected testosterone level (*Testosterone*) of the bank's CEO. We also estimate models in which we replace *fWHR* and *Testosterone* with dummy variables *High fWHR* and *High testosterone* which equal one if the corresponding CEO facial masculinity measure is above the sample median. The control variables account for the potentially confounding effects of bank-specific factors such as size, leverage, and growth on bank riskiness. Throughout the regressions, we use clustered standard errors to account for heteroscedasticity and potential interclass dependence structures of arbitrary kind.

The estimation results of six alternative versions of Eq. (2) with *fWHR* and *High fWHR* as the main independent variables are presented in Table 4. The adjusted R^2s of the regressions range from 24% to 68% and the *F*-statistics are significant ($p < 0.01$). Consistent with the univariate tests, the estimation results in Table 4 indicate that the market-based bank risk measures are positively associated with CEO facial masculinity. The coefficients for *fWHR* and *High fWHR* are positive and statistically significant in the regressions with *Stock return volatility* and *Idiosyncratic risk* as the dependent variables ($p < 0.05$ in Models 2–4; $p < 0.10$ in Model 1). The coefficient estimates for *High fWHR* indicate that stock return volatility and idiosyncratic risk are about 7.2% to 8.9% higher for banks led by CEOs with above median facial width-to-height ratio. The coefficients for *fWHR* and *High fWHR* are insignificant in the regressions with *Z-score* as the dependent variable, suggesting that CEO masculinity is not associated with insolvency risk.

Table 5 reports the regressions with *Testosterone* and *High testosterone* as proxies for CEO masculinity. The estimation results provide further support for the hypothesis that CEO masculinity is positively associated with bank risk-taking. Specifically, the coefficients for *Testosterone* and *High testosterone* are positive and statistically significant in the regressions with *Stock return volatility* and *Idiosyncratic risk* as the dependent variables ($p < 0.05$ in Models 1–4). The magnitudes of the estimated coefficients for *High testosterone* suggest that stock return volatility and idiosyncratic risk are almost 10% higher if the excepted testosterone level of the bank's CEO exceeds the sample median. Similar to Table 4, we do not find any relationship between CEO masculinity and bank Z-scores.

3.3. Additional tests

We performed several additional tests to examine the robustness of our findings. First, to ascertain that our results are not driven by outliers or a few extreme observations, we winsorized all variables at the 1st and 99th percentiles and re-estimated the regressions using winsorized data. The coefficient estimates for the CEO facial masculinity variables (not tabulated) remain virtually unchanged in these regressions; the coefficients for *fWHR*, *High fWHR*, *Testosterone*, and *High testosterone* are positive and statistically significant in the regressions with *Stock return volatility* and *Idiosyncratic risk* as the dependent variables. Thus, we conclude that our results are not affected by outliers.

Second, we estimated constrained versions of Eq. (2) with *Size* and

Table 5
CEO testosterone level and bank risk-taking.

	Volatility		Idiosyncratic risk		Z-score	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	2.583***	2.994***	2.364***	2.770***	5.469***	5.579***
	(7.98)	(12.29)	(6.41)	(9.84)	(17.28)	(23.23)
CEO masculinity:						
Testosterone	0.062**		0.062**		0.018	
	(2.50)		(2.17)		(0.56)	
High testosterone		0.086**		0.091**		0.030
		(2.57)		(2.45)		(0.79)
Control variables:						
Size	−0.014	−0.015	−0.031*	−0.031**	−0.032**	−0.032***
	(−1.11)	(−1.19)	(−1.97)	(−2.02)	(−2.64)	(−2.67)
Capital ratio	0.031***	0.031***	0.032***	0.031***	−0.010	−0.010
	(4.00)	(4.10)	(3.89)	(4.00)	(−1.65)	(−1.62)
Profitability	−0.124***	−0.123***	−0.148***	−0.147***	0.040***	0.041***
	(−7.30)	(−7.26)	(−7.63)	(−7.61)	(3.04)	(3.11)
Loan growth	−0.003**	−0.003***	−0.002*	−0.002*	0.001	0.001
	(−2.61)	(−2.71)	(−1.69)	(−1.80)	(1.53)	(1.50)
Loans to assets	0.001	0.001	0.002*	0.003**	−0.003**	−0.003**
	(0.61)	(0.68)	(1.84)	(2.00)	(−2.31)	(−2.29)
CEO turnover	0.050	0.049	0.060	0.058	−0.142***	−0.143***
	(1.20)	(1.21)	(1.19)	(1.19)	(−3.67)	(−3.69)
Financial crisis	0.980***	0.983***	0.941***	0.944***	−0.022	−0.021
	(31.86)	(32.25)	(26.52)	(26.97)	(−1.05)	(−1.01)
No. of obs.	618	618	618	618	552	552
Adjusted R^2	0.66	0.66	0.68	0.68	0.24	0.24
F-stat.	241.03***	249.94***	171.80***	176.29***	4.75***	5.03***

The dependent variables are defined as follows: *Volatility* is the logarithm of the annualized standard deviation of daily stock returns over a calendar year, *Idiosyncratic risk* is calculated as the standard deviation of the residuals of the market model regression estimated with daily stock returns over a calendar year, and *Z-score* is measured as the sum of return on average asset (ROAA) and equity to total assets ratio divided by the standard deviation of ROAA over the sample period. *Testosterone* is the expected testosterone level and *High testosterone* is a dummy variable that equals one if *Testosterone* is above the sample median. The control variables are defined as follows: (i) *Size* is the natural logarithm of total assets, (ii) *Capital ratio* is calculated as the ratio of Tier 1 and Tier 2 equity capital to risk-weighted assets and off-balance sheet risks under the Basel capital requirements, (iii) *Profitability* is proxied by the return on assets calculated as net income divided by total assets, (iv) *Loan growth* is the annual growth rate of net loans, (v) *Loans to assets* is the ratio of total loans to total assets, (vi) *CEO turnover* is a dummy variable that equals one for banks that experienced CEO turnover during the sample period, and (vii) *Financial crisis* is a dummy variable that equals one in 2008 and 2009. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.10$.

Capital ratio as the only control variables to ensure that our results are not influenced by spurious correlations between the independent variables. The estimates of these additional regressions (not tabulated) are similar to the results reported in Tables 4 and 5 with the exception of an insignificant coefficient for *fWHR* in the regression with *Stock return volatility* as the dependent variable. This suggests that our results are relatively robust to alternative model specifications and are not driven by multicollinearity.

In our main analysis, we use a dummy variable to account for the systematic increase in bank riskiness during the financial crisis. As an alternative approach, we re-estimated the regressions using a truncated sample from which the crisis years 2008 and 2009 were excluded. The results of these regressions (not tabulated) are consistent with the estimates reported in Tables 4 and 5, and indicate that *fWHR*, *High fWHR*, *Testosterone*, and *High testosterone* are positively associated with *Stock return volatility* and *Idiosyncratic risk*. Collectively, the additional tests provide further support for our research hypothesis and suggest that our results are robust to alternative empirical specifications.

4. Discussion and conclusions

In this paper, we examine the association between CEO facial masculinity and bank risk-taking. A large body of literature has previously linked masculine facial features to high testosterone levels and masculine behavioral traits such as increased risk tolerance, aggression, and sensation seeking (e.g., Apicella et al., 2008; Carré et al., 2009; Carré & McCormick, 2008; Lefevre et al., 2013). Furthermore, prior studies have documented that the characteristics, personality, and personal preferences of firms' top executives influence firm-level decisions and outcomes (e.g., Cronqvist et al., 2012; Graham et al., 2013; Malmendier et al., 2011). If facial width-to-height ratio predicts individuals' risk preferences and these preferences, in turn, are reflected in corporate outcomes as suggested by the upper echelons theory, we should observe a positive relationship between CEO facial masculinity and bank risk-taking.

In our empirical analysis, we used data on large U.S. banks over the period 2006–2014. Specifically, we collected pictures of 134 individual bank CEOs in order to calculate their fWHR and we also estimated the expected bank CEO testosterone levels based on CEO fWHR and age and clinical data on baseline and reactive testosterone levels provided in Lefevre et al. (2013). We measured bank risk-taking with stock return volatility, idiosyncratic risk, and *Z*-score which are proxies for slightly different aspects of financial risk. While stock return volatility and idiosyncratic risk are market-based risk measures and reflect market perceptions about the aggregate riskiness of a bank, Z-score is an accounting-based measure of bank stability which provides a backward-looking representation of financial performance and riskiness.

Our results demonstrate that CEO facial masculinity is positively associated with bank risk-taking. Specifically, we document that banks led by CEOs with more masculine facial features have more volatile stock returns and higher levels of idiosyncratic risk. We do not, however, find any evidence that CEO facial masculinity would be associated with bank stability as measured by Z-scores. In general, these findings can be interpreted to indicate that stock market participants perceive the banks led by CEOs with more masculine facial features to be riskier even though these banks are not necessarily associated with higher insolvency risk. This also suggests that there may be a gap between the actual actions of CEOs with more masculine facial features and the investors' inferences and perceptions about the riskiness of banks.

It is important to acknowledge that our analysis is somewhat exploratory in nature and there are several limitations that should be addressed in future research. First, our sample is relatively small and limited to 104 publicly traded U.S. banks and 134 individual CEOs. The small number of banks and individual CEOs naturally influences the statistical precision of our tests, and the use of large U.S. banks may limit the generalizability of our findings to other types of financial institutions and institutional settings. Moreover, we acknowledge that our sample period is relatively short and consists of the years surrounding the financial crisis of 2008–2009 which was particularly severe for financial institutions. Even though this period of financial turmoil provides an expedient setting to examine the relationship between CEO masculinity and bank risk-taking, it is possible that the documented relation would be different under more normal business conditions. Thus, it would be interesting to extend the analysis to a large sample of international banks and to utilize a longer sample period.

In our empirical analysis, we have attempted to control for several bank-specific characteristics that are known to affect bank risk. Nevertheless, it is possible that we have omitted correlated variables or unobservable bank characteristics that influence the level of risk-taking. Furthermore, it should be noted that we only focus on CEO facial masculinity and ignore all other individual differences across the top executives. These omitted personal attributes of the CEOs such as age, education, experience, incentives, and personality may affect bank risk-taking. Clinical studies, for instance, have documented that testosterone levels of men decrease with age (e.g., Feldman et al., 2002; Harman et al., 2001), and consequently, the age of individuals may have a confounding effect on the linkage between masculinity and risk-taking. In general, when interpreting our results, it is important to recognize that CEO masculinity is only one potential component of a complex system that determines bank-level riskiness and many other factors than the characteristics and personal preferences of the top executives affect bank risk-taking.

Finally, we acknowledge that our empirical analysis is subject to endogeneity concerns. It is possible that some bank characteristics simultaneously affect both the level of risk-taking and the selection of bank CEOs. Although we posit that CEO facial masculinity is largely an exogenous variable, our results may be affected by self-selection biases if more risky banks tend to appoint more masculine CEOs, or alternatively, if more masculine CEOs self-select themselves into more risky banks due to personal preferences. Ultimately, the causal relationship between CEO facial masculinity and bank risk-taking could be tested by examining whether the level of bank risk-taking increases (decreases) after the appointment of a CEO with more (less) masculine facial features. Given that we do not formally address endogeneity concerns in our empirical design, any causal interpretations of our findings should be made with caution. Thus, an obvious extension of our analysis would be to establish a causal relationship between CEO facial masculinity and bank risk-taking. It would also be important to analyze how and through which channels CEO masculinity influences the riskiness of financial institutions.

In conclusion, we document a positive association between CEO facial masculinity and bank risk-taking. Our results suggest that individual differences in masculinity not only influence personal risk-taking behavior but may also have important implications for corporate behaviour. These findings can be considered to add knowledge to our understanding of how personal differences among the top executives may be reflected in corporate-level decisions and outcomes.

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Facial attractiveness and CEO compensation: Evidence from the banking industry☆

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A B S T R A C T

This paper examines the effect of facial attractiveness on the compensation of bank Chief Executive Officers (CEOs). Consistent with the so-called beauty premium hypothesis, we document that good looks pay off for bank CEOs. Specifically, by utilizing machine learning to assess the facial appearance of the CEOs of large U.S. banks, we find that CEO facial attractiveness is positively associated with the annual total compensation and the discretionary, performance-based components of compensation. The total compensation of above-average looking bank CEOs is about 24% higher than the compensation of CEOs with below-average looks after controlling for various CEO-specific and bank-specific attributes that are known to affect executive compensation. Furthermore, our results indicate that facial attractiveness is weakly positively related to the annual base salary while being unrelated to the pay-performance and pay-risk sensitivities of bank CEO compensation. Overall, our empirical findings provide strong evidence for the existence of a beauty premium in the executive labor market.

1. Introduction

Beauty matters in life and brings advantages in a wide range of situations and social interactions. Anecdotal evidence as well as an ample body of research indicate that the physical attractiveness of individuals influences various social outcomes such as initial impressions (Feingold, 1992; Jackson, Hunter, & Hodge, 1995), romantic appeal and dating choices (Carmalt, Cawley, Joyner, &

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Sobal, 2008; Meltzer, McNulty, Jackson, & Karney, 2014), peer judgment and treatment (Langlois et al., 2000), the success and popularity of politicians and athletes (Berggren, Jordahl, & Poutvaara, 2010; Brewer & Howarth, 2012; Hamermesh, 2006; Williams, Park, & Wieling, 2010), and even student evaluations of university professors (Hamermesh & Parker, 2005; Jobu Babin, Hussey, Nikolsko-Rzhevskyy, & Taylor, 2020; Oghazi, 2016). As put forth by Webster and Driskell (1983), "it is fortunate to be beautiful and unfortunate to be ugly".

Beauty is also known to affect job-related outcomes and attractive individuals may be rewarded for their good looks in the labor market (see e.g., Chiu & Babcock, 2002; Hosada, Stone-Romero & Coats, 2003; Luxen & van de Vijver, 2006). In their seminal study, Hamermesh and Biddle (1994) document that attractive-looking employees earn higher wages than less attractive individuals. This so-called "beauty premium" is economically meaningful as the wages of above-average looking employees are found to exceed the wages of less good-looking individuals by about 10–15%. Over the last two decades, the existence of the beauty premium has been documented in various experimental studies as well as in many different labor market settings and among different social and occupational groups (see e.g., Biddle & Hamermesh, 1998; Harper, 2000; Mobius & Rosenblat, 2006; Andreoni & Petrie, 2008; Fletcher, 2009; Johnston, 2010; Borland & Leigh, 2014; Deryugina & Shurchkov, 2015; Doorley & Sierminska, 2015; Parrett, 2015; Scholz & Sicinski, 2015). In general, attractiveness appears to be a favorable and enduring labor market attribute that persists even after controlling for individuals' other personal characteristics such as age, gender, education, intelligence, personality, and family background (e.g., Scholz & Sicinski, 2015).

Despite the extensive literature on the beauty premium, surprisingly little is known about the effects of physical attractiveness in the executive labor market. In this study, we attempt to fill this gap. Specifically, we aim to contribute to the beauty premium literature by examining whether facial attractiveness is reflected in the compensation of Chief Executive Officers (CEOs) using data on large, publicly traded U.S. banks. We utilize machine learning to evaluate facial images of individual bank CEOs and then investigate if facial attractiveness influences the level and structure of CEO compensation. In brief, our empirical findings demonstrate that good looks pay off for bank CEOs.

The banking industry provides an expedient and unique context to investigate the existence of a beauty premium at the top executive level for several reasons. First, the CEOs of large banks are among the highest-paid individuals in the economy. Kaplan and Rauh (2010) document that bank CEOs are at the very top end of the income distribution, while the findings of Philippon and Reshef (2012) indicate that the CEOs of financial institutions earn a 250% premium relative to CEOs in other industries. Although the compensation of bank CEOs is often considered excessive, economic theories posit that the compensation policies of the top executives reflect optimal contracting and equilibrium in a competitive market for managerial talent (Murphy, 2013). Unless beauty affects managerial talent and skills, it should not be compensated for in a competitive executive labor market.

Furthermore, due to their economic and societal importance, banks and their compensation policies are subject to extensive regulations, guidelines, and supervision as well as intensive scrutiny by the market participants and other stakeholders. It is widely acknowledged that the compensation policies of bank CEOs which are generally designed to maximize shareholder value may lead to managerial short-termism, excessive risk-taking, and misaligned incentives that are conflicting with the interests of banks' other stakeholders such as depositors, debt holders, and the society in general (e.g., Acrey, McCumber, & Nguyen, 2011; Bai & Elyasiani, 2013; DeYoung, Peng, & Yan, 2013; Bhagat & Bolton, 2014; Bharati & Jia, 2018; Koch, Waggoner, & Wall, 2018). In the aftermath of the global financial crisis of 2008–2009, new legislation such as the Dodd-Frank Act as well as say-on-pay provisions within the Troubled Asset Relief Program (TARP) was explicitly designed to regulate executive compensation in the banking industry. Thus, in contrast to non-financial firms, the regulatory oversight of financial institutions also encompasses their managerial compensation policies.

Finally, the CEOs of large banks are a relatively homogenous group of individuals who have very similar demographic characteristics, educational backgrounds, and employment history (e.g., Nguyen, Hagendorff, & Eshraghi, 2015; King, Srivastav, & Williams, 2016; Altunbaş, Thornton, & Uymaz, 2018). While the top executives of publicly traded U.S. firms generally are very homogenous in terms of their demographic characteristics and educational backgrounds with the archetypical CEO being a white male in his mid-50s, bank CEOs are even more predominantly white men who are in their late-50s. In comparison to non-financial firms, bank CEOs tend to be slightly older and there is also less gender and racial diversity among bank CEOs.[3] Moreover, in addition to undergraduate university degrees, bank CEOs are more likely to have MBA degrees and hold CPA designations than the CEOs of non-financial firms.[4] Given that personal attributes such as age, gender, ethnicity, and educational attainment may influence compensation, the focus on a rather homogenous set of CEOs helps to alleviate challenges related to the confounding effects of other CEO characteristics than facial

[3] The average CEO age in our sample of the S&P 1500 banks is 58 years whereas the average CEO age of non-financial S&P 1500 or Fortune 500 firms reported in previous studies is typically about 55–56 years (see e.g., Serfling, 2014; Peltomäki, Sihvonen, Swidler, & Vähämaa, 2021; Hill, Upadhyay, & Beekun, 2015; He & Hirshleifer, 2022). In contrast to the age range of 28–89 years reported in Peltomäki et al. (2021) for the CEOs of the non-financial S&P 1500 firms, the age of bank CEOs in our sample varies from 34 to 83 years and 75% of the bank CEOs are between 51 and 65 years old. Females hold about 4–8% of the CEO positions of the S&P 1500 and Fortune 500 firms (e.g., Peltomäki et al., 2021; Zweigenhaft, 2021; Aabo & Giorici, 2022), but a mere 2% of bank CEOs are women. While previous studies suggest that whites make up approximately 93% of the CEOs of the S&P 1500 and Fortune 500 firms (e.g., Hill et al., 2015; Zweigenhaft, 2021), bank CEOs are even more predominantly white and only 4% of the CEO positions are held by individuals of other ethnic backgrounds.

[4] 44% of the bank CEOs in our sample hold MBA degrees and about 16% have CPA qualification. Previous studies suggest that about 30–35% of the CEOs of non-financial firms have an MBA and only about 5% of the CEOs hold a CPA designation (e.g., Gottesman & Morey, 2010; Dittmar & Duchin, 2016; Gounopoulos, Loukopoulos, & Loukopoulos, 2021; He & Hirshleifer, 2022).

attractiveness on executive compensation.

Our paper complements a small body of literature on the effects of CEO appearance and facial traits on corporate decisions and outcomes. Previous studies indicate that the physical appearance of the CEO may influence the firm's market valuation and stock returns (Blankespoor, Hendricks, & Miller, 2017; Halford & Hsu, 2020), financial performance (Graham, Harvey, & Puri, 2017; Rule & Ambady, 2008; Wong, Ormiston, & Haselhuhn, 2011), financial reporting practices (Jia, van Lent, & Zeng, 2014), the level of risk-taking (Ahmed, Sihvonen, & Vähämaa, 2019; Kamiya, Kim, & Park, 2019), and CEO selection process and the likelihood of CEO dismissal (Connelly, Lee, Hersel, & Walker, 2020; Cook & Mobbs, 2022; Gomulya, Wong, Ormiston, & Boeker, 2017).

Directly related to but distinct from our study, Graham et al. (2017), Cook and Mobbs (2022), Halford and Hsu (2020), and Li, Triana, Byun, and Chapa (2021) examine the relationship between facial appearance and CEO compensation. Graham et al. (2017) employed a group of business students to grade the facial images of 136 individual CEOs of large U.S. firms in terms of beauty, competence, likability, and trustworthiness. Using a single cross-section for the year 2003, they document that competent and attractive-looking CEOs have higher total compensation. The nearly contemporaneous studies by Cook and Mobbs (2022), Halford and Hsu (2020), and Li et al. (2021) explore the beauty premium in the executive labor market using rather similar samples of the S&P 500 firms.[5] Collectively, their findings demonstrate that facial attractiveness is positively associated with CEOs' annual total compensation. We aim to contribute to this literature by examining whether facial attractiveness affects the level as well as the structure of CEO compensation in the banking industry.

In our empirical analysis, we use data on the S&P 1500 banks over the period 2005–2020. We collect facial images of 272 individual bank CEOs and utilize a deep convolutional neural network developed by He, Zhang, Ren, and Sun (2016) to assess the facial attractiveness of these CEOs on a scale of 1–5. Following the prior executive compensation literature (e.g., Core, Holthausen, & Larcker, 1999; Ang, Lauterback & Schreiber, 2002; Coles, Daniel, & Naveen, 2006; Bugeja, Matolcsy, & Spiropoulos, 2012; Rekker, Benson, & Faff, 2014; Gande & Kalpathy, 2017; Cerasi, Deininger, Gambacorta, & Oliviero, 2020), we measure CEO compensation with annual total compensation, base salary, and the discretionary components of compensation. In addition, we also examine the effect of CEO facial attractiveness on compensation incentives as measured by the CEO's pay-performance sensitivity and pay-risk sensitivity.

Our empirical findings provide strong evidence for the existence of a beauty premium in CEO compensation. Specifically, we document that facial attractiveness is positively associated with the total compensation and the discretionary, performance-based compensation components of bank CEOs. The magnitude of the documented beauty premium in bank CEO compensation is economically significant. Our results suggest that a one standard deviation increase in the CEO facial attractiveness measure increases the total compensation by almost 9% ($395,000) after controlling for various CEO-specific and bank-specific attributes that are known to affect executive compensation. Moreover, the total compensation of above-average looking bank CEOs is about 24% ($1.06 million) higher than the compensation of CEOs with below-average looks, and the above-average looking CEOs have about 55% higher sum of bonuses, stock grants, and option grants than their less attractive peers. Nevertheless, our findings also indicate that facial attractiveness is only weakly positively related to the annual base salary while being unrelated to the pay-performance and pay-risk sensitivities of bank CEO compensation.

We perform a number of additional tests to investigate the robustness of our findings and to rule out alternative explanations. These tests demonstrate that the positive association between facial attractiveness and CEO compensation is not influenced by the strength of board monitoring or managerial power. In addition to controlling for a wide set of CEO-specific and bank-specific attributes and including different types of fixed-effects in the regressions, we also utilize propensity score matching to mitigate any remaining endogeneity concerns. We also show that the beauty premium in the compensation of bank CEOs cannot be explained by demographic attributes such as age, gender, or ethnicity nor by differences in bank size and business models. Collectively, our results offer strong support for the beauty premium hypothesis in the executive labor market. The beauty premium persists at the top executive level and bank CEOs are as susceptible to attractiveness gaps in their compensation as average employees. Intriguingly, the documented size of the beauty premium among bank CEOs is very similar to the beauty premium in the general labor market (e.g., Hamermesh & Biddle, 1994; Scholz & Sicinski, 2015).

Although our study complements and builds on the work of Graham et al. (2017), Cook and Mobbs (2022), Halford and Hsu (2020), and Li et al. (2021), there are at least three important differences. First, unlike the prior studies, we focus on a single industry that provides a particularly attractive setting to examine the association between CEO attractiveness and compensation. Banks operate in a highly competitive and regulated environment and constitute a homogenous industry with a relatively homogenous set of top executives who are among the highest-paid individuals in the economy.[6] By utilizing data from a single homogenous industry, we mitigate concerns that structural differences across industries may influence both the level and the determinants of executive pay. We argue that this restrictive setting reduces noise and provides a more powerful test of the beauty premium hypothesis in the executive labor market.

Second, while Graham et al. (2017), Cook and Mobbs (2022), Halford and Hsu (2020), and Li et al. (2021) examine only the total compensation of CEOs, we also explore the effect of facial attractiveness on bank CEOs' annual base salary, the performance-contingent compensation components and incentives that require considerable discretion by the board of directors, and

[5] Cook and Mobbs (2022) use a sample of 255 unique executives in 100 different S&P 500 firms over the period 2000–2009, Halford and Hsu (2020) use data on 667 CEOs of the S&P 500 firms for years 2000–2012, and Li et al. (2021) use data on 861 individual CEOs of the S&P 500 firms over the period 2004–2013.

[6] Bank CEOs tend to be even more predominantly white men in their late-50 s than the CEOs of other publicly traded U.S. firms.

the sensitivities of CEO compensation to changes in stock prices and stock return volatility. As noted already by Jensen and Murphy (1990), in addition to the level of pay, it is important to consider the structure of how CEOs are paid. In the banking industry, the structure of CEO compensation is different with bonuses and other types of discretionary incentive compensation components comprising a higher proportion of total compensation than in other industries (e.g., Houston & James, 1995; Murphy, 2013). Thus, we contribute to beauty premium literature by providing a more nuanced investigation into different components of CEO compensation and compensation-based incentives.

Finally, in contrast to the prior beauty premium literature, we exploit state-of-the-art machine learning techniques to assess the facial attractiveness of bank CEOs. Our machine learning approach can be considered to yield an objective assessment of facial attractiveness by generalizing perceptions about what constitutes a beautiful face. The beauty assessments based on deep convolutional neural networks reflect both the biological traits of beauty such as facial averageness, bilateral symmetries, and sexual dimorphism as well as nonphysical attributes such as a pleasant expression, youthful appearance, and good grooming (see e.g., Rhodes, 2006 for a review). As a consequence, machine-based image analysis should reduce noise and provide an objective consensus perception of facial attractiveness rather than reflecting the idiosyncrasies in respondents' subjective assessments of appearance as in survey-based designs.[7]

The remainder of the paper proceeds as follows. Section 2 outlines the background on CEO compensation and the beauty premium and presents our research hypotheses. Section 3 describes the data on U.S. banks, presents the machine learning approach to assess CEO facial attractiveness, and introduces the variables used in our empirical analysis. Section 4 presents the empirical setup and reports our results on the effect of facial attractiveness on CEO compensation. Finally, Section 5 summarizes the findings and concludes the paper.

2. Background and hypotheses

Beauty may matter in the labor market for several reasons (for a review, see e.g. Hosoda, Stone-Romero, & Coats, 2003). In general, attractive-looking individuals are judged and treated more positively than unattractive individuals, even by those who know them (Langlois et al., 2000), and, consequently, physical attractiveness is likely to influence observed or presumed competence and job success. Since the seminal study of Hamermesh and Biddle (1994), a vast body of literature has documented evidence of pay differences based on attractiveness in many different labor market settings and among different social and occupational groups (e.g., Biddle & Hamermesh, 1998; Harper, 2000; Borland & Leigh, 2014; Doorley & Siermienska, 2015; Parrett, 2015). In general, the prior literature suggests that beauty is a favorable and enduring labor market attribute that persists even after controlling for individuals' other personal characteristics such as age, gender, weight, education, intelligence, personality, and family background (e.g., Hamermesh, 2011; Scholz & Sicinski, 2015). To explain the higher wages of attractive employees, Mobius and Rosenblat (2006) argue that attractive individuals portray confidence while communicating or socializing with their employers, thereby forming a positive impression about their competence which then, in turn, increases their wages. Psychology literature suggests that people tend to associate positive stereotypes, many of which correspond to leadership ability, to physically attractive people (e.g., Warner & Sugarman, 1986).

Over recent years, the existence of a beauty premium has also been examined in the executive labor market. Directly related to the current study, Graham et al. (2017), Cook and Mobbs (2022), Halford and Hsu (2020), and Li et al. (2021) examine the relationship between facial appearance and CEO compensation in large U.S. firms and document a positive relation between attractiveness and compensation. According to Cook and Mobbs (2022), attractive-looking CEOs may have better interpersonal communication and leadership skills and attractiveness may also influence directors' assessments of a CEO's ability.

The level and structure of CEO compensation are set by the board of directors. In large, publicly traded firms, CEO compensation typically consists of an annual base salary, bonuses, and different types of equity-based compensation components and incentives. According to the optimal contracting approach to executive compensation, CEO compensation policies are designed to maximize shareholder value and to reflect optimal contracting and equilibrium in the competitive market for managerial talent (e.g., Bebchuk, Fried, & Walker, 2002; Murphy, 2013). In order to minimize agency problems, the optimal compensation plan needs to be designed in a way that reduces agency problems and aligns executives' interests with the shareholders. Under the optimal contracting view, beauty should not be compensated for in executive compensation unless it affects managerial skills and creates shareholder value.

In contrast to the optimal contracting view, the managerial power theory suggests that executives have possibilities to influence their own pay. As argued by Bebchuk and Fried (2004), managerial power plays a key role in shaping executive pay arrangements because CEOs may have power over the board of directors due to structural and social-psychological mechanisms that may influence the board's decision-making processes. Consequently, Bebchuk and Fried (2004) postulate that rent extraction plays a significant role in executive compensation, and powerful, self-interested CEOs may extract higher compensation than they would receive under an optimal principal-agent contract. Under this view, the relationships between the CEO and the directors have a pivotal role in the compensation-setting process, and thus, these relationships are a potential mechanism through which attractiveness may influence CEO compensation.

[7] In survey-based assessments of attractiveness, the demographic characteristics of the survey participants may create noise in the assessments. The age and gender of the survey participants are likely to influence their perception of beauty and, moreover, age and gender differences between the survey participants and their assessment objects may be reflected in the assessments. For instance, young males and old females may assess the attractiveness of an older male very differently.

Given the prior evidence of a beauty premium in many different labor market settings and various occupational groups, we posit the following general research hypothesis:

H1: Facial attractiveness is positively associated with the compensation of bank CEOs.

As noted by Jensen and Murphy (1990), in addition to the level of compensation, it is important to consider the structure of how CEOs are paid. Therefore, to provide a more nuanced investigation into the beauty premium in executive compensation, we examine the effect of facial attractiveness on different components of bank CEO compensation. In addition to focusing on the level of total compensation similar to Graham et al. (2017), Cook and Mobbs (2022), Halford and Hsu (2020), and Li et al. (2021), we also explore the effect of facial attractiveness on bank CEOs' base salary and the performance-contingent compensation components and incentives that require considerable discretion and qualitative assessment by the board of directors. A vast proportion of the total CEO compensation is typically paid in the form of bonuses and different types of equity-based compensation components and incentives (see e.g., Murphy, 2013; Ahmed, Davydov, & Vähämaa, 2022). Partially due to tax laws and accounting rules, the annual base salaries of CEOs have been relatively stagnant and most of the variation in the level of CEO compensation both over time and cross-sectionally comes from the other, more discretionary compensation components. The prior literature suggests that these discretionary components of CEO compensation involve more negotiation and are more susceptible to the influence of personal connections, communication skills, and CEO-director relationships (e.g., Bertrand & Mullainathan, 2001; Bebchuk & Fried, 2004; Keller, Molina, & Olney, 2020; Keller & Olney, 2021). If beauty affects the development of interpersonal relationships between the CEO and the directors as argued by Cook and Mobbs (2022), we would expect the discretionary components of compensation to be more susceptible to CEO attractiveness than the base salary. These arguments lead to the following hypothesis:

H2: The effect of facial attractiveness on CEO compensation is more pronounced for the more discretionary elements of compensation.

In addition to the level and structure of CEO compensation, we also examine the effect of facial attractiveness on the sensitivities of compensation to changes in stock prices and stock return volatility. These pay-performance and pay-risk sensitivities are important elements of executive pay arrangements that have been documented to influence corporate outcomes (e.g., Coles et al., 2006; Bai & Elyasiani, 2013; DeYoung et al., 2013). Ex ante, depending on the preferences of the CEO, the relation between facial attractiveness and CEO compensation sensitivities can be positive or negative. On one hand, attractive-looking CEOs may be able to extract compensation arrangements that emphasize discretionary pay components that are less sensitive to the firm's stock market performance. On the other hand, however, if attractiveness is related to self-confidence as suggested e.g. by Langlois et al. (2000) and Mobius and Rosenblat (2006), attractive CEOs may negotiate compensation packages that provide them with stronger pay-performance and risk-taking incentives. Thus, the question of how CEO facial attractiveness influences pay-performance and pay-risk sensitivities is ultimately addressed empirically.

3. Data and variables

3.1. Data

In our empirical analysis, we use data on publicly traded U.S. banks included in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices (i.e., S&P 1500 banks) over the period 2005–2020. Following Fahlenbrach and Stulz (2011), we define banks as firms with primary Standard Industrial Classification (SIC) codes between 6000 and 6300.[8] We begin by compiling the names of the incumbent bank CEOs from ExecuComp and then manually collecting high-resolution professional facial images of these CEOs using Google Image Search. We collect at least two images of each individual bank CEO and use the image that is of the best quality for assessing facial attractiveness. In addition to facial images, we collect data on CEO compensation and observable CEO attributes such as age, gender, tenure, and education from ExecuComp and BoardEx. The balance sheet and income statement data used in our analysis are obtained from Bloomberg and data on the banks' board characteristics are collected from BoardEx. After excluding banks with insufficient data, we are left with a final sample of 272 individual CEOs, 167 individual banks, and 1806 bank-year observations.

3.2. CEO facial attractiveness

We begin by manually collecting professional facial images of the bank CEOs using Google Image Search. The quality of each facial image is evaluated based on resolution, clarity, and the neutrality of the head pose in the picture. In the collection process, we pursued to identify facial images that are as similar as possible to the other CEO images in terms of quality and overall appearance.

After collecting the facial images, we exploit machine learning to assess the facial attractiveness of bank CEOs. Specifically, we utilize the so-called transfer learning approach to deal with limited labeled data. The generic idea of this approach is that models and parameters trained in one context can be used in another. Image classification or object recognition are typical applications because there are usually not enough data to train large-scale convolutional neural networks used in machine-based image analysis. In transfer learning, the convolutional neural networks are first trained with a similar-type dataset and then transferred to other image recognition tasks where only the last layers are trained, and the pre-trained parameters are used as starting values. Intuitively, even though

[8] Firms with SIC codes between 6000 and 6300 are depository institutions, non-depository credit institutions, and security and commodity brokers, dealers, exchanges, and services.

the neural network is ultimately trained to different classification tasks, the first layers of that network learn how to identify general structures in images that are useful for other applications.

We evaluate the attractiveness of facial images with the ResNet50 deep convolutional neural network developed by He et al. (2016). This approach is considered as the state-of-the-art technique for machine-based image analysis (Mishkin, Sergievskiy, & Matas, 2017). The ResNet50 is first pre-trained with ImageNet data (Deng et al., 2009). The last ten layers of the neural network are then re-trained using data on facial attributes, while the parameters of the first 40 layers are kept locked. This fine-tuning is conducted using a dataset of 5500 facial images (Liang, Lin, Jin, Xie, & Li, 2018) for which the facial attractiveness has been evaluated on a scale of 1–5.[9] The neural network is first trained using 70% of the facial images and then validated using the remaining 30% of the data. After fine-tuning, the final training is performed using the full dataset of 5500 facial images. With this procedure, the neural network achieves an average absolute error of 0.34, which is similar to the results reported in Liang et al. (2018). Finally, the trained ResNet50 convolutional neural network is utilized to assess the facial attractiveness of each individual bank CEO on a scale of 1–5, with 5 being the most attractive appearance. The resulting variable, *Attractiveness*, is the main test variable in our empirical analysis.

In addition to *Attractiveness*, we use three alternative binary variables as proxies for facial attractiveness in the regressions. *Above-median attractiveness* is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median. We also use *High attractiveness* and *Low attractiveness* dummies. *High attractiveness* equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, while *Low attractiveness* is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The underlying reasoning for these two dummies is that previous studies have documented that the beauty premium is most prevalent for individuals in the top tercile of attractiveness scores whereas individuals belonging to the bottom sextile in terms of attractiveness tend to suffer a plainness penalty (see e.g., Hamermesh, 2011).

3.3. CEO compensation

We use three alternative measures of CEO compensation as the dependent variable in our main regressions: (i) annual total compensation, (ii) annual base salary, and (iii) annual discretionary compensation. In addition, we also examine the effect of CEO facial attractiveness on compensation incentives as measured by the CEO's pay-performance sensitivity and pay-risk sensitivity. These variables have been extensively used in the prior literature to measure CEO compensation and compensation-based incentives (e.g., Core et al., 1999; Mishra & Nielsen, 2000; Ang, Lauterbach, & Schreiber, 2002; Coles et al., 2006; Gabaix & Landier, 2008; Elkinawy & Stater, 2011; Bugeja et al., 2012; Aivazian, Lai, & Rahaman, 2013; Rekker et al., 2014; Hadley, 2019). *Total compensation* is defined as the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation. *Salary* is the annual base salary of the CEO and measures the fixed component of CEO compensation. We define *Discretionary compensation* as the sum of annual bonuses, non-equity incentive plan compensation, and the grant-date fair value of option and stock awards.

CEOs' pay-performance and pay-risk sensitivities are measured with *Delta* and *Vega*, respectively. *Delta* is defined as the dollar gain or loss in CEO wealth for a 1% change in the bank's stock price. Thus, a higher delta indicates that the CEO will earn higher compensation for strong stock market performance. *Vega* is defined as the dollar gain or loss in CEO wealth for a 1%-point change in the bank's stock return volatility. Thus, it provides a direct proxy for CEO risk-taking incentives. The deltas and vegas for each CEO are defined following the approach of Core and Guay (2002) and Coles et al. (2006).[10]

3.4. CEO-specific control variables

CEO compensation can be influenced by CEO-specific attributes such as age, gender, education, and experience. Therefore, to account for the potentially confounding effects of CEO attributes other than facial attractiveness on CEO compensation, we employ the following set of CEO-specific control variables in our regressions: (i) *CEO age* is the age of the bank's CEO in years, (ii) *Female CEO* is a dummy variable which equals one if the bank's CEO is a female, (iii) *Non-Caucasian CEO* is a dummy variable which equals one if the ethnic background the bank's CEO is other than Caucasian, (iv) *CEO tenure* is the length of tenure of the incumbent CEO in years, (v) *CEO duality* is a dummy variable which equals one if the CEO is also the chairman of the board of directors, (vi) *MBA/CPA* is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant (CPA), and (vii) *PhD* is a dummy variable that equals one if the CEO holds a doctoral degree.

Age, gender, and ethnicity are known to influence the salaries of individuals in the general population, and at the same time, these attributes may also affect the perception of attractiveness. On average, younger individuals are perceived to be more attractive than older individuals (Hamermesh, 2011). Salaries, on the other hand, tend to increase with age, and the findings of Adhikari, Bulmash, Krolikowski, and Sah (2015) demonstrate that older CEOs have higher total compensation than their younger counterparts. Although the existence of a gender wage gap in the general population has been extensively documented in the literature (see e.g., Weichselbaumer and Winter-Ebmer, 2005; Castilla, 2008; Blau & Kahn, 2017), the prior studies on executive compensation provide mixed

[9] We acknowledge that differences in demographic characteristics may potentially influence assessments of attractiveness. The training data of 5500 images comprise facial images of both males and females and individuals of different ages and different ethnic backgrounds. Consequently, the neural network should arguably be able to generalize the traits of beauty across different demographic dimensions. In this regard, it is also important to stress that bank CEOs are a relatively homogenous group of individuals who have very similar demographic characteristics.

[10] The data on deltas and vegas are obtained from Lalitha Naveen's data library at https://sites.temple.edu/lnaveen/data/.

evidence and often suggest that the gender wage gap may disappear or even reverse at the CEO level (Bugeja et al., 2012; Canil, Karpavičius, & Yu, 2019; Elkinawy & Stater, 2011; Gayle, Golan, & Miller, 2012; Gupta, Mortal, & Guo, 2018; Hill et al., 2015; Leszczynska & Chandon, 2019). Moreover, the findings of Hamermesh and Biddle (1994) and Parrett (2015) suggest that gender may also affect the magnitude of the beauty premium. We also control for CEOs' ethnic backgrounds because of the systematic racial wage inequality documented in the U.S. labor market (e.g., McCall, 2001; Antecol & Bedard, 2004; Kim & Sakamoto, 2010; Dreher, Lee, & Clerkin, 2011).

The length of the CEO's tenure and CEO duality are proxies for the CEO's experience and managerial power within the bank which are likely to influence the level of compensation. CEOs with longer tenure are more experienced and are considered to have greater managerial power and higher firm-specific human capital investment. The managerial power theory suggests that powerful CEOs have higher compensation because of greater rent extracting ability (e.g., Bebchuk et al., 2002; Bebchuk & Fried, 2003; Fulmer, 2009; Morse, Nanda, & Seru, 2011). Consistent with this view, previous studies have documented that CEO power is positively associated with compensation (Core et al., 1999; Cyert, Kang, & Kumar, 2002; Hill & Phan, 1991; Song & Wan, 2019). Finally, we control for the CEO's education level because educational attainment may serve as a proxy for the latent abilities of CEOs. CEO education has been documented to influence various firm-level outcomes as well as the level and structure of CEO compensation (e.g., King et al., 2016; Gounopoulos et al., 2021; Chen, Torsin, & Tsang, 2022; Urquhart & Zhang, 2022).

3.5. Bank-specific control variables

Following the prior literature on executive compensation, we control for bank size, financial performance, capital ratio, risk, growth, and board characteristics to account for the effects of bank-specific attributes on CEO compensation. *Size* is measured as the natural logarithm of the bank's total assets. CEO compensation is documented to increase with the firm size as the executives of larger firms arguably face greater responsibilities and demands as well as a more complex operating environment (e.g., Smith & Watts, 1992; Tosi, Werner, Katz, & Gomez-Mejia, 2000; Ang et al., 2002; Gabaix & Landier, 2008; Elkinawy & Stater, 2011; Murphy, 2013). Given that executive compensation is positively associated with the firm's financial performance and growth rate (e.g., Murphy, 1985; Core et al., 1999; Bebchuk et al., 2002), we control for profitability and loan growth. We measure *Profitability* with return on assets (ROA) which is calculated as net income divided by total assets, while *Growth* is calculated as the logarithmic difference in the net loans. Executive compensation may also be related to the bank's capital and asset structures which broadly capture the stability and business policy choices of the financial institution (e.g., Aggarwal & Samwick, 1999; John, Saunders, & Senbet, 2000; Adams & Mehran, 2003; DeYoung et al., 2013). Therefore, we include *Capital ratio* measured as the ratio of Tier 1 equity capital to risk-weighted assets under the Basel capital requirements and *Loans to assets* calculated as total loans divided by total assets among the set of bank-specific controls.

In addition to financial variables, we control for board characteristics because the level and structure of CEO compensation are set by the board of directors. Following the prior literature, we assume that differences in observable board characteristics such as size, independence, and gender diversity reflect differences in the quality and intensity of board monitoring (e.g., Coles, Daniel, & Naveen, 2008; Guthrie, Sokolowsky, & Wan, 2012; Pathan & Faff, 2013; Baselga-Pascual, Trujillo-Ponce, Vähämaa, & Vähämaa, 2018; Owen & Temesvary, 2019). We measure *Board size* as the natural logarithm of the number of board members. *Board independence* is measured as the number of non-executive directors divided by the total number of board members. Finally, *Board gender diversity* is defined as the number of male directors divided by the total number of board members.

3.6. Descriptive statistics and correlations

Table 1 reports descriptive statistics for the variables used in our empirical analysis. The mean level of CEO total compensation in our sample is $4.43 million and the mean annual salary is $802,190, indicating that bonuses and other types of more discretionary compensation items comprise a vast proportion of CEO compensation in the banking industry. On average, the sum of discretionary compensation items is about $3.44 per year. As can be seen from Table 1, there is substantial variation across banks in the level of CEO compensation with *Total compensation* ranging from zero to $43.12 million and *Discretionary compensation* from zero to $42.11 million. The sample banks are also very heterogeneous in terms of pay-performance and pay-risk sensitivities of their CEOs with *Delta* varying between zero and $10.96 million, with a mean of $460,310, and *Vega* ranging from zero to about $3 million.

Fig. 1 depicts the distribution of CEO total compensation into its subcomponents and the developments in pay structure across the years. Although the base salary of the CEOs has remained relatively constant throughout the sample period, the average total compensation first decreased by almost 63% from 2006 to 2009 and then increased by 133% from 2009 to 2020. For an average CEO, bonuses account for approximately one-fourth of the annual total pay, while stock grants and option grants represent about 45–65% of total compensation. Similar to Murphy (2013), it can be observed from Fig. 1 that the composition of CEO compensation has largely shifted from options towards restricted stock in the aftermath of the global financial crisis.

Table 1 further shows that the mean facial attractiveness score of the bank CEOs is 2.67 on a scale of 1–5. The attractiveness scores based on the ResNet50 convolutional neural network range from 1.18 to 3.92 with a standard deviation of 0.54, indicating a reasonable dispersion in the looks of the sample CEOs. Regarding the CEO-specific control variables, the descriptive statistics demonstrate that bank CEOs are a relatively homogenous group of individuals in terms of their demographic characteristics; a typical bank CEO is a 58-year old white male. Our sample of 272 individual CEOs includes 254 Caucasian males, 9 non-Caucasian males, and 9 females, and 75% of the sample CEOs are between 51 and 65 years old. The average CEO tenure is 9.7 years and about half of the CEOs are also board chairs. About 55% of the bank CEOs hold either an MBA degree or are Certified Public Accountants, and 11% of the

Table 1
Descriptive statistics.

	Mean	Median	Min	Max	Std. dev.	Obs.
CEO attractiveness:						
Attractiveness	2.67	2.66	1.18	3.92	0.54	1806
Above-median attractiveness	0.51	1.00	0.00	1.00	0.50	1806
High attractiveness	0.35	0.00	0.00	1.00	0.48	1806
Low attractiveness	0.16	0.00	0.00	1.00	0.37	1806
CEO compensation:						
Total compensation	4434.86	2340.96	0.00	43012.78	5701.69	1806
Salary	802.19	754.17	0.00	5600.00	408.67	1806
Discretionary compensation	3439.34	1395.96	0.00	42110.86	5409.05	1806
Delta	460.31	110.27	0.00	10956.53	1031.73	1407
Vega	109.18	15.11	0.00	3032.99	287.91	1415
CEO-specific control variables:						
CEO age	58.14	58.00	34.00	83.00	7.04	1806
Female CEO	0.02	0.00	0.00	1.00	0.15	1806
Non-Caucasian CEO	0.04	0.00	0.00	1.00	0.20	1806
CEO tenure	9.71	8.00	1.00	42.00	7.94	1806
CEO duality	0.55	1.00	0.00	1.00	0.50	1806
MBA/CPA	0.55	1.00	0.00	1.00	0.50	1806
PhD	0.11	0.00	0.00	1.00	0.31	1806
Bank-specific control variables:						
Size (in millions)	116,442.60	12,258.78	686.08	3384,757.00	376,845.50	1806
Profitability (%)	0.93	0.99	-15.05	18.25	1.41	1806
Growth (%)	9.31	6.64	-97.93	110.44	15.80	1806
Capital ratio (%)	13.24	12.19	3.30	101.00	6.15	1806
Loans to assets (%)	62.99	67.39	1.49	95.42	16.80	1806
Board size	11.97	12.00	5.00	23.00	2.80	1806
Board independence (%)	86.81	88.89	53.33	100.00	6.87	1806
Board gender diversity (%)	84.61	84.60	44.40	100.00	9.84	1806

The table reports summary statistics for the sample of 167 banks over the period 2005–2020. The four CEO facial attractiveness proxies are (i) Attractiveness which is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, (ii) Above-median attractiveness is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median, (iii) High attractiveness equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, and (iv) Low attractiveness is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The five CEO compensation measures are defined as follows: (i) Total compensation is the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, (ii) Salary is the annual base salary of the CEO, (iii) Discretionary compensation is the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards, (iv) Delta measures the dollar gain or loss in CEO wealth for a 1% change in the bank's stock price, and (v) Vega measures the dollar gain or loss in CEO wealth for a 1%-point change in the bank's stock return volatility. The control variables are the following: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is measured by the bank's total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members.

CEOs hold a Ph.D.

Although we are focusing on a single homogenous industry, it can be noted from Table 1 that the sample exhibits considerable variation in terms of the bank-specific control variables. The total assets of the sample banks range from about $686 million to $3.38 trillion, with a mean of $116.44 billion. On average, the banks hold capital ratios of 13.2% and have invested about 63% of their assets into loans. Return on assets varies from a minimum of − 15.1% to a maximum of 18.3% with a mean of 0.93%, and the growth rate of loans fluctuates substantially around its mean of 9.3%. The boards of the sample banks typically consist of 12 directors and about 85% of the board seat are held by males.

The pairwise correlations between the variables used in our regressions are reported in Table 2. Consistent with the beauty premium hypothesis, *Attractiveness* is significantly positively correlated with the five measures of CEO compensation and compensation incentives. With respect to the CEO-specific and bank-specific control variables, it can be noted from Table 2 that *Attractiveness* is most strongly correlated with *CEO tenure*, *MBA/CPA*, and *Board gender diversity*. The negative correlation between *Attractiveness* and *Board gender diversity* suggests that female representation on the board of directors is positively associated with CEO facial attractiveness.

Not surprisingly, *Total compensation*, *Salary*, and *Discretionary compensation* are strongly positively correlated with each other. *Delta*

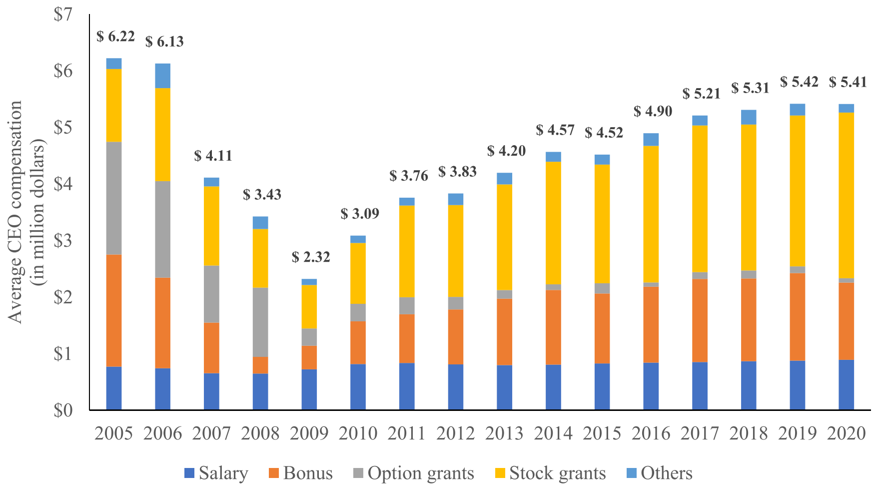

Fig. 1. Bank CEO total compensation. The figure depicts of the distribution of CEO total compensation into its subcomponents and the developments in pay structure during the period 2006–2014. *Total compensation* is the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, *Salary* is the annual base salary of the CEO, *Bonus* is the sum of annual bonus and the non-equity incentive plan, *Stock grants* and *Option grants* are the grant-date fair value of stock and option awards, respectively, and *Other* includes all other compensation items in excess of *Salary*, *Bonus*, *Stock grants* and *Option grants*.

and *Vega* exhibit strong positive correlations with *Total compensation*, but much weaker correlations with *Salary*. The CEO compensation measures are also highly correlated with many of our control variables. Specifically, as can be seen from Table 2, CEO compensation is positively correlated with *CEO age*, *CEO tenure*, *CEO duality*, *Non-Caucasian CEO*, and *MBA/CPA* while being negatively correlated with *Female CEO*. Furthermore, the correlations suggest that the level of CEO compensation is higher in larger and more profitable banks with less traditional business models. Table 2 also shows that several of our control variables are relatively highly correlated with each other.[11] The strongest correlations among the control variables are those between *Capital ratio* and *Profitability* (0.55), *Size* and *Loans to assets* (−0.43), *Capital ratio* and *Loans to assets* (−0.42), and *CEO age* and *CEO tenure* (0.40).

4. Results

4.1. Univariate tests

As a preliminary test of the beauty premium hypothesis, we perform univariate tests to examine compensation differences between more attractive and less attractive bank CEOs. To accomplish this, we divide the sample CEOs into two subsamples based on the median facial attractiveness score. The results of two-tailed *t*-tests for the null that there is no difference in the means of the compensation variables between the subsamples are presented in Table 3.

Overall, the univariate tests in Table 3 provide support for the hypothesis that facial attractiveness is positively associated with CEO compensation. The mean differences in *Total compensation*, *Salary*, and *Discretionary compensation* between the two subsamples are positive and statistically significant at the 1% level, and thereby suggest that good looks pay off for bank CEOs. The observed differences in CEO compensation can be considered economically significant; the annual total compensation of more attractive CEOs exceeds the compensation of their less attractive counterparts by about $1.33 million (35%) and the good-looking CEOs earn about $94,000 more in annual base salary. Nevertheless, the univariate tests also indicate that facial attractiveness is unrelated to the sensitivities of CEO compensation to changes in stock prices and stock return volatility.

4.2. Main results

We test the hypothesis that facial attractiveness is positively associated with the compensation of bank CEOs by estimating alternative versions of the following panel regression specification:

[11] Given these relatively high correlation coefficients, we perform several robustness checks to ascertain that our results are not affected by multicollinearity.

Table 2
Correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) Attractiveness																				
(2) Total compensation	0.15																			
(3) Salary	0.08	0.35																		
(4) Discretionary compensation	0.14	0.82	0.24																	
(5) Delta	0.12	0.61	0.12	0.49																
(6) Vega	0.07	0.37	0.03	0.28	0.56															
(7) CEO age	0.01	0.12	0.12	0.04	0.25	0.04														
(8) Female CEO	0.05	-0.11	-0.06	-0.06	-0.12	-0.04	-0.03													
(9) Non-Caucasian CEO	0.08	0.11	0.07	0.08	0.11	0.11	0.04	-0.04												
(10) CEO tenure	0.14	0.04	0.01	0.03	0.35	0.03	0.40	-0.05	0.07											
(11) CEO duality	-0.03	0.28	0.11	0.21	0.43	0.28	0.29	-0.10	0.12	0.32										
(12) MBA/CPA	0.17	0.13	-0.06	0.14	0.02	0.06	-0.06	-0.06	0.02	-0.11	0.01									
(13) PhD	-0.02	0.03	0.01	0.02	0.11	0.09	-0.11	-0.01	0.21	0.02	0.00	-0.21								
(14) Size	0.11	0.74	0.23	0.53	0.58	0.47	0.14	-0.08	0.07	-0.08	0.28	0.10	0.01							
(15) Profitability	0.00	0.19	0.02	0.24	0.31	0.07	-0.05	-0.06	0.03	0.04	0.01	0.06	0.07	0.04						
(16) Growth	0.01	0.01	-0.08	0.07	0.08	0.00	-0.05	-0.02	0.01	0.05	-0.02	0.01	0.07	-0.10	0.10					
(17) Capital ratio	-0.02	0.04	-0.03	0.05	0.05	-0.13	-0.13	-0.02	-0.02	-0.02	-0.07	0.06	0.01	-0.07	0.55	-0.11				
(18) Loans to assets	-0.06	-0.37	-0.10	-0.27	-0.30	-0.29	0.15	0.06	-0.04	0.10	-0.13	0.03	-0.10	-0.43	-0.22	0.12	-0.42			
(19) Board size	0.11	0.26	0.19	0.18	0.18	0.18	0.02	-0.07	-0.07	-0.11	0.12	0.02	-0.03	0.39	0.04	0.04	-0.10	-0.14		
(20) Board independence	0.00	0.08	0.07	0.07	-0.14	0.06	-0.11	0.02	-0.08	-0.18	-0.07	0.10	-0.22	0.23	-0.11	-0.06	-0.21	0.11	0.25	
(21) Board gender diversity	-0.13	-0.31	-0.16	-0.26	-0.12	-0.04	-0.01	-0.22	-0.02	0.06	-0.06	-0.14	0.09	-0.38	-0.06	0.08	0.00	0.15	-0.19	-0.29

The table reports pairwise correlation coefficients between variables used in the regressions. Attractiveness is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, Total compensation is the logarithm of the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, Salary is the logarithm of the annual base salary of the CEO, Discretionary compensation is the logarithm of the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards, Delta is the logarithm of the dollar gain or loss in CEO wealth for a 1% change in the bank's stock price, Vega is the logarithm of the dollar gain or loss in CEO wealth for a 1%-point change in the bank's stock return volatility, CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of the bank's total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members.

Table 3
Univariate tests.

Variables	Low Attractiveness (a)	Obs.	High Attractiveness (b)	Obs.	Difference (b-a)	*t*-stat
Total compensation	3770.60	903	5099.13	903	1328.53***	4.98
Salary	755.02	903	849.36	903	94.34***	4.94
Discretionary compensation	2862.50	903	4016.18	903	1153.69***	4.56
Delta	456.52	707	464.13	700	7.62	0.14
Vega	109.28	712	109.08	703	-0.19	-0.01

The table reports the results of t-tests for the null hypothesis that there is no difference in the means of the CEO compensation measures between the subgroups of banks constructed based on the median CEO facial attractiveness. Total compensation is the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, Salary is the annual base salary of the CEO, Discretionary compensation is the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards, Delta measures the dollar gain or loss in CEO wealth for a 1% change in the bank's stock price, and Vega measures the dollar gain or loss in CEO wealth for a 1%-point change in the bank's stock return volatility. The t-statistics are based on heteroskedasticity and autocorrelation corrected standard errors. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

$$log\left(\text{Compensation}_{j,t}\right) = \alpha + \beta_1 \text{Attractiveness}_{j,t} + \sum_{k1=1}^{7} \beta_{k1}\text{CEO-specific controls}_{j,t} + \sum_{k2=1}^{8} \beta_{k2}\text{Bank-specific controls}_{j,t} + \sum_{s=1}^{S-1} \beta_s \text{State}_j + \sum_{b=1}^{N-1} \beta_b \text{Bank}_j + \sum_{y=2006}^{2020} \beta_y \text{Year}_t + \varepsilon_{j,t} \quad (1)$$

where $Compensation_{j,t}$ is one of the five alternative compensation measures (*Total compensation*, *Salary*, *Discretionary compensation*, *Delta*, or *Vega*) of bank *j*'s CEO at time *t* and $Attractiveness_{j,t}$ is the facial attractiveness of the CEO on a scale of 1–5. In addition to the attractiveness score, we estimate specifications with the following three alternative proxies for CEO facial attractiveness as the test variables of interest: (i) *Above-median attractiveness*, (ii) *High attractiveness*, and (iii) *Low attractiveness*.

The set of CEO-specific control variables in Equation (1) includes *CEO age*, *Female CEO*, *Non-Caucasian CEO*, *CEO tenure*, *CEO duality*, *MBA/CPA*, and *PhD* and the bank-specific control variables are *Size*, *Profitability*, *Growth*, *Capital ratio*, *Loans to assets*, *Board size*, *Board independence*, and *Board gender diversity*. These control variables should account for the potentially confounding effects of CEO attributes and bank characteristics on compensation. Given that state-specific factors and norms may influence CEO compensation and bank performance, we include state fixed-effects (*State*) based on the bank's headquarter state. Furthermore, to control for potential biases related to omitted variables and time-invariant unobserved heterogeneity in CEO compensation, Equation (1) includes *Bank* which denotes either bank fixed-effects or bank-type fixed-effects based on two-digit SIC codes. We also account for systematic variation in CEO compensation over time by including year fixed-effects (*Year*) in the regressions. To moderate the effects of outliers, we winsorize the dependent and the independent variables at the 1st and 99th percentiles. Throughout all the alternative model specifications, we use robust standard errors which are adjusted for heteroskedasticity and clustered by bank.

The estimation results of six alternative versions of Equation (1) with *Total compensation* as the dependent variable are reported in Table 4. In Models 1 and 4, *Attractiveness* is used as the proxy for CEO facial attractiveness, while in Models 2, 3, 5, and 6 we employ the three alternative binary variants of *Attractiveness* as the test variable of interest. All specifications include the full set of control variables and state and year fixed-effects. In addition, bank-type fixed-effects are included in Models 1–3 and bank fixed-effects in Models 4–6. The adjusted R^2s indicate that the bank-type fixed-effects regressions explain about 70% of the variation in *Total compensation*.

As can be noted from Table 4, the estimated coefficient for *Attractiveness* in Model 1 is positive and significant at the 1% level, thus providing support for the beauty premium hypothesis. The magnitude of the coefficient estimate suggests that the positive relation between facial attractiveness and total compensation is economically significant; a one standard deviation increase in the CEO facial attractiveness measure increases annual total compensation by almost 9% ($395,000). When bank-type fixed-effects are replaced with bank fixed-effects in Model 4, the coefficient for *Attractiveness* is positive and significant at the 10% level and remains almost unchanged in magnitude.

Consistent with Models 1 and 4, the estimates of Models 2–3 and 5–6 indicate that facial attractiveness is positively associated with CEO total compensation as the coefficients for *Above-median attractiveness* and *High attractiveness* are positive and statistically highly significant. The estimates of Model 2 suggest that the annual total compensation of bank CEOs with above-median facial attractiveness scores is about 24% ($1.06 million) higher than the compensation of their less attractive peers. Intriguingly, the size of the beauty premium among bank CEOs is very similar to the beauty premium in the general labor market (e.g., Hamarmesh & Biddle, 1994; Scholz & Sicinski, 2015), suggesting that the highly-paid bank CEOs are as susceptible to attractiveness gaps in their compensation as average employees. When the *High attractiveness* dummy variable is used as the proxy for CEO facial attractiveness in Models 3 and 6, the beauty premium remains very similar in economic magnitude, while the coefficient for *Low attractiveness* appears insignificant in both specifications.

The coefficient estimates for the control variables in Table 4 indicate that *Total compensation* is significantly positively associated with *CEO duality*, *CEO tenure*, *Size*, *Profitability*, *Capital ratio*, and *Loans to assets*, and negatively related to *Female CEO* and *Board gender diversity*. Thus, consistent with the prior literature, the results suggest that CEO compensation increases with increasing bank size and

Table 4
CEO facial attractiveness and total compensation.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CEO facial attractiveness:						
Attractiveness	0.165***			0.166*		
	(3.01)			(1.70)		
Above-median attractiveness		0.240***			0.267***	
		(4.12)			(2.63)	
High attractiveness			0.192***			0.227***
			(3.41)			(2.89)
Low attractiveness			-0.014			0.101
			(−0.17)			(0.91)
CEO-specific controls:						
CEO age	-0.002	-0.004	-0.003	-0.004	-0.004	-0.007
	(−0.39)	(−0.81)	(−0.75)	(−0.65)	(−0.68)	(−1.18)
Female CEO	-0.347***	-0.354***	-0.344***	-0.605***	-0.594***	-0.576***
	(−3.58)	(−4.17)	(−4.04)	(−3.33)	(−3.40)	(−3.31)
Non-Caucasian CEO	0.054	0.020	0.069	-0.352	-0.340	-0.193
	(0.23)	(0.09)	(0.31)	(−0.61)	(−0.62)	(−0.32)
CEO tenure	0.057	0.067*	0.070*	0.115**	0.122**	0.143***
	(1.51)	(1.79)	(1.87)	(2.42)	(2.55)	(3.05)
CEO duality	0.190***	0.196**	0.197**	0.038	0.044	0.040
	(2.62)	(2.56)	(2.58)	(0.73)	(0.82)	(0.75)
MBA/CPA	-0.053	-0.052	-0.039	-0.188*	-0.170*	-0.180*
	(−0.81)	(−0.89)	(−0.65)	(−1.86)	(−1.91)	(−1.78)
PhD	-0.112	-0.124	-0.128	0.008	-0.010	-0.053
	(−1.04)	(−1.27)	(−1.22)	(0.07)	(−0.08)	(−0.41)
Bank-specific controls						
Size	0.447***	0.445***	0.445***	0.497***	0.491***	0.499***
	(15.29)	(13.96)	(13.71)	(9.56)	(9.31)	(9.60)
Profitability	4.383	4.575	4.397	9.460***	9.329***	9.196***
	(1.56)	(1.64)	(1.57)	(3.36)	(3.36)	(3.31)
Growth	0.130	0.111	0.097	0.179*	0.172*	0.168*
	(1.27)	(1.09)	(0.96)	(1.78)	(1.72)	(1.68)
Capital ratio	0.387	0.372	0.364	1.234***	1.189***	1.207***
	(0.76)	(0.71)	(0.70)	(3.18)	(3.11)	(3.17)
Loans to assets	0.057	0.128	0.035	1.162***	1.180***	1.161***
	(0.26)	(0.60)	(0.17)	(4.64)	(4.68)	(4.63)
Board size	-0.055	-0.036	-0.037	-0.113	-0.124	-0.118
	(−0.44)	(−0.28)	(−0.29)	(−0.84)	(−0.93)	(−0.91)
Board independence	-0.159	-0.151	-0.202	-0.250	-0.265	-0.271
	(−0.35)	(−0.33)	(−0.43)	(−0.45)	(−0.49)	(−0.51)
Board gender diversity	-0.395	-0.368	-0.417	-1.172***	-1.161***	-1.183***
	(−1.45)	(−1.42)	(−1.53)	(−3.31)	(−3.37)	(−3.28)
Constant	3.620***	3.861***	4.135***	3.083***	3.472***	3.576***
	(4.67)	(4.91)	(5.09)	(3.92)	(4.09)	(4.03)
Bank-type fixed-effects	Yes	Yes	Yes	No	No	No
Bank fixed-effects	No	No	No	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1806	1806	1806	1806	1806	1806
Adjusted R^2	0.69	0.70	0.69	0.28	0.29	0.28

The table reports the estimates of six alternative versions of Equation (1). The dependent variable Total compensation is the logarithm of the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation. The four alternative CEO facial attractiveness measures are (i) Attractiveness which is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, (ii) Above-median attractiveness is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median, (iii) High attractiveness equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, and (iv) Low attractiveness is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The control variables are defined as follows: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

stronger financial performance. Moreover, our estimates indicate that powerful CEOs with a long tenure receive higher total compensation and that female CEOs are paid less than their male counterparts.

Table 5 presents the regression results with *Salary* as the dependent variable. Analogously to Table 4, Models 1 and 4 are the baseline models with *Attractiveness* employed as the measure of CEO facial attractiveness, while the three alternative CEO attractiveness proxies are used in Models 2, 3, 5, and 6. In general, the regression results show that CEO facial attractiveness is weakly positively related to the annual base salary. As shown in Table 5, the coefficient estimates for the facial attractiveness measures are positive and statistically significant at the 10% level in Models 2 and 4, and the positive coefficient for *High attractiveness* is significant at the 5% level in Model 6. Consistent with the beauty premium hypothesis, the coefficient estimate for *High attractiveness* indicates that bank CEOs with facial attractiveness scores in the top tercile earn about 13.7% ($73,800) higher salaries than the less good-looking CEOs.

With respect to the control variables, it can be noted from Table 5 that the coefficient estimates for many of the control variables are statistically significant. In particular, the regressions indicate that *Salary* is positively associated with *Size*, *Capital ratio*, *CEO tenure*, and *Board size*, while being negatively related to *Loan growth* and *Female CEO*. Thus, our estimates suggest that CEOs who manage larger banks with higher capital ratios and lower growth rates have higher salaries. Although previous studies have documented that the prevalent gender wage gap does not necessarily persist at the CEO level (e.g., Bugeja et al., 2012; Gupta et al., 2018), our regressions indicate that the annual base salary of female bank CEOs is over 20% lower than that of their male counterparts. Nevertheless, given that our sample includes only nine female CEOs, the coefficient estimates must be approached cautiously.

We proceed by regressing *Discretionary compensation* on the alternative CEO facial attractiveness measures. The estimation results of these regressions are reported in Table 6. Overall, the regression results with *Discretionary compensation* as the dependent variable are very similar to the total compensation regressions presented in Table 4. The coefficient estimates for the alternative CEO facial attractiveness variables are positive and highly significant, with the only exceptions being the insignificant coefficient for *Low attractiveness* in Model 3 and for *Attractiveness* in Model 4. Taken as a whole, the regressions in Tables 4–6 suggest that the observed beauty premium in total compensation of bank CEOs mostly pertains to the discretionary, performance-based pay components rather than to the base salary.

In addition to being statistically highly significant, the observed positive relationship between CEO facial attractiveness and the discretionary compensation components can be considered economically significant. In Model 1, the estimated coefficient suggests that a one standard deviation increase in *Attractiveness* would increase the CEO's performance-based compensation by approximately 21.6% ($743,000), while Model 2 indicates that bank CEOs with above-median facial attractiveness scores have about 55% higher sum of bonuses, stock grants, and option grants. Regarding the control variables, it can be noted from Table 6 that the level of discretionary compensation of bank CEOs is positively linked to *CEO chair*, *Size*, *Profitability*, *Loan growth*, *Loans to assets*, while being negatively associated with *CEO age* and *Board gender* diversity.

Collectively, the regression results reported in Tables 4–6, as well as the univariate tests in Table 3, demonstrate that good looks pay off for bank CEOs. We find strong evidence that CEO facial attractiveness is positively associated with the annual total compensation and discretionary, performance-based compensation components while being only weakly related to the annual base salary. Thus, consistent with hypothesis 2, the results suggest that the beauty premium in total compensation of bank CEOs is mostly driven by performance-based compensation components and incentives that require considerable discretion by the board of directors. The size of the beauty premium can be considered economically significant as we document that the total compensation of bank CEOs with above-median facial attractiveness scores is about 24% higher than the compensation of less attractive CEOs. Overall, our empirical findings provide strong support for the beauty premium hypothesis in the executive labor market.

4.3. CEO compensation sensitivities

Going forward, we examine the effect of facial attractiveness on the sensitivities of CEO compensation to changes in stock prices (pay-performance sensitivity) and stock return volatility (pay-risk sensitivity). Panel A of Table 7 reports the estimation results of six alternative versions of Equation (1) with *Delta* as the dependent variable. Models 1–3 include the full set of control variables and state, bank-type, and year fixed-effects whereas bank-type fixed-effects are replaced with bank fixed-effects in Models 4–6. As can be seen from Panel A, the adjusted R^2s indicate a good fit of the regressions. Intriguingly, the coefficients for the alternative CEO facial attractiveness measures are insignificant in all six model specifications, suggesting that the pay-performance sensitivity of bank CEOs is unaffected by facial attractiveness. The coefficient estimates for the control variables (not tabulated) indicate that *Delta* is positively associated with *CEO tenure*, *CEO duality*, *Size*, *Profitability*, and *Growth*, and negatively related to *Board independence*.

The regression results with *Vega* as the dependent variable are presented in Panel B of Table 7. Similar to Panel A, the coefficients for the CEO facial attractiveness measures appear statistically insignificant throughout the regressions. Thus, we conclude that facial attractiveness does not influence the sensitivity of bank CEO compensation to changes in stock return volatility. The coefficients for most of the control variables (not tabulated) are statistically significant, thereby demonstrating the importance of these variables for explaining cross-sectional differences in CEO risk-taking incentives. Specifically, the regression results indicate that CEOs' compensation-based risk-taking incentives are stronger in large banks with higher profitability and growth rates and lower capital ratios and lending activity.

Table 5
CEO facial attractiveness and salary.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CEO facial attractiveness:						
Attractiveness	0.046			0.170*		
	(0.82)			(1.90)		
Above-median attractiveness		0.099*			0.148	
		(1.75)			(1.61)	
High attractiveness			0.060			0.137**
			(1.31)			(2.16)
Low attractiveness			0.028			0.134
			(0.41)			(1.29)
CEO-specific controls:						
CEO age	-0.001	-0.002	-0.002	-0.014	-0.015	-0.017
	(−0.29)	(−0.38)	(−0.46)	(−1.44)	(−1.43)	(−1.63)
Female CEO	-0.230***	-0.240***	-0.222***	-0.351**	-0.309**	-0.278*
	(−3.04)	(−3.14)	(−2.94)	(−2.46)	(−2.39)	(−1.86)
Non-Caucasian CEO	0.356	0.333	0.366	-0.475	-0.418	-0.279
	(1.36)	(1.32)	(1.40)	(−1.31)	(−1.22)	(−0.70)
Tenure	0.071	0.071	0.078	0.158**	0.170***	0.191***
	(1.39)	(1.30)	(1.50)	(2.59)	(2.67)	(2.88)
CEO duality	0.026	0.030	0.029	-0.017	-0.015	-0.017
	(0.49)	(0.59)	(0.58)	(−0.39)	(−0.34)	(−0.38)
MBA/CPA	-0.085	-0.089	-0.080	0.001	0.018	0.015
	(−1.30)	(−1.28)	(−1.18)	(0.01)	(0.17)	(0.14)
PhD	0.125	0.122	0.119	0.110	0.093	0.056
	(1.15)	(1.12)	(1.07)	(1.04)	(0.86)	(0.51)
Bank-specific controls:						
Size	0.144***	0.142***	0.144***	0.276***	0.269***	0.273***
	(4.04)	(3.88)	(4.04)	(5.50)	(5.44)	(5.63)
Profitability	0.464	0.581	0.483	2.640	2.703	2.640
	(0.16)	(0.20)	(0.17)	(1.27)	(1.29)	(1.26)
Growth	-0.533***	-0.541***	-0.545***	-0.188	-0.193	-0.194
	(−2.84)	(−2.86)	(−2.87)	(−1.58)	(−1.59)	(−1.61)
Capital ratio	0.209	0.205	0.207	1.532***	1.493***	1.496***
	(0.55)	(0.54)	(0.54)	(2.84)	(2.84)	(2.85)
Loans to assets	0.055	0.084	0.048	0.442*	0.440*	0.419*
	(0.26)	(0.40)	(0.22)	(1.83)	(1.83)	(1.79)
Board size	0.234**	0.240**	0.244**	-0.094	-0.095	-0.089
	(1.98)	(2.01)	(2.02)	(−0.92)	(−0.96)	(−0.95)
Board independence	0.710	0.725*	0.695	-0.008	0.014	0.001
	(1.65)	(1.69)	(1.60)	(−0.02)	(0.03)	(0.00)
Board gender diversity	-0.262	-0.239	-0.274	-0.533*	-0.523*	-0.543*
	(−0.73)	(−0.69)	(−0.76)	(−1.84)	(−1.80)	(−1.82)
Constant	3.922***	3.949***	4.070***	4.064***	4.504***	4.602***
	(5.96)	(6.44)	(6.34)	(5.46)	(5.85)	(5.91)
Bank-type fixed-effects	Yes	Yes	Yes	No	No	No
Bank fixed-effects	No	No	No	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1806	1806	1806	1806	1806	1806
Adjusted R^2	0.49	0.49	0.49	0.13	0.13	0.13

The table reports the estimates of six alternative versions of Equation (1). The dependent variable Salary is the logarithm of the annual base salary of the CEO. The four alternative CEO facial attractiveness measures are (i) Attractiveness which is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, (ii) Above-median attractiveness is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median, (iii) High attractiveness equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, and (iv) Low attractiveness is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The control variables are defined as follows: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

4.4. The role of board monitoring and CEO power

The level and structure of CEO compensation are set by the board of directors. If the board provides strong oversight of executive compensation and ensures that the bank acts in the best interests of its shareholders, CEO compensation policies should reflect optimal contracting and equilibrium in the executive labor market. In this optimal contracting setting, the strength of board monitoring may moderate the influence of facial attractiveness on CEO compensation. Therefore, as the next step of our analysis, we examine whether the positive association between CEO attractiveness and compensation is moderated by boards that exert more stringent monitoring. For this purpose, we follow the approach of Baselga-Pascual et al. (2018) and build a composite index variable based on board characteristics to measure the boards' monitoring strength. In particular, *Strong monitoring* is a (0,3) index measure constructed as the sum of the following three binary criteria: (i) the number of directors is above the sample median (0,1), (ii) the percentage of independent directors is above the sample median (0,1), and (iii) the percentage of female directors is above the sample median (0,1). We then estimate modified versions of Equation (1) in which *Attractiveness* is interacted with *Strong monitoring*.

In contrast to the optimal contracting view, the managerial power theory of Bebchuk and Fried (2004) suggests that powerful, self-interested executives may receive excessive compensation by influencing the board's pay-setting process and compensation policies. Under this view, managerial power may strengthen the influence of facial attractiveness on CEO compensation. Thus, we also explore whether CEO power affects the relationship between facial attractiveness and CEO compensation. Similar to *Strong monitoring*, we implement this test by constructing a (0,3) index measure *CEO power* as the sum of the following three binary criteria: (i) *CEO duality*, i.e. the CEO is the chairman of the board of directors (0,1), (ii) *CEO tenure* is above the sample median (0,1), and (iii) the CEO's total compensation relative to the bank's total assets is above the sample median (0,1). We then include an interaction term between *Attractiveness* and *CEO power* in the regressions.

Table 8 reports the estimates of six alternative interaction regressions. As can be noted from the table, the coefficients for both interaction variables *Attractiveness* × *Strong monitoring* and *Attractiveness* × *CEO power* are statistically insignificant and relatively small in magnitude throughout the regressions. This suggests that the documented positive association between facial attractiveness and CEO compensation is not influenced by the strength of board monitoring or managerial power. The coefficient estimates for *Attractiveness* are positive and significant in Models 1–2 and 4–5, thereby providing further support for the beauty premium hypothesis. Consistent with the managerial power theory, the interaction regressions also indicate that *CEO power* is positively associated with *Total compensation* and *Salary*.

4.5. Endogeneity concerns

As with any empirical analysis such as ours, it is possible that some omitted variables or unobservable factors are correlated with CEO facial attractiveness and compensation, thereby creating an artificial linkage between the two variables of interest. In our regressions, we have controlled for various bank-specific and CEO-specific attributes that are known to affect CEO compensation.[12] Moreover, in order to mitigate endogeneity concerns related to omitted variables and unobserved heterogeneity, we have included either bank or bank-type fixed-effects as well as state and year fixed-effects in the regressions. Given that the facial attractiveness measures for individual CEOs are time-invariant, the inclusion of bank fixed-effects in Tables 4–7 essentially implies that the estimates reflect within-firm changes in CEO attractiveness around the time of CEO succession events. It can also be argued that the potentially confounding effects of omitted CEO characteristics should be of lesser concern for our study because bank CEOs are a relatively homogenous group of individuals in terms of their demographic characteristics and educational backgrounds. Nevertheless, we acknowledge that some omitted personal characteristics of the CEOs such as personality, intelligence, communication skills, height, weight, body type, and self-confidence could bias our regressions if CEO beauty and compensation are correlated with these attributes.[13] Because we are unable to completely rule out endogeneity caused by omitted variable bias, it is important to recognize that many other factors than facial attractiveness obviously may affect the compensation of bank CEOs.

The second potential source of endogeneity in empirical analysis such as ours is reverse causality. However, in the beauty premium context, reverse causality would somewhat counterintuitively imply that a higher CEO compensation would lead to more attractive facial features, for instance, through the use of cosmetic surgery. The diminishing marginal utility of income would also suggest that the compensation differences across highly paid bank CEOs are unlikely to influence their looks. Thus, although not completely implausible, it is unlikely that our estimates are plagued by reverse causality. Nonetheless, given that we do not formally address

[12] While Graham et al. (2016) only control for firm size in their analysis, Halford and Hsu (2020) include a broad set of firm-specific and CEO-related control variables to mitigate omitted variable bias. Specifically, in their total compensation regressions, Halford and Hsu (2020) control for firm size, market-to-book ratio, and leverage as well as CEO age, gender, educational background, tenure, overconfidence, and facial width-to-height ratio. Their results suggest that in addition to facial attractiveness, CEO age is the only CEO-specific attribute that influences total compensation.

[13] Hamermesh (2011) provides a comprehensive discussion of potentially confounding factors that could affect the beauty premium. Nevertheless, he concludes that the beauty premium is only marginally influenced by confounds such as individual's personality and weight.

Table 6
CEO facial attractiveness and discretionary compensation.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CEO facial attractiveness:						
Attractiveness	0.400***			0.278		
	(3.34)			(1.49)		
Above-median attractiveness		0.554***			0.639***	
		(4.50)			(3.03)	
High attractiveness			0.304**			0.495***
			(2.30)			(3.34)
Low attractiveness			-0.220			0.553**
			(−1.02)			(2.14)
CEO-specific controls:						
CEO age	-0.025**	-0.029***	-0.026**	0.000	0.000	-0.010
	(−2.35)	(−2.90)	(−2.45)	(0.02)	(0.02)	(−0.64)
Female CEO	-0.229	-0.238	-0.228	-0.478	-0.507	-0.347
	(−1.12)	(−1.17)	(−1.09)	(−1.41)	(−1.60)	(−0.89)
Non-Caucasian CEO	-0.185	-0.255	-0.150	-0.405	-0.454	0.135
	(−0.55)	(−0.80)	(−0.42)	(−0.50)	(−0.63)	(0.15)
Tenure	0.092	0.119	0.115	0.102	0.105	0.194
	(0.83)	(1.12)	(1.05)	(0.69)	(0.71)	(1.35)
CEO duality	0.353**	0.366**	0.345**	0.117	0.131	0.121
	(2.24)	(2.34)	(2.17)	(0.69)	(0.77)	(0.72)
MBA/CPA	0.097	0.104	0.138	-0.011	0.019	0.013
	(0.69)	(0.78)	(0.99)	(−0.04)	(0.08)	(0.05)
PhD	-0.240	-0.268	-0.264	0.042	0.009	-0.131
	(−1.29)	(−1.42)	(−1.37)	(0.17)	(0.04)	(−0.51)
Bank-specific controls:						
Size	0.660***	0.655***	0.659***	0.894***	0.887***	0.897***
	(8.70)	(8.76)	(8.64)	(6.85)	(6.68)	(7.18)
Profitability	20.424**	20.831**	20.168**	38.376***	37.856***	37.826***
	(2.42)	(2.51)	(2.38)	(3.64)	(3.64)	(3.60)
Growth	0.535*	0.489*	0.491*	0.798***	0.785**	0.784**
	(1.91)	(1.77)	(1.79)	(2.64)	(2.60)	(2.60)
Capital ratio	-0.534	-0.572	-0.612	1.843	1.758	1.769
	(−0.43)	(−0.46)	(−0.49)	(1.61)	(1.55)	(1.56)
Loans to assets	0.026	0.189	-0.006	2.031***	2.093***	1.989***
	(0.05)	(0.38)	(−0.01)	(2.74)	(2.79)	(2.73)
Board size	-0.329	-0.282	-0.315	-0.767*	-0.803**	-0.770**
	(−0.98)	(−0.85)	(−0.94)	(−1.96)	(−2.03)	(−2.03)
Board independence	0.360	0.368	0.240	0.223	0.140	0.122
	(0.35)	(0.35)	(0.23)	(0.19)	(0.12)	(0.10)
Board gender diversity	-1.088	-1.036	-1.153*	-2.104***	-2.084***	-2.165***
	(−1.65)	(−1.61)	(−1.75)	(−2.66)	(−2.72)	(−2.72)
Constant	2.365	2.987*	3.613**	-1.353	-0.767	-0.342
	(1.26)	(1.69)	(2.00)	(−0.66)	(−0.38)	(−0.16)
Bank-type fixed-effects	Yes	Yes	Yes	No	No	No
Bank fixed-effects	No	No	No	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1806	1806	1806	1806	1806	1806
Adjusted R^2	0.47	0.47	0.47	0.18	0.19	0.18

The table reports the estimates of six alternative versions of Equation (1). The dependent variable Discretionary compensation is the logarithm of the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards The four alternative CEO facial attractiveness measures are (i) Attractiveness which is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, (ii) Above-median attractiveness is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median, (iii) High attractiveness equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, and (iv) Low attractiveness is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The control variables are defined as follows: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 7
CEO facial attractiveness and compensation sensitivities.

Panel A: CEO facial attractiveness and pay-performance sensitivity	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CEO facial attractiveness:						
Attractiveness	0.119			-0.073		
	(1.17)			(−0.41)		
Above-median attractiveness		0.182			0.072	
		(1.43)			(0.35)	
High attractiveness			0.204			-0.005
			(1.43)			(−0.02)
Low attractiveness			-0.015			-0.248
			(−0.09)			(−0.93)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-type fixed-effects	Yes	Yes	Yes	No	No	No
Bank fixed-effects	No	No	No	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1407	1407	1407	1407	1407	1407
Adjusted R^2	0.73	0.73	0.73	0.39	0.39	0.39
Panel B: CEO facial attractiveness and pay-risk sensitivity	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
CEO facial attractiveness:						
Attractiveness	0.097			-0.078		
	(0.66)			(−0.24)		
Above-median attractiveness		0.109			-0.161	
		(0.61)			(−0.48)	
High attractiveness			0.314			0.015
			(1.54)			(0.04)
Low attractiveness			-0.020			-0.040
			(−0.09)			(−0.10)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-type fixed-effects	Yes	Yes	Yes	No	No	No
Bank fixed-effects	No	No	No	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1415	1415	1415	1415	1415	1415
Adjusted R^2	0.56	0.56	0.56	0.19	0.19	0.19

The table reports the estimates of six alternative versions of Equation (1). In Panel A, the dependent variable Delta is the logarithm of the CEO's pay-performance sensitivity measured as the dollar gain or loss in CEO wealth for a 1% change in the bank's stock price. In Panel B, the dependent variable Vega is the logarithm of the CEO's pay-risk sensitivity measured as the dollar gain or loss in CEO wealth for a 1%-point change in the bank's stock return volatility. The four alternative CEO facial attractiveness measures are (i) Attractiveness which is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5, (ii) Above-median attractiveness is a dummy variable which equals one for bank CEOs with facial attractiveness scores above the sample median, (iii) High attractiveness equals one for bank CEOs with facial attractiveness score in the top tercile of the attractiveness distribution, and (iv) Low attractiveness is assigned to one for bank CEOs with facial attractiveness score in the bottom sextile. The control variables used in the regressions are defined as follows: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 8
The role of board monitoring and CEO power.

	Total compensation		Salary		Discretionary compensation	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Attractiveness	0.177**	0.158*	0.050	0.16**	0.557***	0.141
	(2.28)	(1.95)	(0.61)	(2.3)	(3.86)	(0.77)
Attractiveness x Strong monitoring	-0.006		-0.002		-0.117	
	(-0.13)		(-0.07)		(-1.41)	
Attractiveness x CEO power		-0.025		-0.073		0.100
		(-0.63)		(-1.35)		(1.04)
Strong monitoring	0.019		0.037		0.389	
	(0.16)		(0.37)		(1.65)	
CEO power		0.308***		0.251*		0.298
		(2.71)		(1.72)		(1.12)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-type fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1806	1806	1806	1806	1806	1806
Adjusted R^2	0.69	0.71	0.49	0.49	0.47	0.50

The table reports the estimates of six alternative versions of Equation (1). The three CEO compensation measures are defined as follows: (i) Total compensation is the logarithm of the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, (ii) Salary is the logarithm of the annual base salary of the CEO, and (iii) Discretionary compensation is the logarithm of the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards. Attractiveness is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5. Strong monitoring is a (0,3) index measure constructed as the sum of the following three binary criteria: (i) the number of directors is above the sample median (0,1), (ii) the percentage of independent directors is above the sample median (0,1), and (iii) the percentage of female directors is above the sample median (0,1). CEO power is a (0,3) index measure constructed as the sum of the following three binary criteria: (i) CEO duality, i.e. the CEO is the chairman of the board of directors (0,1), (ii) CEO tenure is above the sample median (0,1), and (iii) the CEO's total compensation relative to the bank's total assets is above the sample median (0,1). All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

endogeneity concerns related to reverse causality in our empirical design, any causal interpretations of our findings should be made with caution.[14]

To alleviate any remaining endogeneity concerns, we utilize propensity score matching (PSM) to build a matched-bank sample in which banks led by CEOs with facial attractiveness scores in the top decile are matched with banks that are as similar as possible in terms of size, profitability, growth rate, and capital ratio but are led by less attractive CEOs. This PSM approach should control for any endogenous selection on observed bank characteristics. After constructing the propensity score matched sample of banks based on one-to-one nearest neighbor matching without replacement, we estimate CEO compensation regressions with *Attractiveness* as the test variable of interest.

Table 9 presents the regression results based on the propensity score matched sample of banks. As can be seen from the table, the estimates are broadly consistent with our main analysis in Tables 4–6. The estimated coefficients for *Attractiveness* are positive and statistically significant in the regressions with *Total compensation* and *Discretionary compensation* as the dependent variables, and insignificant in the regression with *Salary* as the dependent variable. Interestingly, the effect size of facial attractiveness is greater in the matched-bank sample than in our main regressions. Overall, the estimates based on the propensity score matched sample provide additional support for the beauty premium hypothesis in the executive labor market.

4.6. Additional tests

We perform several additional tests to examine the robustness of our findings. Table 10 summarizes the results of these robustness checks. The table reports the estimated coefficients for *Attractiveness* from 16 different regression setups with *Total compensation*, *Salary*, and *Discretionary compensation* as the dependent variables. The baseline estimation results from Tables 4–6 are summarized in the first row of Table 10 (Specification 0).

First, to ascertain that our results are not influenced by spurious correlations between the independent variables, we estimate constrained versions of Equation (1) with *Size*, *Profitability*, and *Capital ratio* as the only control variables (Specification 1). In addition, we also estimate constrained models without the CEO-specific control variables (Specification 2). The estimates of these additional

[14] Endogeneity concerns arising from reverse causality could be addressed with two-stage instrumental variable regressions. It is, however, challenging to identify a suitable instrument that would be strongly correlated with CEO facial attractiveness while being uncorrelated with CEO compensation.

Table 9
Propensity score matching.

	Total compensation	Salary	Discretionary compensation
CEO facial attractiveness:			
Attractiveness	0.233***	0.001	0.639**
	(3.27)	(0.02)	(2.48)
CEO-specific controls:			
CEO age	0.004	0.001	-0.027
	(0.52)	(0.17)	(−1.27)
Female CEO	-0.312*	-0.375**	-0.093
	(−1.70)	(−2.49)	(−0.22)
Non-Caucasian CEO	0.081	0.580*	-0.748
	(0.46)	(1.91)	(−1.31)
Tenure	0.058	0.090	0.000
	(0.7)	(0.85)	(0)
CEO duality	0.121	-0.115	0.792**
	(1.19)	(−1.23)	(2.52)
MBA/CPA	0.050	-0.214**	0.161
	(0.53)	(−2.16)	(0.57)
PhD	0.026	0.317*	-0.230
	(0.14)	(1.88)	(−0.44)
Bank-specific controls:			
Size	0.433***	0.132***	0.439**
	(9.73)	(2.72)	(2.52)
Profitability	-1.723	-1.336	-0.366
	(−0.41)	(−0.66)	(−0.03)
Growth	-0.191	-0.787***	-0.676
	(−0.83)	(−2.94)	(−0.88)
Capital ratio	1.359	0.565	1.824
	(1.2)	(0.66)	(0.64)
Loans to assets	-0.124	-0.124	-0.691
	(−0.30)	(−0.38)	(−0.62)
Board size	0.133	0.154	-0.317
	(0.62)	(1.17)	(−0.47)
Board independence	-0.669	0.783*	-2.624
	(−1.15)	(1.82)	(−1.57)
Board gender diversity	-0.221	-0.352	-1.477
	(−0.54)	(−0.85)	(−1.09)
Constant	3.023***	4.519***	6.867**
	(2.89)	(4.62)	(2.28)
Bank-type fixed-effects	Yes	Yes	Yes
State fixed-effects	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes
No. of observations	405	405	405
Adj. R^2	0.76	0.58	0.48

The table reports the estimates of three alternative versions of Equation (1) based on a propensity score matched sample of banks. The three CEO compensation measures are defined as follows: (i) Total compensation is the logarithm of the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, (ii) Salary is the logarithm of the annual base salary of the CEO, and (iii) Discretionary compensation is the logarithm of the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards. Attractiveness is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5. The control variables used in the regressions are defined as follows: CEO age is the age of the bank's CEO in years, Female CEO is a dummy variable which equals one if the bank's CEO is a female, Non-Caucasian CEO is a dummy variable which equals one if the ethnic background of the bank's CEO is other than Caucasian, CEO tenure is the length of tenure of the incumbent CEO in years, CEO duality is a dummy variable which equals one if the CEO is also the chairman of the board of directors, MBA/CPA is a dummy variable which equals one if the CEO holds an MBA graduate degree or is a Certified Public Accountant, PhD is a dummy variables that equals one if the CEO holds a doctoral degree, Size is the logarithm of total assets, Profitability is the return on assets calculated as net income divided by total assets, Growth is the logarithmic difference in net loans, Capital ratio is the ratio of Tier 1 equity capital to risk-weighted assets, Loans to assets is calculated as total loans divided by total assets, Board size is the logarithm of the number of board members, Board independence is the number of non-executive directors divided by the total number of board members, and Board gender diversity is the number of male directors divided by the total number of board members. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

regressions are very similar to the results reported in Tables 4–6, and indicate that CEO facial attractiveness is positively associated with *Total compensation* and *Discretionary compensation*. In both specifications, the coefficients for *Attractiveness* retain their statistical significance and are slightly larger in magnitude. Thus, we conclude that our results are robust to alternative model specifications and are not driven by multicollinearity.

Table 10
Additional tests.

Specification	Total compensation	Salary	Discretionary compensation
S0. The baseline results from Tables 4–6	0.165***	0.046	0.400***
S1. Constrained set of control variables	0.174***	0.059	0.456***
S2. Exclude CEO-specific control variables	0.167***	0.062	0.441***
S3. Exclude female and non-Caucasian CEOs	0.163***	0.050	0.408***
S4. Exclude oldest CEOs	0.154***	0.006	0.413***
S5. Exclude youngest CEOs	0.177***	0.069	0.366***
S6. Include only commercial banks	0.154**	0.078**	0.343**
S7. Exclude most non-traditional banks	0.188***	0.120**	0.491***
S8. Exclude most traditional banks	0.138**	0.046	0.420***
S9. Exclude TBTF banks	0.168***	0.062	0.424***
S10. Exclude smallest banks	0.165**	0.064	0.269**
S11. Dependent variables scaled by total assets	0.173***	0.011	0.212***
S12. Include TARP-recipient dummy	0.161***	0.040	0.388***
S13. Exclude TARP-recipient banks	0.144**	0.077	0.390***
S14. Truncated sample period, years 2005–2009	0.113	0.023	0.539**
S15. Truncated sample period, years 2010–2020	0.212***	0.057	0.383***
S16. Truncated sample period, exclude years 2008–2009	0.185***	0.058	0.389***

The table reports the estimated coefficients for Attractiveness from 16 different regression setups. The baseline estimates from Tables 4–6 are summarized in the first row (Specification 0). The three CEO compensation measures are defined as follows: (i) Total compensation is the logarithm of the sum of the CEO's annual base salary, bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, the grant-date fair value of stock awards, deferred compensation earnings, and other compensation, (ii) Salary is the logarithm of the annual base salary of the CEO, and (iii) Discretionary compensation is the logarithm of the sum of bonuses, non-equity incentive plan compensation, the grant-date fair value of option awards, and the grant-date fair value of stock awards. Attractiveness is a machine-based assessment of the CEO's facial attractiveness on a scale of 1–5. All the continuous variables are winsorized at the 1th and 99th percentiles. The t-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by bank. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Second, given that bank CEOs are primarily white males and female and non-white CEOs comprise only about 6% of firm-year observations in our sample, we next examine the robustness of our findings by re-estimating the regressions using a sample from which the female and ethnic minority CEOs have been excluded (Specification 3).[15] Given that the perception of facial attractiveness may apply differently to different demographic groups (see e.g., Li et al., 2021), this additional test also ensures that our results are not affected by potential biases in the beauty assessments related to demographic dimensions. The estimates of these regressions are consistent with the results presented in Tables 4–6. Most importantly, the estimated coefficients for *Attractiveness* are positive and significant at the 1% level in the regressions in which *Total compensation* and *Discretionary compensation* are used as the dependent variables.

Third, to further address concerns related to demographic attributes, we re-estimate the regressions using two subsamples from which either the youngest or the oldest quintiles of CEOs are excluded (Specifications 4 and 5). As documented by Adhikari et al. (2015), CEO total compensation increases with age, while, on the other hand, CEO age may also influence the perceived facial attractiveness. As can be seen from Table 10, the coefficients for *Attractiveness* are very similar to our main findings. Interestingly, the beauty premium in total compensation appears slightly larger for the subsample from which the youngest CEOs have been excluded whereas the effect of facial attractiveness on the discretionary components of compensation is slightly larger in economic magnitude for the subsample without the oldest CEOs.

Fourth, although our sample mostly comprises commercial banks, it also includes a small number of other savings and credit institutions, investment banks, and other financial services firms. To ensure that our findings are not affected by the different types of financial institutions, we re-estimate the regressions using three different subsamples. When the sample is constrained to include only commercial banks (Specification 6), the estimated coefficients for *Attractiveness* are positive and statistically significant not only in the *Total compensation* and *Discretionary compensation* regressions, but also in the regression with *Salary* as the dependent variable. As an alternative approach to investigate the sensitivity of our findings, we build two subsamples from which either the most non-traditional banks or the most traditional banks are excluded. For this purpose, we use *Loans to assets* and classify banks in the bottom and top quintiles as the most non-traditional and the most traditional banks in terms of their business model, respectively. When the most non-traditional banks are excluded (Specification 7), the coefficients for *Attractiveness* are positive and significant regardless of the dependent variable, and the coefficient estimates are larger in magnitude in comparison to our baseline results. When the most traditional banks are excluded from the sample (Specification 8), the coefficients for *Attractiveness* are positive and significant in the regressions with *Total compensation* and *Discretionary compensation* as the dependent variables.

Fifth, because bank size influences CEO compensation as well as the bank's business strategies, corporate governance mechanisms, and monitoring stringency, we next examine the sensitivity of our results to potential bank-size effects. We first re-estimate the

[15] Our sample of 272 individual bank CEOs includes 254 Caucasian males, 9 non-Caucasian males, and 9 females.

regressions using a subsample from which the too-big-to-fail banks with total assets in excess of $100 billion have been excluded (Specification 9). The estimated coefficients for *Attractiveness* are remarkably similar to our main regressions both in terms of statistical significance and economic magnitude. When the regressions are re-estimated using a subsample that excludes the smallest quintile of banks (Specification 10), the coefficients for *Attractiveness* are positive and significant at the 5% level in the regressions with *Total compensation* and *Discretionary compensation* as the dependent variables. As an alternative approach, we scale the CEO compensation variables by bank size. When these size-scaled compensation variables are used as the dependent variables (Specification 11), the coefficient estimates for *Attractiveness* remain positive and are statistically significant at the 1% level in the *Total compensation* and *Discretionary compensation* regressions. Thus, we can conclude that our results are not driven by bank-size effects.

Sixth, we acknowledge that banks participating in the Troubled Asset Relief Program (TARP) in the aftermath of the global financial crisis faced strict restrictions on their executive compensation policies (see e.g., Murphy, 2013). To investigate the potential influence of TARP executive-pay restrictions on our findings, we estimate regressions in which a dummy variable for the TARP recipients is used as an additional control variable (Specification 12). Once again, consistent with our main findings, the regression results indicate that *Attractiveness* is positively associated with *Total compensation* and *Discretionary compensation*, while being unrelated to *Salary*. Our second approach is to re-estimate the regressions using a subsample from which the TARP recipient banks have been excluded (Specification 13). The estimates based on this constrained subsample are similar to our main regressions; the coefficients for *Attractiveness* are positive and significant in the regressions with *Total compensation* and *Discretionary compensation* as the dependent variables.

Finally, we re-estimate the regressions using three truncated samples in order to examine the sensitivity of our results to the sample period used in the analysis. When the sample period is truncated to years 2005–2009 (Specification 14), the coefficient for *Attractiveness* is insignificant in the *Total compensation* and *Salary* regressions. Interestingly, however, in the regression with *Discretionary compensation* as the dependent variable, the coefficient estimate for *Attractiveness* is positive and significant and larger in magnitude than in any other specification. This finding may indicate that the influence of CEO facial attractiveness on the pay-setting process that involves more discretion and qualitative assessment has been constrained in the aftermath of the financial crisis by the advent of the new compensation-related regulations and disclosure requirements and more stringent market and regulatory oversight of executive compensation policies. As can be noted from Table 10, the estimation results based on the post-crisis years 2010–2020 (Specification 15) are consistent with our main regressions, and indicate that CEO facial attractiveness is positively associated with *Total compensation* and *Discretionary compensation*. Perhaps it is also worth noting that the effect of *Attractiveness* on *Total compensation* appears larger in economic magnitude during years 2010–2020. When we exclude the financial crisis years 2008–2009 from the sample, the regression results are qualitatively similar to our main analysis (Specification 16). Specifically, the coefficient estimates for *Attractiveness* are once again positive and significant at the 1% level in the regressions with *Total compensation* and *Discretionary compensation* as the dependent variables, while being insignificant in the *Salary* regressions.

Taken as a whole, the robustness checks demonstrate that our results are robust to many different empirical specifications and sample restrictions. Therefore, these additional tests provide strong evidence for the existence of a beauty premium in the executive labor market.

4.7. Limitations

Our empirical analysis is subject to several limitations that should be considered when interpreting the results. The most obvious critique towards any beauty premium study is omitted variable bias. We acknowledge that it is very difficult to isolate the effect of facial attractiveness and control for all the other, potentially latent confounding factors that are correlated with attractiveness and may influence CEO compensation. Although bank CEOs are a relatively homogenous group of individuals and we have controlled for a wide set of CEO-specific and bank-specific attributes and included different types of fixed-effects in the regressions, it is possible that omitted variables create a spurious linkage between the two variables of interest. Another related caveat in our analysis is that we focus only on facial attractiveness and ignore all other attractiveness traits such as body type or height.

Furthermore, while we argue that the banking industry provides an expedient context to investigate the beauty premium, the drawback of this choice is that it results in a relatively small sample of 167 banks and 272 individual CEOs. The small number of banks and individual CEOs naturally influences the statistical precision of our tests, and the use of large, publicly traded U.S. banks may limit the generalizability of our findings to other types of financial institutions and institutional settings.

Finally, it is important to recognize the common critique of machine learning techniques as black boxes. While beauty assessments based on deep convolutional neural networks should provide an objective consensus perception of facial attractiveness, we acknowledge that the model is not inherently interpretable and it is impossible to trace how the multitude of parameters are extracted from different facial attributes to make predictions about individuals' facial attractiveness. Moreover, training of the neural network requires large amounts of structured training data. The training data on facial attributes utilized in the fine-tuning of the deep convolutional neural network consists of 5500 facial images for which facial attractiveness has been evaluated on a scale of 1–5 by human assessment. Although the strong generalization power of deep learning models is already well established in the literature, given the relatively small number of facial images, our facial attractiveness scores based on the deep-learning algorithm may nevertheless be subject to potential idiosyncrasies in the human assessment of the training data.

5. Conclusions

This paper studies the effect of facial attractiveness on CEO compensation in the banking industry. A large body of literature has documented that physical attractiveness may bring advantages in various situations and social interactions. Furthermore, beauty is also known to affect labor market outcomes. In their seminal study, Hamermesh and Biddle (1994) found that attractive-looking individuals are rewarded in the labor market for their good looks with higher wages. Over the last two decades, the existence of a beauty premium in wages has been documented in various experimental studies as well as in many different labor market settings and among different social and occupational groups. But does physical attractiveness influence compensation at the top executive level? In this paper, we address this question by examining whether facial attractiveness is reflected in the compensation of bank CEOs. Banks operate in a highly competitive environment and constitute a homogenous industry with a relatively homogenous set of top executives who are among the highest-paid individuals in the economy. Therefore, the banking industry provides a particularly attractive setting to investigate the beauty premium in the executive labor market.

We empirically test the beauty premium hypothesis using data on the S&P 1500 banks over the period 2005–2020. We exploit state-of-the-art machine learning techniques to evaluate facial images of 272 individual bank CEOs and then examine whether facial attractiveness influences the level and structure of CEO compensation. Our empirical findings demonstrate that good looks pay off for bank CEOs. Specifically, we find that CEO facial attractiveness is positively associated with the annual total compensation and discretionary, performance-based compensation components while being only weakly related to the annual base salary. Nevertheless, our findings also indicate that the pay-performance and pay-risk sensitivities of bank CEOs are unaffected by facial attractiveness.

The magnitude of the documented beauty premium in bank CEO compensation is economically meaningful. Our estimates suggest that a one standard deviation increase in the CEO facial attractiveness measure increases the total compensation by almost 9% ($395,000) after controlling for various CEO-specific and bank-specific attributes that are known to affect executive compensation. Moreover, the total compensation of above-average looking bank CEOs is about 24% ($1.06 million) higher than the compensation of CEOs with below-average looks, and the above-average looking CEOs have about 55% higher sum of bonuses, stock grants, and option grants than their less attractive peers.

Overall, the results documented in this paper offer strong evidence for the existence of a beauty premium in the executive labor market. The beauty premium persists even among the highest-paid individuals in the economy and bank CEOs seem to be as susceptible to attractiveness gaps in their compensation as average employees.

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Executive age and bank Risk-Taking☆

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Abstract

This paper examines the influence of CEO and CFO age on bank risk-taking. Using data on large U.S. banks between 2006 and 2018, we document a negative association between CEO age and the bank's insolvency risk and market-based measures of risk-taking after controlling for bank size, asset growth, funding and income structures, and various other bank characteristics. In stark contrast, however, we find that banks with older CFOs exhibit higher levels of stock return volatility, systematic risk, idiosyncratic risk, and tail risk. Our further tests suggest that the positive relationship between CFO age and bank risk-taking can be at least partially explained by differences in banks' investment policies, funding structure, and executive compensation incentives.

JEL classification: G21, G30, G32

Keywords: Bank risk, risk-taking, executive age, CEOs, CFOs, bank executives

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1. Introduction

This paper examines the association between Chief Executive Officer (CEO) and Chief Financial Officer (CFO) age and bank risk-taking. Age encompasses a diverse and dynamic collection of personal characteristics and traits accumulated over the lifespan of an individual, and studies in psychology and behavioral economics suggest that age plays a significant role in shaping an individual's risk preferences and tolerance. The early literature reviewed in Okun (1976) suggests that aging causes individuals to become more cautious and risk-averse, a relationship that has been linked to declining cognitive abilities, neurological changes, and shifts in personality traits such as neuroticism or decreased motivation (see e.g., Korniotis and Kumar, 2011; Boyle et al., 2012; Brooks et al., 2018). On the other hand, more recent experimental studies have produced conflicting results, with some finding no systematic relationship between aging and risk-taking (Mather, 2006). The complexity of this relationship is further highlighted by the findings of a meta-analysis by Mata et al. (2011), who concluded that the relationship between age and risk-taking is context-dependent. Taken as a whole, prior studies indicate that the relationship between an individual's age and risk preferences is far from clear-cut.

The upper echelons theory of Hambrick and Mason (1984) provides a compelling argument for why executive characteristics and behavior are likely to play a critical role in bank risk-taking. The theory posits that the personal preferences, attitudes, and behavior of top executives play a critical role in shaping the strategies and culture of an organization. Abundant empirical evidence indeed suggests that the characteristics, personalities, and experiences of individual CEOs and CFOs are reflected in firms' business strategies, performance, financial and investment policies, and various other corporate outcomes (see e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Malmendier, Tate and Yan, 2011; Graham, Harvey and Puri, 2013; Cline, Walkling and Yore, 2018; Hrazdil et al., 2020; Hu et al., 2020; Jebran, Chen and Cai, 2022; El Mahdy and Alali, 2023). In terms of executive age, prior literature finds that aging is negatively related to firm value, growth, operating performance, and corporate deal-making activities (Child, 1974; Cline and Yore, 2016; Li, Low and Makhija, 2017). Older CEOs may pursue less risky policies, such as investing less in research and development, acquiring new firms to diversify firm operations, and maintaining a lower level of leverage (Serfling, 2014). On the other hand, younger CEOs are shown to exhibit a higher inclination towards bold investment (Li, Low and Makhija, 2017) and being more motivated by performance-based financial incentives (Yim, 2013), resulting in a higher crash risk for firms (Andreou, Louca and Petrou, 2017).

Most directly related to our study, Serfling (2014), Andreou et al. (2017), Peltomäki et al. (2021) examine the linkage between executive age and firm risk. Using data on U.S. non-financial firms, these studies document that firms led by older top executives are associated with lower stock return volatility, idiosyncratic risk, and firm-specific crash risk. Given that executive age has been found to influence risk-taking of non-financial firms, this paper aims to extend the literature by focusing on bank CEOs and CFOs. This can be considered important for several reasons. First, as argued by Bai and Elyasiani (2013) and De Haan and Vlahu (2016), evidence based on non-financial firms cannot be generalized to banks without empirical examination. Compared to non-financial firms, banks have fundamentally different business models, capital and ownership structures, and executive compensation schemes. Second, the banking industry plays a crucial role in facilitating economic growth and stability. Since excessive risk-taking in the financial sector has economy-wide consequences (Fahlenbrach and Stulz, 2011; Fahlenbrach et al., 2012; Berger et al., 2016), it is important to fully understand the factors that influence the risk-taking behavior of financial institutions. Third, due to their economic and societal importance, banks and their risk-taking are subject to extensive governmental regulations and supervision as well as intensive scrutiny by investors and other stakeholders. In light of these considerations, this study seeks to contribute to the literature by providing new evidence on the age-risk linkage in the financial sector and, more broadly, its implications for financial stability.

To empirically investigate the relationship between bank risk-taking and the ages of bank CEOs and CFOs, we use data on large U.S. banks belonging to the S&P 1500 index between 2006 and 2018. In our analysis, we gauge bank risk-taking with Z-score which reflects the level of insolvency risk (see e.g., Laeven and Levine, 2009; Guo, Jalal and Khaksari, 2015; Adhiraki and Agrawal, 2016; Ahmed et al., 2019; Gontarek and Belghitar, 2021) as well as four alternative market-based measures of risk-taking. Following the prior literature (e.g., Anderson and Fraser, 2000; Pathan, 2009; Akhigbe, Martin and Whyte, 2016; Acharya et al., 2017), we use stock return volatility, the levels of systematic and idiosyncratic risk, and tail risk as market-based risk-taking measures.

Our empirical results demonstrate that bank risk-taking is influenced by executive age. Specifically, we document that CEO age is negatively associated with bank insolvency risk and the market-based risk measures after controlling for bank size, financial performance, asset growth, funding and income structures, and various other bank-specific characteristics. These findings are broadly consistent with the prior empirical evidence for non-financial firms documented in Serfling (2014), Andreou et al. (2017), and Peltomäki et al. (2021). In stark contrast, however, we find that banks led by older CFOs are associated with higher stock return volatility, systematic risk, idiosyncratic risk as well as tail risk. This suggests that the personal characteristics of CEOs and CFOs may have very different or even counterbalancing influences on bank risk-taking which can potentially be related, for instance, to their different roles and responsibilities. Specifically, while the CEO has more responsibility for the longer-term strategic decisions and business performance, the CFO is more involved in shorter-term operational decisions related to the bank's funding structure, financial management, and risk exposure.

After documenting the contrasting effects of CEO and CFO age on bank risk, we proceed by investigating whether the age-induced differences in risk-taking can be traced to specific policy decisions. Our findings suggest that the differences in bank riskiness can at least to some extent be attributed to differences in banks' investment policies, funding structure, and executive compensation incentives. Specifically, we document that banks with older CFOs are associated with more risky lending policies, higher reliance on non-deposit funding as well as higher executive compensation sensitivity to changes in the bank's stock price. We perform several additional tests to rule out alternative explanations and to ensure the reliability of our findings, including two-stage instrumental variable regressions to address potential concerns related to endogeneity and reverse causality and random effects regressions to account for unobserved bank heterogeneity. These tests provide further evidence to conclude that older CEOs constrain bank risk-taking, while banks with older CFOs are associated with higher levels of risk.

This paper contributes to three strands of literature. First, our study contributes to the literature on the sources of risk in financial institutions which are fundamentally different from non-financial firms and which have usually been excluded from prior studies. Theoretically, the interplay between regulations, industry construct, implicit guarantees related to deposit insurance schemes, and government supervision and monitoring makes it difficult to predict the extent to which executives' age can affect bank risk-taking. We conduct a detailed empirical analysis to show that CEO and CFO age are important determinants of bank risk after controlling for a variety of confounding factors. In this respect, our study confirms and complements the findings based on non-financial firms (Serfling, 2014; Andreou et al., 2017; Peltomäki et al., 2021).

Second, we contribute to the literature that has focused on the influence of executive characteristics on risk-taking in the banking industry (Adhikari and Agrawal, 2016; Ahmed et al., 2019; Buyl, Boone, and Wade, 2019). While we find that executive age is associated with bank risk, our results indicate the direction of this relationship ultimately depends on the role of the executive. We document that executives' age primarily affects bank risk through short-term funding decisions and performance-based compensation incentives, and to a lesser extent asset composition, but not necessarily by influencing the bank's operating strategies or capital structure.

Finally, we contribute to the upper echelons literature by investigating the roles of the top two executives, CEOs and CFOs, in risk-related decision-making. Prior literature suggests that non-CEO executives and managers may be induced to take more risks due to moral hazard incentives (Kini and Williams, 2012; Berger et al., 2016) and can positively reinforce the CEO's risk-taking attitude if they are of similar age (Serfling, 2014; Peltomäki et al., 2021). In contrast, we find that the ages of CEOs and CFOs have a counterbalancing effect on bank risk-taking, highlighting the importance of considering both of these executive positions when investigating the riskiness of financial institutions. We believe that our results have important implications for corporate governance and risk management in the banking industry.

The remainder of this paper is organized as follows. Section 2 describes the data and the variables used in our empirical analysis. Section 3 presents our empirical findings, beginning with a discussion of the baseline regression results. In addition, this section reports the results of instrumental variable regressions to address endogeneity concerns, random effects regressions to account for unobserved bank heterogeneity, and additional tests based on different sample restrictions. We then proceed by investigating whether executive age-induced differences in bank-risk taking can be linked to differences in banks' operating, funding, and compensation policies. Finally, Section 4 provides concluding remarks.

2. Data

We use data on publicly traded U.S. banks included in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices between 2006 and 2018. The data on CEO and CFO age are collected from ExecuComp, the annual financial data are obtained from Compustat Bank Fundamentals and quarterly data from the banks' FR Y-9 statements, and the stock price data are from CRSP. After excluding banks with insufficient or missing data, we follow Berger and Bouwman (2009) and Berger et al. (2017) to identify financial institutions that are focusing on traditional banking activities. Specifically, we exclude banks with total assets below 25 million or negative common equity. Furthermore, the banks included in the sample are required to have positive amounts of loans, deposits, and total revenue in each fiscal year, and the year-end stock price has to exceed one dollar for at least three consecutive years. In addition, we require that our main variables of interest, CEO and CFO age, are available for at least four years during the sample period. After applying these criteria, we obtain an unbalanced panel of 1,436 bank-year observations. The final sample comprises 160 banks, 271 individual CEOs, and 300 individual CFOs.

2.1. CEO and CFO age

The main independent variables in our empirical analysis are the ages of the bank's Chief Executive Officer and Chief Financial Officer. We collect the year-end ages of the incumbent CEO and CFO in years for each bank from ExecuComp. Following Serfling (2014), we use the natural logarithms of CEO and CFO age as the executive age variables in our regressions.

2.2. Bank risk-taking

We use five alternative measures of bank risk-taking as the dependent variables in the regressions: (i) insolvency risk, (ii) total risk, (iii) idiosyncratic risk, (iv) systematic risk, and (v) tail risk. *Insolvency risk* is measured as the inverse of the natural logarithm of Z-score which is calculated as the sum of return on assets (ROA) and the ratio of equity to total assets (i.e., capital ratio) divided by the standard deviation of ROA. In the estimation of Z-scores for each bank-year, we use the rolling averages ROA and capital ratio for the year-end quarter and 12 lagged quarters and the standard deviation of ROA over the previous 12 quarters. Essentially, the Z-score measures a bank's distance to default based on the amount of equity capital, ROA, and the variability of ROA, and lower values of Z-score indicate a higher insolvency risk of the bank. Following Adhiraki and Agrawal (2016), for ease of interpretation, we use the inverse of the natural logarithm of Z-score as our measure of banks' insolvency risk so that higher values indicate higher insolvency risk.

Whereas *Insolvency risk* is a backward-looking representation of the bank's riskiness based on accounting information, the four other risk-taking measures are based on the stock returns. Following Anderson and Fraser (2000), Pathan (2009), and Ahmed et al. (2019), *Total risk* is measured as the annualized standard deviation of daily stock returns over the previous 12 months. Total risk measured by stock return volatility captures the overall riskiness of the bank and it can be considered to reflect the market's perceptions about the risks inherent in the bank's assets, liabilities, and off-balance-sheet positions. *Idiosyncratic risk* is estimated as the standard deviation of residuals from the market model regression using daily stock returns over the previous 12 months and *Systematic risk* is measured as the market model beta coefficient estimated against the daily returns of the CRSP value-weighted market portfolio. Idiosyncratic risk measures bank-specific riskiness that is unrelated to systematic market developments, while systemic risk captures the perceived level of risk related to systematic market developments and uncertainty. Finally, following Ellul and Yerramilli (2013) and Acharya et al. (2017), *Tail risk* is defined as the negative of the average of the 5 percent of the bank's worst daily stock returns over the previous 12 months. Tail risk is an expected short-fall measure that aims to gauge how much the bank's shareholders lose during extreme adverse events or market crises.

2.3. Control variables

We control for a number of bank-specific characteristics that have been documented to influence the riskiness of individual banks in prior literature. Specifically, we employ the following set of control variables in our regressions: (i) *Size* is the natural logarithm of the book value of total assets, (ii) *Size*^{2} is the orthogonal squared term of *Size*, (iii) *Profitability* is proxied by the return on assets (ROA) which is calculated as net income divided by the total assets, (iv) *Non-performing assets* is the ratio of non-performing assets to total loans, (v) *Loans to assets* is the ratio of total loans to total assets, (vi) *Deposits to assets* as the total customers' deposits divided by total assets, (vii) *Capital ratio* is the risk-adjusted Tier 1 capital ratio, (viii) *Non-interest income* is the ratio of non-interest income to the sum of interest and non-interest income, (ix) *Asset growth* as the average of annual asset growth over the previous four years, (x) *Acquisition activity* is a dummy variable that takes the value of one if the bank has acquisition-related expenditure during the fiscal year, and (xi) *Bank age* is the logarithm of the age of the bank which is determined as the greater of the number of months from the banks's initial public offering or the number of months from the bank's first appearance in Compustat.

2.4. Descriptive statistics and correlations

Table 1 presents the descriptive statistics for the variables used in the regressions. The average age of bank CEOs in our sample is 58.4 years, while the average age of CFOs stands at 52.2 years. Both executive age variables display notable dispersion with CEO age varying from 34 to 83 years and CFO age spanning between 32 and 69 years. As shown in Table 1, the Z-score has a mean value of 58.3 with a standard deviation of 55.9. The average annualized stock return volatility, *Total risk*, is about 35 percent, and the average *Idiosyncratic risk* is about 29 percent. The average beta coefficient, our measure of *Systematic risk*, is 1.14, suggesting that banks are systematically riskier than the market portfolio. The mean *Tail risk* of 0.05 indicates that banks, on average, lose about 5 percent of their market value during the worst decline days in the stock market.

With respect to the control variables, Table 1 shows that the sample banks are very heterogeneous in terms of their size, profitability, growth, and income and asset structure. The mean of total assets is about $81.2 billion, but the amount of total assets of the sample banks varies substantially from about $807 million to $2.62 trillion. On average, the sample banks have capital ratios of 12 percent, about 82 percent of their funding comes from deposits, and about 70 percent of total assets are invested in traditional banking activities like lending, and non-interest income comprises approximately 28 percent of the total income. About 21 percent of the bank-year observations have acquisition-related expenditures, and the average age of the sample banks is 23.6 years.

[Insert Table 1 about here]

Table 2 reports the correlation coefficients between the key variables of interest. As expected, the five alternative indicators of bank risk-taking display strong positive correlations with each other. Consistent with the hypothesis that executive age is negatively associated with bank risk-taking, we observe that *CEO age* is significantly negatively correlated with *Insolvency risk*, *Total risk*, *Idiosyncratic risk*, and *Tail risk*. However, the correlations in Table 2 also indicate that *CFO age* is largely unrelated to the risk-taking measures, except for a positive correlation with *Systematic risk*. Interestingly, the ages of bank CEOs and CFOs are almost uncorrelated with each other.

[Insert Table 2 about here]

3. Results

3.1. Univariate tests

We first perform univariate *t*-tests to examine differences in the five bank risk-taking measures between banks led by older and younger CEOs and CFOs. Table 3 reports the means of the risk measures for subsamples based on executive age terciles and the results of the *t*-tests for the null that there is no difference in the means of the bank risk-taking variables between the first and third executive age terciles. The reported *t*-tests are based on standard errors which are adjusted for heteroskedasticity and clustered by bank.

[Insert Table 3 about here]

Overall, the univariate tests in Table 3 suggest that CEO age is strongly negatively associated with bank risk-taking, while CFO age is mostly unrelated to the level of risk. Specifically, banks led by CEOs in the oldest age tercile have statistically significantly lower *Insolvency risk*, *Total risk*, *Idiosyncratic risk*, and *Tail risk*. In contrast, the *t*-tests indicate that the level of *Systematic risk* is significantly higher for banks with CFOs in the oldest age tercile whereas the differences in all other bank risk-taking measures are insignificant.

3.2. Main results

We estimate alternative versions of the following fixed-effects regression specification to examine the association between executive age and bank risk-taking:

$$\begin{aligned} \textit{Bank risk}_{i,t} &= \alpha + \beta_1 \log\left(\textit{CEO age}_{i,t}\right) + \beta_2 \log\left(\textit{CFO age}_{i,t}\right) \\ &\quad + \gamma\, \textit{Control variables}_{i,t} + \delta\, \textit{Bank-type}_i + \varphi\, \textit{Year}_t + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where the dependent variable $\textit{Bank risk}_{i,t}$ is one of the five alternative bank risk measures (*Insolvency risk*, *Total risk*, *Idiosyncratic risk*, *Systematic risk,* or *Tail risk*) for bank *i* at time *t*. With the exception of *Systematic risk*, we use the natural logarithms of the alternative dependent variables. The independent variables of interest in Equation (1) are *CEO age* and *CFO age* which are measured as the natural logarithms of the year-end ages of the bank's incumbent CEO and CFO. The bank-specific control variables used in the regressions account for the potentially confounding effects of factors such as bank size, capital ratio, profitability, and income structure on the level of risk. Because the Z-score is calculated based on *Profitability* and *Capital ratio*, we exclude these two control variables from the regressions with *Insolvency risk* as the dependent variable. To control for biases related to omitted variables and systematic variation in bank risk measures over time, we include bank-type fixed-effects (*Bank-type*) which are based on two-digit SIC coded and year fixed-effects (*Year*) in Equation (1). All variables are winsorized at the 1st and 99th percentiles to moderate the effects of potential outliers and robust standard errors which are adjusted for heteroskedasticity and clustered by bank are used in the regressions.

Table 4 presents the estimation results of our primary regressions. Intriguingly, the results indicate that the ages of CEOs and CFOs have contrasting effects on bank risk-taking. As can be noted from Table 4, the coefficient estimates for *CEO age* are consistently negative and statistically significant across all five regression specifications. Conversely, the coefficients for *CFO age* are positive and significant in the regressions that employ the four market-based risk measures as the dependent variables. In terms of economic significance, the magnitudes of the coefficient estimates for *CEO age* suggest that a one standard deviation increase in the age of the bank's CEO is associated with an approximately 8 percent decrease in *Insolvency risk* as well as reductions of about 2.2-2.4 percent in the levels of *Total risk*, *Idiosyncratic risk*, *Systematic risk*, and *Tail risk*. In contrast to CEO age, the regression results in Table 4 demonstrate that banks with older CFOs are associated with higher market-based measures of risk. The estimates indicate that a one standard deviation increase in *CFO age* increases all four market-based measures of bank risk-taking by about 2 percent.

[Insert Table 4 about here]

The documented negative association between CEO age and bank risk-taking supports the view that aging may lead to higher risk-aversion and is broadly consistent with the prediction of Prendergast and Stole (1996) that younger executives are willing to take more risk to signal their superior managerial quality. On the other hand, our finding that banks with older CFOs are riskier is broadly consistent with the career concern models of Hirshleifer and Thakor (1992), Holmström (1999), and Zwiebel (1995), and thereby provides support for the view that younger executives may be more risk-averse due to the fears that poor performance could hinder their career development. Moreover, similar to the prior empirical evidence based non-financial firms (e.g., Ginesti et al., 2021; Schopohl, Urquhart and Zhang, 2021; Peltomäki et al., 2021), our results demonstrate that CFO characteristics and preferences may have a strong role in influencing risk-taking and other firm-level outcomes also in the banking industry.

With respect to the control variables, the regression results in Table 4 indicate that *Size*, *Profitability*, *Non-performing assets*, *Non-interest income*, and *Acquisition activity* are important attributes for explaining cross-sectional differences in bank riskiness. Specifically, the estimates suggest that larger banks with lower profitability and higher amounts of non-performing assets and non-interest income are more risky. Somewhat surprisingly, *Acquisition activity* is significantly negatively associated with Total risk, *Idiosyncratic risk*, and *Tail risk*.

3.3. Endogeneity

We proceed by utilizing two-stage instrumental variable regressions and random effects specifications to mitigate endogeneity concerns and facilitate causal interpretation of our results. Following Serfling (2014), Cline and Yore (2016), and Peltomäki et al (2021), we use the logarithm of the consumer price index in the birth year of the executive (*CPI at birth*) as the instrumental variable for *CEO age* and *CFO age*. Obviously, older executives have earlier birth years during which the consumer price index has lower values, and thus, *CPI at birth* should be strongly negatively correlated with the executive age variables. Moreover, as argued by Serfling (2014), *CPI at birth* should not have any direct influence on the current financial policies or riskiness of individual firms. Therefore, *CPI at birth* should satisfy the exclusion restriction.

[Insert Table 5 about here]

Table 5 presents the estimates of the instrumental variable regressions. The first two numerical columns report the estimates of the first-stage regressions, and the following five columns present the results of the second-stage regressions with the alternative bank risk-taking measures used as the dependent variables. The first-stage regressions indicate that our instrument, the level of consumer price index in the birth year of the specific executive (*CPI at birth*) is strongly negatively correlated with *CEO age* and *CFO age*. Consistent with our main regressions, the instrumental variable regressions indicate that the ages of the top executives influence bank risk-taking. The coefficient estimates for the instrumented *CEO age* are negative and statistically significant in the regressions with *Insolvency risk*, *Total risk*, and *Idiosyncratic risk* as the dependent variables, while the coefficients for *CFO age* are positive and significant in the *Total risk* and *Systematic risk* regressions. Overall, the estimates of the instrumental variable regressions confirm our main findings by indicating that the ages of CEOs and CFOs influence bank risk-taking in opposite directions.

We next test whether our main results are driven by bank-specific unobserved heterogeneity. Bank fixed-effects specification would be best suited to capture unobserved heterogeneity across banks when the independent variable of interest has substantial variation over time. However, our main variables of interest, *CEO age* and *CFO age*, obviously have very limited within-firm variation over time. Therefore, we employ a random effects specification to alleviate endogeneity concerns arising from potentially omitted variables and unobserved heterogeneity. The stronger assumptions about the error correlation structure under this approach allow for estimating the effect of time-invariant covariates in panel data.

[Insert Table 6 about here]

Table 6 reports the estimation results of the random-effects regressions. Similar to our main regressions, the coefficient estimates for *CEO age* are positive and the coefficients for *CFO age* are negative throughout the different model specifications. Nevertheless, the positive coefficients for CEO age are now significant only at the 10 percent level and only in the regressions with *Total risk*, and *Idiosyncratic risk* and *Tail risk* as the dependent variables. Consistent with Table 4, despite being smaller in magnitude, the coefficients for *CFO age* are positive and highly significant in the regressions with the four market-based risk measures as the dependent variables.

3.4. Too-big-to-fail banks

Large banks that are considered "too-big-to-fail" are believed to be bailed out if they get into trouble (see e.g., Berger and Bouwman, 2013). The perceived implicit government guarantee may cause moral hazard problems and incentivize the top executives of large banks to adopt more risky business strategies (e.g., Iqbal and Vähämaa, 2019). Thus, we next examine whether the association between executive age and bank risk-taking is influenced by bank-size effects by excluding the too-big-to-fail banks with total assets in excess of $100 billion from the sample.

[Insert Table 7 about here]

Table 7 presents the regression results based on the subsample from which the too-big-to-fail banks have been excluded. Once again, the regression results indicate that bank risk-taking is negatively associated with CEO age while being positively associated with CFO age. As can be noted from the table, the estimated coefficients for *CEO age* and *CFO age* are remarkably similar to our main regressions both in terms of statistical significance and economic magnitude, with the only difference being the insignificant coefficient for *CEO age* in the regression with *Systematic risk* as the dependent variable. Interestingly, it is also worth noting that the coefficient estimate for *Size* is statistically significant only in the regressions with *Idiosyncratic risk* as the dependent variable whereas the coefficient for $Size^2$ is positive and significant in the regressions with *Insolvency risk* and *Idiosyncratic risk* as the dependent variables and negative and significant in the regression with *Systematic risk* regression.

3.5. Executive age and bank's policy decisions

So far, we have documented that bank risk-taking is negatively associated with CEO age while being positively associated with CFO age after controlling for bank size, financial performance, funding and income structures, and other bank-specific characteristics. Given that the measures of bank risk-taking used in our analysis are not managerial choice variables that the CEOs and CFOs can directly influence, we next investigate potential channels through which executive age may affect insolvency risk and the market-based measures of bank risk. Following the prior literature, we focus on the banks' investment policies, funding structure, and executive compensation incentives as the potential mechanisms by which CEO and CFO age may affect bank riskiness. For this purpose, we estimate alternative versions of the following fixed-effects regression specification:

$$\begin{aligned} \textit{Bank policy}_{i,t} &= \alpha + \beta_1 \log\left(\textit{CEO age}_{i,t}\right) + \beta_2 \log\left(\textit{CFO age}_{i,t}\right) \\ &+ \gamma\ \textit{Control variables}_{i,t} + \delta\ \textit{Bank-type}_i + \varphi\ \textit{Year}_t + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where the dependent variable *Bank policy*$_{j,t}$ denotes one of the alternative bank policy variables that are proximal to managerial decision-making and *CEO age* and *CFO age* are measured as the natural logarithms of the year-end ages of the bank's incumbent CEO and CFO. The set of control variables used in Equation (2) is the same as in Equation (1). Tables 8, 9, and 10 present the estimation results of the policy regressions.

3.5.1. Business model and investment policies

We begin by examining the influence of CEO and CFO age on the bank's asset growth. Rossi (2010) documents that rapid asset growth contributes to increased insolvency risk, while the findings of Fahlenbrach at al. (2012) indicate that the pre-crisis growth rate was negatively associated with bank performance during the financial crisis of 2007-2009. The regression results with bank asset growth are reported in the first numerical column of Table 8. As can be noted from the table, *CEO age* and *CFO age* are unrelated to the growth rate of bank assets.

[Insert Table 8 about here]

Second, we investigate whether CEO and CFO age are associated with the bank's business model in terms of involvement in non-traditional banking activities. Previous studies have documented that higher involvement in non-traditional banking activities makes banks riskier relative to banks with more traditional business models based on interest income (e.g., DeYoung and Roland, 2001; Stiroh and Rumble, 2006; and Brunnermeier, Dong and Palia, 2020). We use the proportion of non-interest income to total income as a proxy for non-traditional banking activities. The second numerical column of Table 8 presents the regressions with the proportion of non-interest income as the dependent variable. The coefficient estimates for *CEO age* and *CFO age* are statistically insignificant, suggesting that involvement in non-traditional banking activities is not influenced by the ages of the top executives.

Third, we assess the influence of CEO and CFO age on asset risk. Our proxies for banks' asset risk are asset write-downs and risk-weighted assets. The write-downs can be seen as imminent expected losses based on the bank's own assessment, while the amount of risk-weighted assets gauges the bank's relative riskiness based on its asset classes from a regulatory perspective. Banks with less risky investment policies are likely to have lower asset write-downs and risk-weighted assets. Following Adhiraki and Agrawal (2016), we measure write-downs as the ratio of net write-downs to total assets. The net write-downs include provisions for credit losses, other provisions, pre-tax write-downs, losses on investment securities, and allowances for reserves for other losses. Risk-weighted assets, in turn, is measured as the risk-weighted assets scaled by total assets.

The regression results with asset write-downs and risk-weighted assets as the dependent variables are presented in the third and fourth numerical columns of Table 8. The estimates indicate that banks with older CFOs are associated with more risky investment policies as the coefficients for *CFO age* are positive and statistically significant in both regression specifications. The coefficient for *CEO age* is also positive and significant at the 10 percent level in the regression with risk-weighted assets as the dependent variable.

3.5.2. Leverage and funding structure

We proceed by investigating whether the executive age-induced differences in bank risk can be traced to banks' capital and funding structure. First, we estimate regressions with book leverage and market leverage as the dependent variables. Book leverage is measured as the logarithm of the sum of the book value of long and short-term debt divided by the book value of total assets. Following Boyallian and Ruiz-Verdu (2018), we calculate market leverage as the logarithm of the sum of the book value of long and short-term debt divided by quasi-total assets in which the book value of shareholder's equity is replaced by its market value. The first two numerical columns of Table 9 report the estimation results of regressions with book and market leverage as the dependent variables. The estimates suggest that the amount of leverage is not influenced by the ages of the bank's top executives.

[Insert Table 9 about here]

In the traditional business model of banks, lending activities are mostly funded with customer deposits. In addition to customer deposits, the liability side of the bank funding includes shareholders' equity as well as short-term and long-term debts. While customer deposits are explicitly covered by deposit insurance schemes, non-deposit funding sources are not, and consequently, creditors have an incentive to withdraw short-term funding more quickly than depositors withdraw their deposits. Thus, larger reliance on non-deposit wholesale funding can expose banks to liquidity crunches and reduce bank stability (e.g., Demirgüç-Kunt and Huizinga, 2010; Davydov, Vähämaa and Yasar, 2021). To examine whether executive age influences bank funding structure, we estimate regressions with two alternative measures of non-deposit funding as the dependent variables. The first measure of non-deposit funding is calculated as the logarithm of the ratio of non-deposit short-term funding to the sum of customer deposits and short-term funding. Short-term funding in the denominator is obtained by subtracting equity capital, long-term debt, and customer deposits from the total assets. Our second measure of funding structure is calculated as the logarithm of the ratio of short-term funding to total assets in excess of stockholders' equity.

The regression results with the two alternative non-deposit funding measures as the dependent variables are presented in the third and fourth numerical columns of Table 9. As can be seen from the table, the coefficient estimates for *CEO age* are negative and highly insignificant and thereby indicate that banks led by older CEOs use lower amounts of non-deposit funding. In contrast, the estimated coefficients for *CFO age* are positive and statistically significant, suggesting that banks with older CFOs are more reliant on wholesale funding. Therefore, we conclude that the contrasting effects of CEO and CFO age on bank risk can be, at least to some extent, attributed to differences in banks' funding structure.

3.5.3. Executive compensation incentives

As the final step of our analysis, we examine the role of executive compensation incentives. Previous studies have noted that compensation-based incentives of the top executives may encourage excessive risk-taking in the financial industry (e.g., Chen et al. 2006; Bai and Elyasiani 2013; Guo, Jalal and Khaksari, 2015; Gande and Kalpathy 2017; Iqbal and Vähämaa, 2019), and therefore, it is of interest to examine whether the effects of CEO and CFO age on bank risk-taking are induced by compensation incentives. Following the prior literature, we measure compensation incentives with the sensitivities of CEO and CFO compensation to changes in stock prices (pay-performance sensitivity) and stock return volatility (pay-risk sensitivity). These two compensation sensitivities are commonly known as delta and vega, respectively. While a higher delta indicates that executives will earn higher compensation for better stock market performance, the vega provides a direct proxy for compensation-based risk-taking incentives of the top executives. Following the approach of Core and Guay (2002) and Coles, Daniel and Naveen (2006), delta is defined as the dollar gain or loss in executive wealth for a 1 percent change in the bank's stock price, while vega is the dollar gain or loss in executive wealth for a 1 percentage-point change in the bank's stock return volatility. In the regressions, we use the deltas and vegas scaled by the executive's total compensation as the dependent variables.

[Insert Table 10 about here]

The regression results with executive compensation incentives as the dependent variables are presented in Table 10. The estimates indicate that both *CEO age* and *CFO age* are significantly positively associated with pay-performance sensitivity, suggesting that older top executives gain more compensation with increasing stock prices than younger executives. In the regressions with pay-risk sensitivity as the dependent variable, the coefficient estimates for *CEO age* and *CFO age* are statistically insignificant. Thus, with the exception of the positive relation between *CFO age* and delta, the executive compensation regressions do not provide evidence to suggest that differences in compensation-based incentives would explain the documented contrasting effects of CEO and CFO age on bank risk-taking.

4. Conclusions

In this paper, we investigate the association between Chief Executive Officer (CEO) and Chief Financial Officer (CFO) age and bank risk-taking. The age of an individual encompasses a diverse and dynamic collection of personal characteristics and traits accumulated over one's lifetime, and previous studies have suggested that age may have a significant role in shaping risk preferences and tolerance. Furthermore, building on the upper echelons theory, a large body of literature has previously documented that the personal characteristics and preferences of firms' top executives influence firm-level decisions and outcomes. With respect to executive age, prior theoretical work predicts that younger executives may increase firm risk-taking in order to signal their superior managerial ability (Prendergast and Stole, 1996) unless the fear of punishment for poor performance makes them more risk-averse (Hirshleifer and Thakor, 1992, Holmström, 1999; Zwiebel, 1995). Previous empirical studies by Serfling (2014), Andreou et al. (2017), and Peltomäki et al. (2021) have documented that firms led by older top executives are associated with lower stock return volatility, idiosyncratic risk, and firm-specific tail risk. We aim to contribute to this literature by empirically examining the influence of CEO and CFO age on risk-taking in the banking industry.

In our empirical analysis, we use data on publicly-traded U.S. banks over the period 2006-2018. We measure bank risk-taking with Z-score, stock return volatility, the levels of systematic and idiosyncratic risk, and tail risk. While the Z-score is a backward-looking representation of the bank's insolvency risk based on accounting information, the four other risk-taking measures are based on the stock returns and thereby reflect market perceptions about the riskiness of the bank. Our results indicate that CEO age is negatively associated with the bank's insolvency risk and the market-based risk measures after controlling for bank size, financial performance, funding and income structures, and various other bank-specific characteristics. In stark contrast, however, we document that banks led by older CFOs are associated with higher stock return volatility, systematic risk, idiosyncratic risk as well as tail risk. Overall, our empirical findings suggest that the ages of bank CEOs and CFOs may have a counterbalancing influence on bank risk-taking which can potentially be related, for instance, to their different roles and responsibilities.

We use two-stage instrumental variable regressions to address concerns related to endogeneity and reverse causality, and we perform several additional tests to rule out alternative explanations and to ensure the robustness of our findings. Collectively, these additional tests provide further evidence that older CEOs constrain bank risk-taking, while banks with older CFOs are associated with higher levels of risk. We also investigate potential channels through which the ages of the top executives may affect insolvency risk and the market-based measures of bank risk. Although we do not find compelling evidence to suggest that the negative relationship between CEO age and bank risk-taking is induced by differences in banks' policy decisions, our results indicate that the positive association between CFO age and bank risk can be, at least to some extent, attributed to differences in banks' investment policies, funding structure, and executive compensation incentives.

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Table 1: Descriptive statistics

	Mean	Std. Dev.	Min	25th	Median	75th	Max	Obs.
<u>Bank risk:</u>								
Z-score	58.32	55.9	0.42	17.49	42.84	79.88	402.77	1361
Total risk	0.35	0.21	0.10	0.23	0.27	0.39	1.50	1371
Idiosyncratic risk	0.29	0.18	0.09	0.18	0.22	0.33	1.31	1371
Systematic risk	1.14	0.48	-0.01	0.82	1.04	1.34	3.65	1371
Tail risk	0.05	0.03	0.01	0.03	0.04	0.05	0.21	1371
<u>Executive age:</u>								
CEO age	58.35	7.17	34	54	58	63	83	1374
CFO age	52.24	7.06	32	47	52	57	69	1374
<u>Control variables:</u>								
Size	81237	315299	807	5042	10236	25525	2622532	1374
Profitability	0.01	0.01	-0.14	0.01	0.01	0.01	0.07	1364
Non-performing assets	0.02	0.02	0.00	0.01	0.01	0.02	0.20	1366
Loans to assets	0.70	0.20	0.05	0.59	0.70	0.81	1.81	1364
Deposits to assets	0.82	0.16	0.28	0.73	0.81	0.89	1.93	1364
Capital ratio	0.12	0.03	0.06	0.10	0.12	0.14	0.52	1373
Non-interest income	0.28	0.16	-0.25	0.17	0.26	0.36	0.82	1374
Asset growth	0.10	0.11	-0.13	0.03	0.08	0.15	0.72	1364
Acquisition activity	0.21	0.41	0.00	0.00	0.00	0.00	1.00	1373
Bank age	282.82	135.82	1.00	180	276	372	672	1374
<u>Bank policy variables:</u>								
Asset write-downs	0.00	0.01	-0.02	0.00	0.00	0.00	0.06	1374
Risk-weighted assets	0.60	0.10	0.25	0.54	0.61	0.66	0.99	1232
Book leverage	0.12	0.08	0.00	0.06	0.11	0.17	0.62	1374
Market leverage	0.12	0.08	0.00	0.06	0.10	0.16	0.62	1374
Non-deposit funding	0.10	0.07	0.01	0.05	0.08	0.13	0.55	1374
Short-term funding	0.09	0.07	0.01	0.04	0.08	0.12	0.55	1374
CEO delta	316.52	791.22	0.00	42.85	94.98	282.01	10956.53	1284
CFO delta	49.39	92.78	0.00	8.64	20.84	48.13	997.98	1282
CEO vega	71.41	181.8	0.00	0.43	14.75	53.20	2506.86	1284
CFO vega	22.61	73.65	0.00	0.11	4.13	15.30	1407.81	1282

The bank risk variables are: (i) *Z-score* calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, (ii) *Total risk* is the annualized standard deviation of daily stock return over the previous 12 months, (iii) *Idiosyncratic risk* is the standard deviation of the residuals from the market model regression over the previous 12 months, (iv) *Systematic risk* is the market model beta coefficient, and (v) *Tail risk* is the average of the five percent of worst daily returns over the previous 12 months multiplied by -1. *CEO age* and *CFO age* are the executives' ages in years. The control variables are defined as follows: (i) *Size* is the book value of total assets in million U.S. dollars, (ii) *Profitability* is proxied by the return on assets (ROA) and defined as net income divided by the total assets, (iii) *Non-performing assets* is non-performing assets divided by the total loans, (iv) *Loans to assets* is the ratio of total loans to total assets, (v) *Deposits to assets* is total customers' deposits scaled by total assets, (vi) *Capital ratio* is the risk-adjusted Tier 1 capital ratio, (vii) *Non-interest income* is the ratio of non-interest income to the sum of interest and non-interest income, (viii) *Asset growth* is the average of annual asset growth over four years, (ix) *Acquisition activity* is a dummy variable that takes the value of one if the bank has any acquisition-related expenditure during the fiscal year, and (x) *Bank age* is the number of months from the bank's IPO or the number of months from the bank's first appearance in Compustat. The bank policy variables are defined as follows: (i) *Asset write-downs* is the ratio of net asset write-downs to total assets, (ii) *Risk-weighted assets* is the aggregate riskiness of different bank asset categories based on risk weights assigned by regulators, (iii) *Book leverage* is the sum of the book value of long and short-term debt divided by the book value of total assets, (iv) *Market leverage* is total debt divided by the quasi-total assets obtained by replacing the book value of shareholder's equity in total assets with its market value, (v) *Non-deposit funding* is the ratio of non-deposit short-term funding to the sum of total customer deposits and short-term funding, (vi) *Short-term funding* is the ratio of short-term funding to total assets in excess of shareholders' equity, (vii) *Delta* is the dollar change in thousand dollars in an executive's bank-specific wealth for a 1 percent change in the bank's stock price, and (viii) *Vega* is the dollar change in an executive's bank-specific option holdings in thousand dollars for a 1 percentage-point change in the bank's stock return volatility.

Table 2: Correlations

	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk	CEO age
Total risk	0.52***					
Idiosyncratic risk	0.53***	0.98***				
Systematic risk	0.16***	0.35***	0.24***			
Tail risk	0.50***	0.98***	0.96***	0.35***		
CEO age	-0.10***	-0.10***	-0.11***	0.01	-0.09***	
CFO age	0.01	-0.01	-0.02	0.04*	-0.02	0.12***

This table reports pairwise Pearson correlation coefficients between the bank risk and executive age variables. *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, and *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1. *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 3: Univariate tests

Panel A: Differences in bank risk for CEO age terciles

	Low	Medium	High	High - Low	*t*-stat.
Insolvency risk	-3.342	-3.616	-3.630	-0.288**	-2.13
Total risk	-1.098	-1.254	-1.193	-0.096**	-2.53
Idiosyncratic risk	-1.271	-1.458	-1.383	-0.112***	-2.76
Systematic risk	1.126	1.152	1.143	0.017	0.42
Tail risk	-3.099	-3.249	-3.189	-0.089**	-2.39

Panel B: Differences in bank risk for CFO age terciles

	Low	Medium	High	High - Low	*t*-stat.
Insolvency risk	-3.509	-3.585	-3.489	0.019	0.12
Total risk	-1.175	-1.198	-1.172	0.003	0.07
Idiosyncratic risk	-1.361	-1.386	-1.366	-0.005	-0.12
Systematic risk	1.114	1.121	1.187	0.073*	1.98
Tail risk	-3.170	-3.196	-3.172	-0.002	-0.07

The table reports the mean values of the bank risk measures across three terciles of *CEO age* and *CFO age* and the differences in the means between the low and high terciles. *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, and *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1. *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. The *t*-statistics are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4: Executive age and bank risk-taking

	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk
Executive age:					
CEO age	-0.648*	-0.178**	-0.178**	-0.186*	-0.192**
	(-1.73)	(-2.07)	(-2.05)	(-1.75)	(-2.12)
CFO age	0.450	0.154**	0.150**	0.166*	0.133**
	(1.37)	(2.45)	(2.34)	(1.91)	(2.10)
Control variables:					
Size	-0.112	-0.029**	-0.077***	0.100***	-0.017
	(-1.65)	(-2.29)	(-6.33)	(5.19)	(-1.31)
Size^2	0.055	0.010	0.020**	-0.052***	0.002
	(1.09)	(1.10)	(2.25)	(-3.31)	(0.23)
Profitability		-5.259***	-5.517***	-6.932***	-5.755***
		(-4.31)	(-4.27)	(-4.38)	(-4.49)
Non-performing assets	29.927***	4.901***	5.352***	3.460***	4.924***
	(10.54)	(6.82)	(6.88)	(2.88)	(7.25)
Loans to assets	0.892**	0.086	0.139*	0.065	0.075
	(2.20)	(1.07)	(1.80)	(0.59)	(0.94)
Deposits to assets	-0.399	0.014	-0.021	-0.017	-0.007
	(-0.94)	(0.18)	(-0.28)	(-0.14)	(-0.08)
Capital ratio		-0.142	-0.301	1.141**	-0.281
		(-0.37)	(-0.74)	(2.44)	(-0.81)
Non-interest income	1.795***	0.115	0.190***	-0.113	0.083
	(4.19)	(1.64)	(2.73)	(-0.97)	(1.18)
Asset growth	-0.372	0.148	0.211*	0.157	0.180
	(-0.64)	(1.26)	(1.71)	(1.03)	(1.63)
Acquisition activity	-0.089	-0.035**	-0.035**	-0.027	-0.036**
	(-1.28)	(-2.49)	(-2.48)	(-1.12)	(-2.35)
Bank age	0.027	-0.009	-0.017	0.024	-0.006
	(0.23)	(-0.41)	(-0.77)	(0.77)	(-0.29)
Constant	-4.412**	-1.498***	-1.657***	0.933*	-3.384***
	(-2.32)	(-3.84)	(-4.19)	(1.68)	(-8.38)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1352	1354	1354	1354	1354
Adjusted R^2	0.391	0.825	0.816	0.569	0.820

The table reports the estimates of fixed effects regressions of bank risk on CEO and CFO age. The dependent variables and the main independent variables of interest are defined as follows: *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5: Instrumental variable regressions

	First-stage regressions		Second-stage regressions				
	CEO age	CFO age	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk
Executive age:							
Instrumented CEO age			-0.716*	-0.118*	-0.153**	-0.032	-0.126
			(-1.90)	(-1.68)	(-2.07)	(-0.31)	(-1.64)
Instrumented CFO age			0.157	0.094*	0.073	0.196***	0.084
			(0.43)	(1.74)	(1.14)	(2.77)	(1.59)
Control variables:							
Size	0.004	0.004	-0.142**	-0.019	-0.070***	0.107***	-0.005
	(0.91)	(1.01)	(-2.00)	(-1.44)	(-5.32)	(5.63)	(-0.39)
Size^2	-0.005*	-0.009***	-0.033	-0.000	0.005	-0.060***	-0.001
	(-1.86)	(-2.83)	(-0.65)	(-0.05)	(0.46)	(-3.69)	(-0.11)
Profitability				-4.247***	-4.607***	-5.863***	-4.773
				(-3.99)	(-3.96)	(-3.82)	(-4.18)
Non-performing assets	0.016	0.152	21.088***	4.388***	4.841***	3.358***	4.694
	(0.20)	(1.40)	(9.23)	(6.77)	(6.97)	(2.64)	(7.47)
Loans to assets	0.009	0.015	0.200	0.081	0.135	0.064	0.063
	(0.51)	(0.73)	(0.62)	(1.00)	(1.60)	(0.61)	(0.80)
Deposits to assets	-0.002	-0.007	0.197	0.002	-0.021	-0.058	-0.017
	(-0.13)	(-0.39)	(0.63)	(0.03)	(-0.29)	(-0.59)	(-0.24)
Capital ratio				0.070	-0.083	1.145***	-0.081
				(0.23)	(-0.25)	(2.65)	(-0.27)
Non-interest income	-0.018	-0.045**	0.857*	0.037	0.121	-0.115	-0.005
	(-1.01)	(-2.23)	(1.86)	(0.46)	(1.51)	(-0.96)	(-0.06)
Asset growth	-0.009	-0.012	-1.037*	0.018	0.074	0.174	0.095
	(-0.49)	(-0.46)	(-1.90)	(0.17)	(0.63)	(1.26)	(0.90)

	First-stage regressions		Second-stage regressions				
	CEO age	CFO age	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk
Acquisition activity	-0.001	-0.003	0.006	-0.025**	-0.025*	-0.020	-0.023
	(-0.35)	(-0.90)	(0.11)	(-2.07)	(-1.89)	(-0.90)	(-1.65)
Bank age	0.000	-0.003	0.175	0.000	-0.007	0.033	-0.001
	(0.03)	(-0.41)	(1.58)	(0.01)	(-0.30)	(1.09)	(-0.03)
Constant	5.661***	5.946***	-3.370	-1.541***	-1.505***	0.158	-3.474
	(83.43)	(63.60)	(-1.52)	(-4.28)	(-3.69)	(0.31)	(-9.27)
Instrumental variables:							
CPI at CEO birth	-0.527***	0.010					
	(-28.62)	(0.84)					
CPI at CFO birth	0.004	-0.617***					
	(0.55)	(-26.07)					
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations			1352	1354	1354	1354	1354
Adjusted R^2			0.366	0.825	0.816	0.575	0.821

The table reports the estimates of two-stage instrumental variable regressions. The first two numerical columns present the first-stage regressions and the following five numerical columns present the second-stage regressions. The consumer price index in the birth year of the executive, *CPI at birth*, is used as the instrument for *CEO age* and *CFO age*. *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. The dependent variables in the second-stage regressions are defined as follows: *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, and *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1. All continuous variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and are clustered by banks for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 6: Random effects regressions

	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk
<u>*Executive age:*</u>					
CEO age	-0.491	-0.132*	-0.147*	-0.103	-0.152*
	(-1.29)	(-1.83)	(-1.95)	(-1.02)	(-1.94)
CFO age	0.395	0.113**	0.117**	0.161**	0.108**
	(1.17)	(2.25)	(2.03)	(2.36)	(2.20)
<u>*Control variables:*</u>					
Size	-0.139**	-0.018	-0.070***	0.107***	-0.005
	(-1.99)	(-1.42)	(-5.27)	(5.64)	(-0.36)
$Size^2$	-0.026	-0.000	0.005	-0.061***	-0.001
	(-0.52)	(-0.05)	(0.47)	(-3.73)	(-0.14)
Profitability		-4.234***	-4.579***	-5.874***	-4.751***
		(-3.97)	(-3.94)	(-3.84)	(-4.17)
Non-performing assets	21.217***	4.399***	4.853***	3.360***	4.705***
	(9.31)	(6.81)	(7.03)	(2.65)	(7.53)
Loans to assets	0.206	0.081	0.133	0.068	0.063
	(0.64)	(1.00)	(1.58)	(0.66)	(0.81)
Deposits to assets	0.192	0.001	-0.021	-0.062	-0.019
	(0.61)	(0.02)	(-0.29)	(-0.64)	(-0.26)
Capital ratio		0.065	-0.091	1.152***	-0.086
		(0.21)	(-0.28)	(2.65)	(-0.29)
Non-interest income	0.898*	0.036	0.123	-0.122	-0.006
	(1.96)	(0.46)	(1.54)	(-1.02)	(-0.08)
Asset growth	-0.997*	0.020	0.077	0.168	0.096
	(-1.82)	(0.19)	(0.66)	(1.21)	(0.91)
Acquisition activity	0.003	-0.026**	-0.025*	-0.020	-0.023*
	(0.06)	(-2.08)	(-1.90)	(-0.90)	(-1.66)
Bank age	0.163	0.000	-0.008	0.034	-0.001
	(1.48)	(0.00)	(-0.33)	(1.13)	(-0.04)
Constant	-5.157**	-1.557***	-1.694***	0.575	-3.462***
	(-2.44)	(-4.34)	(-4.33)	(1.10)	(-9.15)
Observations	1352	1354	1354	1354	1354
Adjusted R^2	0.369	0.825	0.816	0.576	0.822

The table reports the estimates of random effects regressions of bank risk on CEO and CFO age. The dependent variables and the main independent variables of interest are defined as follows: *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 7: Regressions without too-big-to-fail banks

	Insolvency risk	Total risk	Idiosyncratic risk	Systematic risk	Tail risk
Executive age:					
CEO age	-0.684*	-0.173**	-0.179**	-0.143	-0.194**
	(-1.79)	(-1.98)	(-2.06)	(-1.31)	(-2.13)
CFO age	0.390	0.153**	0.146**	0.172*	0.131**
	(1.16)	(2.37)	(2.25)	(1.96)	(1.99)
Control variables:					
Size	0.083	-0.010	-0.052**	0.042	0.019
	(0.62)	(-0.38)	(-2.08)	(1.01)	(0.78)
$Size^2$	0.266**	0.031	0.051**	-0.107***	0.036
	(2.14)	(1.38)	(2.19)	(-3.15)	(1.64)
Profitability		-4.464***	-4.732***	-6.234***	-4.932***
		(-3.72)	(-3.75)	(-3.83)	(-3.89)
Non-performing assets	30.477***	5.064***	5.499***	3.476***	5.097***
	(10.41)	(6.77)	(6.83)	(2.94)	(7.09)
Loans to assets	1.098**	0.089	0.135	0.057	0.081
	(2.60)	(1.02)	(1.63)	(0.49)	(0.94)
Deposits to assets	-0.508	0.027	-0.010	0.050	-0.009
	(-1.11)	(0.32)	(-0.12)	(0.41)	(-0.10)
Capital ratio		-0.371	-0.570	0.959**	-0.470
		(-1.00)	(-1.48)	(2.07)	(-1.35)
Non-interest income	1.379***	0.066	0.128*	-0.120	0.040
	(3.01)	(0.89)	(1.77)	(-0.99)	(0.54)
Asset growth	-0.591	0.099	0.146	0.079	0.162
	(-0.92)	(0.81)	(1.16)	(0.49)	(1.39)
Acquisition activity	-0.082	-0.039***	-0.042***	-0.030	-0.040***
	(-1.11)	(-2.82)	(-2.88)	(-1.27)	(-2.62)
Bank age	0.046	-0.011	-0.020	0.019	-0.006
	(0.37)	(-0.46)	(-0.85)	(0.61)	(-0.28)
Constant	-4.025**	-1.456***	-1.569***	0.762	-3.296***
	(-2.10)	(-3.67)	(-3.98)	(1.30)	(-8.13)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1220	1222	1222	1222	1222
Adjusted R^2	0.397	0.821	0.812	0.593	0.815

The table reports the estimates regressions of bank risk on CEO and CFO age based on a subsample from which the too-big-to-fail banks have been excluded. The dependent variables and the main independent variables of interest are defined as follows: *Insolvency risk* is the natural logarithm of *Z-score* multiplied by −1, *Total risk* is the logarithm of the annualized standard deviation of daily stock return over the previous 12 months, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals from the market model regression over the previous 12 months, *Systematic risk* is the market model beta coefficient, *Tail risk* is the logarithm of the average of the five percent of worst daily returns over the previous 12 months multiplied by -1, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 8: Executive age and bank policies

	Asset growth	Non-interest income	Asset write-downs	Risk-weighted assets
Executive age:				
CEO age	-0.050	-0.067	-0.001	0.064*
	(-1.60)	(-0.98)	(-0.77)	(1.96)
CFO age	-0.023	-0.075	0.002*	0.077***
	(-0.88)	(-1.36)	(1.96)	(2.70)
Control variables:				
Size	0.017***	0.028***	0.000	0.004
	(4.52)	(3.96)	(1.10)	(0.90)
Size^2	-0.001	0.016*	-0.000	-0.002
	(-0.23)	(1.90)	(-0.02)	(-0.40)
Profitability	0.085	0.155	-0.286***	0.024
	(0.24)	(0.22)	(-6.66)	(0.07)
Non-performing assets	-0.809***	-0.094	0.168***	0.278
	(-4.00)	(-0.19)	(8.24)	(1.05)
Loans to assets	0.025	-0.365***	0.005***	0.402***
	(0.77)	(-4.38)	(3.55)	(11.23)
Deposits to assets	0.292***	0.285***	-0.002	-0.233***
	(9.55)	(3.41)	(-0.92)	(-6.47)
Capital ratio	-0.239	-0.612**	0.000	-0.999***
	(-1.36)	(-2.09)	(0.03)	(-6.20)
Non-interest income	-0.050		0.006***	0.046
	(-1.59)		(3.14)	(1.22)
Asset growth		0.034***	-0.000	-0.003
		(3.39)	(-1.37)	(-0.46)
Acquisition activity	0.012**	0.047***	-0.000	-0.013*
	(2.12)	(2.84)	(-0.25)	(-1.77)
Bank age	-0.065***	-0.103*	0.003	-0.129***
	(-4.58)	(-1.72)	(1.24)	(-3.31)
Constant	0.386**	0.463	-0.006	0.113
	(2.30)	(1.30)	(-0.82)	(0.72)
Year fixed effects	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes
Observations	1354	1354	1354	1215
Adjusted R^2	0.434	0.460	0.686	0.611

The table reports the estimates regressions of different bank policy variables on CEO and CFO age. The dependent variables and the main independent variables of interest are defined as follows: *Asset growth* is the average of annual asset growth over four years, *Non-interest income* is the ratio of non-interest income to the sum of interest and non-interest income, *Asset write-downs* is the ratio of net asset write-downs to total assets, *Risk-weighted assets* is the aggregate riskiness of different bank asset categories based on risk weights assigned by regulators, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 9: Executive age and bank capital and funding structures

	Book leverage	Market leverage	Non-deposit funding	Short-term funding
Executive age:				
CEO age	-0.153	-0.165	-0.770***	-0.837***
	(-0.56)	(-0.59)	(-2.79)	(-3.07)
CFO age	0.032	0.025	0.376*	0.427**
	(0.16)	(0.12)	(1.82)	(2.03)
Control variables:				
Size	0.070***	0.079***	0.039	0.026
	(2.63)	(2.96)	(1.34)	(0.87)
$Size^2$	-0.029	-0.031	0.024	0.025
	(-0.90)	(-0.96)	(0.72)	(0.74)
Profitability	1.819	-0.072	1.306	0.784
	(0.81)	(-0.03)	(0.49)	(0.29)
Non-performing assets	-2.138	-1.727	-3.596*	-3.677**
	(-1.13)	(-0.88)	(-1.96)	(-2.13)
Loans to assets	1.541***	1.609***	0.859***	0.754***
	(6.76)	(6.90)	(3.85)	(3.32)
Deposits to assets	-3.550***	-3.635***	-2.775***	-2.501***
	(-13.85)	(-14.07)	(-10.71)	(-9.83)
Capital ratio	-0.142	-0.133	-0.577	-0.974
	(-0.11)	(-0.10)	(-0.48)	(-0.82)
Non-interest income	0.927***	0.954***	1.446***	1.494***
	(3.57)	(3.66)	(5.81)	(5.98)
Asset growth	1.454***	1.462***	1.508***	1.363***
	(4.37)	(4.37)	(3.88)	(3.49)
Acquisition activity	0.037	0.034	0.106**	0.115**
	(0.91)	(0.84)	(2.32)	(2.45)
Bank age	-0.055	-0.061	0.073	0.075
	(-0.87)	(-0.98)	(1.03)	(1.04)
Constant	-0.679	-0.724	-0.427	-0.424
	(-0.51)	(-0.54)	(-0.33)	(-0.33)
Year fixed effects	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes
Observations	1354	1354	1354	1354
Adjusted R^2	0.515	0.527	0.369	0.326

The table reports the estimates regressions of different capital and funding structure variables on CEO and CFO age. The dependent variables and the main independent variables of interest are defined as follows: *Book leverage* is the sum of the book value of long and short-term debt divided by the book value of total assets, *Market leverage* is total debt divided by the quasi-total assets obtained by replacing the book value of shareholder's equity in total assets with its market value, *Non-deposit funding* is the ratio of non-deposit short-term funding to the sum of total customer deposits and short-term funding, *Short-term funding* is the ratio of short-term funding to total assets in excess of shareholders' equity, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 10: Executive age and compensation incentives

	CEO delta	CFO delta	CEO vega	CFO vega
<u>*Executive age:*</u>				
CEO age	0.262**		0.006	
	(2.45)		(0.58)	
CFO age		0.053***		0.004
		(4.07)		(0.80)
<u>*Control variables:*</u>				
Size	-0.002	0.006***	0.003**	0.003***
	(-0.27)	(3.47)	(2.28)	(2.69)
$Size^2$	-0.001	-0.002	-0.000	0.000
	(-0.08)	(-0.99)	(-0.03)	(0.32)
Profitability	3.271**	0.633***	0.428**	0.252**
	(2.27)	(3.49)	(2.03)	(2.01)
Non-performing assets	0.487	-0.121	-0.092	-0.099*
	(1.00)	(-1.06)	(-1.32)	(-1.83)
Loans to assets	-0.180	-0.004	-0.011	-0.008
	(-1.54)	(-0.25)	(-0.85)	(-0.72)
Deposits to assets	0.138*	0.014	0.002	0.005
	(1.73)	(0.83)	(0.20)	(0.47)
Capital ratio	-0.194	0.123	-0.016	0.025
	(-0.59)	(1.42)	(-0.24)	(0.49)
Non-interest income	-0.056	-0.007	-0.010	-0.002
	(-0.62)	(-0.41)	(-0.72)	(-0.25)
Asset growth	0.020	-0.013	-0.001	0.001
	(0.24)	(-0.74)	(-0.05)	(0.17)
Acquisition activity	-0.012	0.001	0.001	0.002
	(-0.89)	(0.44)	(0.38)	(1.06)
Bank age	0.005	-0.014*	0.000	0.001
	(0.26)	(-1.88)	(0.10)	(0.40)
Constant	-0.875*	-0.142**	-0.011	-0.023
	(-1.79)	(-2.50)	(-0.21)	(-1.06)
Year fixed effects	Yes	Yes	Yes	Yes
Bank-type fixed effects	Yes	Yes	Yes	Yes
Observations	1265	1260	1265	1260
Adjusted R^2	0.094	0.213	0.182	0.206

The table reports the estimates regressions of executive compensation incentives on CEO and CFO age. The dependent variables and the main independent variables of interest are defined as follows: *Delta* is the dollar change in thousand dollars in an executive's bank-specific wealth for a 1 percent change in the bank's stock price, *Vega* is the dollar change in an executive's bank-specific option holdings in thousand dollars for a 1 percentage-point change in the bank's stock return volatility, and *CEO age* and *CFO age* are the logarithms of the respective executives' ages in years. All continuous variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and clustered by bank. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

CEO Myopia and Bank Risk-taking☆

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Abstract

This paper studies the association between bank risk-taking and executive decision horizon for long-tenured bank CEOs. As CEOs with long tenures or imminent retirement age have shorter decision horizons, they tend to focus more on stability rather than on risky investment ventures. Consequently, bank riskiness can decrease (increase) when the expected managerial decision horizon is shorter (longer). Using a sample of publicly traded large U.S. banks, we find that the expected CEO decision horizon positively impacts bank risk-taking. Specifically, CEOs with shorter expected tenures reduce bank risk-taking, whereas their counterparts with longer expected career horizons increase bank riskiness. However, CEO's expected tenure in the office does not affect insolvency risk. Furthermore, the expected career horizon of large bank CEOs has a more pronounced effect on the banks' total and systematic risk than that of smaller banks, and the impact has decreased since the global financial crisis. We identify CEO's pay-performance sensitivity and bank loan growth as the potential policy channel for propagating the expected tenure-driven bank risk-taking. Overall, we document that expected tenure-induced CEO myopic behavior has an important impact on bank risk-taking.

JEL classification: G21, G30, G32

Keywords: Bank risk-taking, CEO decision horizon, CEO myopia

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1. Introduction

CEOs with a short decision horizon often display temporal myopia by focusing more on short-term results that benefit them personally over strategies impacting long-term firm growth (Eisenhardt, 1989; Gibbons and Murphy, 1992). As executives' decision horizons are limited to their expected tenure in the office, CEOs with longer tenure or imminent retirement become more myopic (Antia, Pantzalis, and Park, 2010 & 2021). A myopic CEO can opt out of risky ventures in favor of less risky investment opportunities to smoothen the firm's performance for the remainder of his/her expected tenure. This paper investigates the extent of the relationship between the expected executive career horizon and firm risk-taking for relatively long-tenured bank CEOs.

A typical firm's lifespan is longer than the CEO's time in the office, i.e., CEOs have a much shorter decision horizon than the firm they work for has. As a result, self-indulging CEOs pursue corporate policies that are favorable to their intertemporal preferences but are suboptimal from shareholders' perspectives. This mismatch of decision horizons between executives and their firms is a key source of agency problems (Jensen and Smith, 1985). A short expected tenure is not suitable for implementing long-term strategies. In addition, CEOs' commitment to the organizational status quo increases with tenure, while their willingness to adapt or respond adequately to dynamic environments decreases (Hambrick, Geletkanycz, and Fredrickson, 1993). Thus, the horizon problem intensified with the increase in CEO tenure.

CEOs with longer expected career horizons can afford to undertake value-creating projects with deferred payoffs. In contrast, short-term-oriented CEOs may find ways to cut costs to improve firm outcomes that are not sustainable in the long run (Antia, Pantzalis, and Park, 2021). Consistent with the view that CEOs with a shorter remaining period in office deter long-run value maximization, a shorter decision horizon is associated with lower firm valuation and higher levels of information risk (Antia, Pantzalis, and Park, 2010). Following the same arguments, auditors perceive CEOs' horizon problems as a reporting risk. Consequently, audit fees are higher for CEOs in their final year in office, considering departing CEOs are more likely to manage earnings (Mitra et al., 2020).

A typical view in corporate finance is that long-term CEOs are entrenched. For instance, long-term CEOs enjoy greater managerial power as they gain control over the board over time and are more likely to be appointed board chairs (Graham, Kim, and Leary, 2020)[1]. As a result of this increased influence over the board, long-tenured CEOs are associated with increased investment quantity but decreased investment quality (Pan, Wang, and Weisbach, 2016). Over their tenure, the increased managerial power attained by long-serving CEOs also enables them to imprint their personal choices into their firm policies. Accordingly, Korkeamäki, Liljeblom, and Pasternack (2017) find a positive link between firm leverage and the personal indebtedness of long-tenured CEOs.

CEOs' incentive structure may also contribute to the myopic tendencies of long-tenured CEOs. Gopalan et al. (2014) document that the vesting period of both stock and option grants is about three to five years, with a large proportion of these grants being vested in a graded manner, i.e., in equal installments over the vesting period. As a result, managerial incentives vest at an increasing rate over time, making the CEO compensation more sensitive to short-term performance in the later years of their term. This intensifies the horizon problem whereby CEOs manipulate firm performance in their final years in office (Marinovic and Varas, 2019). In general, CEOs with shorter decision horizons prefer investments that produce relatively faster paybacks instead of undertaking risky ventures with long-term value creation ability (Antia, Pantzalis, and Park, 2010).

Evidence of the shorter career horizon and myopic behavior can also be found among executives who experience unpredictable personal shocks that result in a turnover or curtail the remaining time in the office (Aktas et al., 2021). Following the shock, the CEOs reduce investments in research and development (R&D) and capital expenditures and increase cash distributions. These results confirm a behavioral explanation of the tenure-driven differences in CEO decision-making.

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[1] There is a decreasing trend in CEO duality among large U.S. firms. Graham, Kim, and Leary (2020) report that the proportion of firms that have CEOs who are also board chairs started to increase substantially in the 1970s, reached its peak of 73% in the mid-1980s, and began to decline in the following decades. In 2022, 57% of the S&P 500 firms had a separation between the role of CEO and chair (Spencer Stuart, 2022). The support of Governance activists, such as the National Association of Corporate Directors (NACD), for separating these two roles contributed heavily toward the decline in CEO duality (Graham, Kim, and Leary, 2020). Furthermore, the amendments to Regulation S–K (under the U.S. Securities Act of 1933) in 2009 that set out the SEC filing requirements require firms to explain the reason for separating or combining the roles of CEOs and chairs (see, e.g., Goergen, Limbach, and Scholz-Daneshgari, 2020). Similarly, the presence of a dominant official, in consort with weak internal controls and board oversight, constitutes a supervisory concern for the Federal Deposit Insurance Corporation (FDIC). Section 4.1 of FDIC's Risk Management Manual of Examination Policies (available at: https://www.fdic.gov/regulations/safety/manual/), thus, suggests bank examiners to identify dominant bank officials exerting material influence over almost all bank policies and operations-related decisions and describe the official's level of influence, board independence and oversight adequacy, and other mitigating controls in the report of the bank examination.

Further, event study results suggest investors recognize this myopic behavior of long-tenured powerful CEOs as the stock market reacts positively to the news of their sudden death (Graham, Kim, and Leary, 2020).

Prior literature also finds firm risk-taking is associated with CEO decision horizon. For example, Pan, Wang, and Weisbach (2015) document that stock return volatility declines with CEO tenure. The rate of decline is faster towards the end of their term. Moreover, a shorter career horizon is also associated with a lower idiosyncratic risk (Antia, Pantzalis, and Park, 2021). These findings are consistent with the view that CEOs show myopic behavior because of their predisposition toward career safety (Hirshleifer and Thakor, 1992). This view is also consistent with the finding from the CEO succession that firms experience a higher level of riskiness in the presence of lower CEO termination risk (Cziraki and Groen-Xu, 2020), and managers pursue less risky investments when the CEO turnover threat is high (Chakraborty, Sheikh, and Subramanian, 2007).

Fama (1980) suggests that the labor market disciplining mechanism can alleviate this agency problem. However, this mechanism is more effective for younger executives at the beginning of their careers (Davidson et al., 2007), as the extent of career concern becomes irrelevant or less important for CEOs with an imminent retirement age (see e.g., Gibbons and Murphy, 1992). Besides, the CEO turnover rate increases with age, indicating older CEOs have shorter expected career horizons (Ocasio, 1994). Thus, in addition to CEO tenure, CEO age is another attribute of the decision horizon-related agency problems between a firm and its top executives. Therefore, in this paper, we take into account both the CEO's age and tenure in studying the CEO decision horizon’s evolving effect on bank risk-taking for a sample of relatively long-tenured CEOs.

Our study primarily contributes to two strands of literature. First, this paper contributes to the banking literature by examining the relationship between executive myopia and bank risk-taking. Policymakers pinpoint managerial short-termism as the main contributor to the subprime crisis of 2007–2009. Firms incentivizing CEOs to behave more myopically were found to have greater exposure to the subprime crisis, a higher probability of financial distress, lower risk-adjusted stock returns during the crisis, and higher fines and settlements for subprime-related fraud (Kolasinski and Yang, 2018). Moreover, the harmful effect of myopic decisions made by long-tenured CEOs persists even after their succession. Specifically, after the succession of a long-term CEO, firms suffer from lower operating performance and stock returns (Colak and Liljeblom, 2022). Firm recovery also takes a longer period and incurs higher restructuring costs. In this paper, we show how CEO myopia affects bank risk-taking.

Studies reporting firms with shorter CEOs' career horizons take less risk are predominantly based on non-financial firms. Nevertheless, the fundamental differences between banks and non-financial firms in ownership structure, exposure to regulations, and business models can influence the relationship between executive CEO decision horizon and bank risk-taking. Conventionally, banks operate with high leverage, which allows executives to take excessive risks at the expense of other stakeholders like creditors, depositors, and taxpayers. In addition, the high coordination cost and government deposit insurance make depositors less interested in monitoring banking activities. Thus, banks lack creditor disciplining (Jensen and Meckling, 1976). Besides, a *de facto* government guarantee to bail out "too-big-to-fail" banks encourages higher risk-taking (see e.g., Haan and Vlahu, 2016, for a review).

While some of these unique bank features encourage risk-taking, government regulations and supervision aim to reduce excessive risk-taking. However, Faleye, Hoitash, and Hoitash (2011) argue that better monitoring reduces excess executive compensation and earnings management, but it amplifies CEO myopia by weakening managers' perception of board support in undertaking value-enhancing risky projects. Furthermore, the negative effect of board monitoring is more severe for firms with complex operations, a distinctive feature of the banking industry. The interplay between industry construct and government supervision and monitoring makes it hard to predict how the executive decision horizon would affect risk-taking in the banking industry. This paper tests the extent of this relation empirically.

Second, we contribute to the executive characteristics literature focusing on how CEO personal characteristics influence bank risk-taking. Given personal characteristics affect an executive's choices, preferences, and decision-making, the Upper Echelons Theory predicts that individual differences among top executives are likely to affect their corporate decisions and firm outcomes (see, e.g., Cronqvist, Makhija, and Yonker, 2012; Hambrick and Mason, 1984). Consistent with this prediction, prior studies find firm operational strategies, performance, and risk-taking are associated with several executive characteristics (see, e.g., Malmendier and Tate, 2005a, 2005b; Malmendier, Tate, and Yan, 2011; Serfling, 2014; Faccio, Marchica, and Mura, 2016; Palvia, Vähämaa, and Vähämaa, 2015; Graham, Harvey, and Puri, 2017).

Similarly, Adhikiraki and Agrawal (2016) pointed out that only bank-specific variables cannot solely explain bank risk-taking. As executives decide on corporate strategies, their personal choices, beliefs, and characteristics play a role. Our study adds novel knowledge to the growing literature focusing on the effect of bank executive characteristics in the banking industry (see, e.g., Ahmed et al., 2023; Ahmed, Sihvonen, and Vähämaa, 2019; Buyl, Boone, and Wade, 2019; Nguyen, Hagendorff, and Eshraghi, 2015; King, Srivastav, and Williams, 2016).

To investigate the relationship between CEO decision horizon and bank risk-taking, we use the data on large U.S. banks belonging to the S&P 1500 index over the sample period 2005-2020. This paper considers five alternative bank risk measures: four market-based risk measures and accounting-based bank default risk. As market-based risk measures, total volatility and its two components – systematic and idiosyncratic risk, are used. The fourth risk measure is the tail risk, which estimates how much a bank is likely to lose in extreme adverse events or crises.

Controlling for a number of bank-specific factors and board characteristics that prior literature found to have a confounding effect on bank riskiness, this paper documents a positive relationship between CEO expected career horizon and bank risk-taking. Specifically, we find that the level of risk reduction from older or long-tenured CEOs is higher than their younger or newly appointed counterparts' contribution to risk-taking. A matched sample of banks using propensity score matching and Lewbel's (2012) instrumental variable (IV) regression also confirm our main findings that a longer expected tenure increases risk-taking among bank executives.

Further analysis shows that the magnitude and pattern of age and tenure-driven myopic behavior affect bank risk differently. While CEO age affects both bank-specific idiosyncratic and systematic risk, tenure-driven risk-taking is limited to idiosyncratic risk. In addition, the expected career horizon of large bank CEOs has a more pronounced effect on the banks' total and systematic risk than that of smaller banks. The expected career horizon-driven risk-taking has decreased since the global financial crisis. We find that the CEO's pay-performance sensitivity and bank loan growth contribute to the expected tenure-driven bank risk-taking. Overall, we find that the CEO's expected tenure-induced CEO myopic behavior has an important impact on bank risk-taking.

The remainder of this paper is organized as follows: Section 2 introduces the variables used in the paper and presents their descriptive statistics. Section 3 presents the univariate tests, baseline regression results, and endogeneity tests. Section 4 discusses the robustness tests. Section 5 focuses on the potential policy channel explaining the relationship between a CEO's expected career horizon and bank risk-taking. Finally, section 6 provides the concluding remarks.

2. Data and summary statistics

We examine the relationship between CEO myopia and bank risk-taking in the United States and collect the CEO information from Standard & Poor's Execucomp database for current and past constituents of S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices with primary Standard Industrial Classification (SIC) codes between 6000 and 6300. Following Fahlenbrach and Stulz (2011), the sample firms are banks. For the sample banks, we collect the stock prices from Datastream, annual financial data from Bloomberg, and board characteristics from BoardEx. After excluding firm-year observations with insufficient financial or stock data and CEOs with less than five years of data availability, the final sample includes 1,535 firm-year observations with 164 individual CEOs from 140 banks from 2005 to 2020.

2.1. Bank risk measures

The five alternative bank risk measures used in this paper are (i) *ZScoreInverse*, (ii) *Total risk*, (iii) *Idiosyncratic risk,* (iv) *Market beta,* and (v) *Tail risk*. *ZScoreInverse* is a measure of bank insolvency, while the other alternative measures are market-based bank risk measures. Following Adhiraki and Agrawal (2016), we measure *ZScoreInverse* as the inverse of the natural logarithm of *ZScore,* which measures a bank's distance to default. We follow Laeven and Levine (2009) to calculate the *ZScore* by adding the bank's return on assets (ROA) to its capital-to-assets ratio (CAR) and dividing the sum by the standard deviation of ROA. ROA is calculated by dividing the 12-month trailing net income by the average total assets, and the total equity is the difference between a bank's assets and total liability. The ROA, total equity, and total asset data are collected from Bloomberg. The standard deviation of ROA is measured using a six-year rolling window. For the observations where ROA data is unavailable for six years, we calculate the *ZScore* based on shorter data if at least four years of data are available. If the ROA data is not available for a minimum of four years, the observation is excluded from the sample. *ZScore* predicts the probability that current losses would exceed the capital (Roy, 1952). An increase in *ZScore* implies a greater distance to default, whereas an increase in *ZScoreInverse* indicates an increase in the bank risk level.

As a proxy of realized volatility, we use *Total risk* to capture the overall variability in bank stock returns. The total risk reflects the market's perceptions about the risks inherent in the bank's assets, liabilities, and off-balance-sheet positions. Following Anderson and Fraser (2000) and Pathan (2009), we calculate the *Total risk* of a bank as the annualized standard deviation of daily stock returns over the fiscal year. We estimate *Idiosyncratic risk* as the sample standard deviation of residuals from the market model regression using daily stock returns over a fiscal year. The *Market beta* is the beta of the market index obtained from the market model regression. Finally, the *tail risk* is a measure of the expected shortfall, which estimates how much a bank is likely to lose in extreme adverse events or crises. Following Ellul and Yerramilli (2013) and Acharya et al. (2017), we define T*ail risk* as the average of five percent worst daily returns over the fiscal year multiplied by -1.

2.2. CEO decision horizon measure

Following Antia, Pantzalis, and Park (2010; 2021) and Cassell et al. (2012), we measure the CEO career horizon as the linear combination of industry-adjusted CEO age and CEO tenure. As short-termism is more common among executives with a longer tenure or near retirement age, Antia, Pantzalis, and Park (2010) argue that considering these two variables together instead of separately looking at them provides a more accurate measure of the expected CEO decision horizon. Furthermore, CEO myopia increases when the expected decision horizon is shorter than the expected tenure. Thus, using industry-adjusted age and tenure provides a natural benchmark to gauge the expected CEO tenure by taking into account industry-specific demographic attributes of CEOs' characteristics and CEO succession norms (Jain, Jiang, and Mekhaimer, 2016). Specifically, we calculate the CEO decision horizon using the following equation:

$$CEO\ decision\ horizon_{i,t} = (\mathrm{Age}_{\mathrm{median,\ t}} - \mathrm{Age}_{\mathrm{i,t}}) + (\mathrm{Tenure}_{\mathrm{median,\ t}} - \mathrm{Tenure}_{\mathrm{i,t}}) \quad (1)$$

where, $Age_{median,t}$ and $Tenure_{median,t}$ are the median CEO age and tenure in our sample in year t. $Age_{i,t}$ and $Tenure_{i,t}$ are the CEO age and tenure of firm i at year t, where age is the CEO's age in years and tenure is the number of years since the incumbent CEO occupied the top executive's office. Following Korkeamäki, Liljeblom, and Pasternack (2017), we round the tenure to the closest full year. Both CEO age and tenure data are collected from Execucomp. By construction, the CEO decision horizon can take positive or negative values. A positive value would indicate the CEO is younger or new to their position compared to the typical CEO in that year, or both. Hence, the CEO is expected to have a longer career with the current bank. On the contrary, for older or long-serving CEOs, our measure of CEO decision horizon is likely to have negative values.

2.3. Control variables

Following Adhikari and Agrawal (2016), Ellul and Yerramilli (2013), and Serfling (2014), we control for bank size, profitability, income, asset and funding structure, and loan growth and quality that are likely to influence banks' riskiness. Specifically, we measure *Size* as the natural logarithm of the book value of total assets in million U.S. dollars and $Size^2$ as the orthogonal squared term of *Size*. *Profitability* is proxied by the return on assets (ROA). *Non-performing loans* is the ratio of non-performing loans to total loans, where non-performing assets are the loans that are in default or close to default and do not accrue interest. *Loans to assets* is measured as the percentage of net loans to total assets, and the *Deposit ratio* is the total customer's deposits scaled by the sum of customer deposits and bank borrowing, where borrowing incorporates short- and long-term debt and repurchase agreements. The ratio of Tier 1 or core capital to risk-weighted capital is used as the measure of *Capital ratio*. *Non-interest income* is the proportion of total income generated from non-interest-related activities such as fees and commissions, trading gains, and foreign exchange activities. Finally, the annual growth in total loans is used as the measure of *Loan growth*. All these financial variables are collected from Bloomberg.

In addition to financial variables, we control for board characteristics, as board monitoring has been found to affect CEO myopic behaviors (Faleye, Hoitash, and Hoitash, 2011). Following prior literature, we use board size, independence, gender diversity, and CEO duality to account for board monitoring quality and intensity (e.g., Coles, Daniel, and Naveen, 2008; Guthrie, Sokolowsky, and Wan, 2012; Pathan and Faff, 2013; Baselga-Pascual et al., 2018; Owen and Temesvary, 2019). *Board size* is measured as the natural logarithm of the number of board members, *Board independence* as the number of non-executive directors divided by the total number of board members, and *Board gender diversity* as the proportion of female directors in the board. *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zero otherwise. We collect *CEO duality* data from the Execucomp database and the rest of the board control variables from BoardEx.

2.4. Descriptive statistics and correlations

Table 1 reports the descriptive statistics of the variables used in our empirical analysis. Bank risk variables indicate that the average bank in our sample has a *Total risk* of about 36 % and a 27 % bank-specific *Idiosyncratic risk*. Therefore, the bank-specific idiosyncratic risk appears to be the main driver of the total risk for our sample banks. The *Tail risk* indicates an average bank is expected to lose about five percent during its worst-performing trading days. However, the maximum *Tail risk* shows the worst affected bank can lose up to 27 % of daily stock return on average over its five percent worst trading days. The average *Market beta* of 1.23 suggests our sample banks are systematically riskier than the aggregate market. The *ZScore* has a mean value of 60.36, with a standard deviation of 60.43. The main variable of interest *CEO decision horizon* has a mean value of -3.60 and ranges between -49 to 28 with a standard deviation of 13.06, indicating our sample CEOs are heterogeneous in terms of expected tenure. The average CEO age is about 58 years, and the average tenure is about 11 years[2].

The total assets of the sample banks range from about $533 million to $3.38 trillion, with a mean of about $94 billion. As the *size* variable is skewed to the right, we use the logarithm of bank *size* in the regression analysis. The average bank is financed with 13 % of Tier 1 capital, 85 % of funds come from deposits, and 63 % of its total assets are invested in traditional banking activities, i.e., in loans. The loans grow at a rate of 11 % per year. About 1 % of the total loans are classified as non-performing assets. An average bank earns 25 % of its yearly revenue from non-interest income sources and about a 1 % yearly return on its average assets. A typical bank has 12 board members. Overwhelmingly, 87 % of the board members are non-executive directors, with about 15 % being female. In most of our sample banks, CEOs also serve as the board chair.

[Insert Table 1 about here]

Table 2 reports the pairwise correlations between the main variables used in this paper. From the correlation table, we find a positive relationship between *CEO decision horizon* and *ZScoreInverse,* indicating CEOs with longer expected tenure in the office are associated with increased bank instability. Thus, younger CEOs or CEOs in their early years take more risks. The correlations between *CEO age* and bank risk variables, except for the *Market beta,* consistently show a negative association. Results suggest older CEOs reduce bank insolvency, idiosyncratic, and tail risk. However, a longer CEO tenure is significantly associated with a lower insolvency risk, and its impact is higher than that of CEO age. Even though we find a negative association between CEO tenure and market-based risk measures, they are not statistically significant.

All the primary control variables correlate significantly with one or multiple bank risk measures. *Bank size* negatively correlates with all risk measures except the *Market beta,* indicating as banks grow larger, associated bank-specific risk

[2] As less than 2.5% of our sample CEOs are female, we do not control for the CEO gender in our empirical analysis. However, under the robustness checks section, we provide a sub-sample analysis excluding the banks with female CEOs.

reduces. However, $Size^2$ has a diametrically opposite effect on bank riskiness, suggesting that large banks inherit more risks from their diverse operations instead of benefiting from the initial diversification effect associated with increased size. Among other control variables, *Profitability* and *Loan growth* consistently reduce all forms of bank risk while *Non-performing loans* increase all. Considering the correlations, *Profitability* has the highest mitigating effect on bank risk. Increased Tier 1 capital contribution reduces bank idiosyncratic and tail risk.

However, an increasing share of income generated from non-banking activities reduces idiosyncratic risk and increases systematic risk. Similarly, our asset structure proxy of *Loans to assets* indicates an increased share of traditional loan-making banking activities increases idiosyncratic risk but reduces systematic risk. Together, the results for *Loans to assets* and *Non-interest income* signify the asymmetric effect of diversification benefit in reducing bank-specific riskiness at the expense of increasing systematic risk. For the *Deposit ratio*, we only observe a marginal negative effect on bank insolvency risk.

Among the board characteristics variables, CEO duality consistently has a negative impact on bank riskiness, with the highest impact on idiosyncratic risk. While the CEO being the board chair reduces bank riskiness, other board monitoring variables, the board size, independence, and gender diversity, reduce idiosyncratic risk but increase systematic risk. *Board size* and *Board gender diversity* are also associated with lower bank insolvency risk. Overall, the significant association of the control variables with our risk measures demonstrates the importance of controlling for these variables in our regression analysis.

[Insert Table 2 about here]

3. Results

3.1. Univariate analyses

In the univariate analyses presented in Table 3, we document the means of five risk measures for the bottom and top terciles formed based on executive career horizons. The bank risk variable *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*. Also, the natural logarithms of *Total risk, Idiosyncratic risk,* and *Tail risk* are used here. The last column of the table shows the differences in risk measures between these two terciles. The t-statistics in parentheses are based on robust standard errors clustered by firms for all models. Like in the correlation matrix, univariate tests show CEOs with longer expected career horizons are associated with higher bank instability. Nevertheless, the CEO decision horizon is not associated with market-based risk measures in a statistically significant way.

[Insert Table 3 about here]

3.2. Regression analyses

We test the association between executive decision horizon and bank riskiness using the alternative versions of the following regression:

$$\text{Bank risk}_{i,t} = \alpha + \beta_1 \text{CEO decision horizon}_{i,t} + \gamma \text{Control variables}_{i,t} + \delta \text{Year}_t + \theta \text{Bank}_i + \varepsilon_{i,t} \quad (2)$$

where, the dependent variable *Bank risk*$_{j,t}$ is one of the five alternative bank risk measures for bank *i* at time *t*. The risk measures are (i) *ZScoreInverse*, (ii) *Total volatility*, (iii) *Idiosyncratic volatility,* (iv) *Market beta,* and (v) *Tail risk*. We use the natural logarithm of market-based risk measures except for the *Market beta*. All variables except the dummy variables are winsorized at the 1st and 99th percentiles to moderate the effects of extreme observations and outliers. All regressions include firm and year-fixed effects and robust standard errors adjusted for heteroskedasticity and clustered by firms. As profitability and capital ratio are used to calculate *ZScore*, we exclude them as control variables in the regression with *ZScoreInverse* as dependent variables.

The baseline regression results in Table 4 show that the CEO decision horizon is positively associated with all five risk measures. Three market-based risk measures, *Total risk*, *Idiosyncratic risk,* and *Tail risk,* are statistically significant at the conventional 1 % level. We do not find that the CEO's career horizon has any impact on bank systemic risk. Unlike the correlations and univariate analysis results, the regression results in Table 4 do not find any evidence that the CEO decision horizon is significantly associated with bank instability. The results suggest that the CEO's career horizon-driven risk-taking arises from bank-specific idiosyncratic risk-taking. Specifically, we find one standard deviation increase in *CEO decision horizon* from its average value increases the idiosyncratic and tail risk by about 5.22 %.

[Insert Table 4 about here]

We further analyze whether CEOs with low career horizon are associated with low risk-taking or CEOs with longer expected decision horizon takes excessive risks.

For this, we construct two dummy variables, *Bottom quartile* and *Top quartile*, that take the value of zero when the CEO decision horizon belongs to the bottom and top quartile of its distribution, respectively. CEOs in the top quartile represent a longer expected CEO tenure, while the CEOs belonging to the lower quartile have a shorter expected term in office. The tabulated results in Table 5 show CEOs with longer expected tenure are associated with higher risk-taking, particularly with *Tail risk*. On the contrary, CEOs in the bottom quartile of the CEO decision horizon distribution are negatively associated with bank risk-taking. We consistently find across the five employed risk measures that CEOs in the bottom quartile reduce more risk than their peers in the top quartile and increase bank risk. Our results suggest CEOs in the bottom quartile reduce *Idiosyncratic risk* by 7.4 %, while CEOs in the top quartile increase it by 4.7 %. Consistent with the finding in Table 4, we find that banks with CEOs that have a shorter expected tenure take lower total, idiosyncratic, and tail risks. In addition, there is weaker evidence that they reduce their bank's systematic risk.

[Insert Table 5 about here]

3.3 Endogeneity

This section concentrates on the possible endogeneity problem in our research design. Even though the use of an extended set of control variables and bank- and year-fixed effects take care of the omitted variables or unobservable factors correlated with CEO decision horizon and bank riskiness, concern remains about the endogenous sample selection and reverse causality. We address the endogenous sample selection concern by building a matched sample of banks using propensity score matching (PSM) based on one-to-one nearest neighbor matching without replacement. Specifically, we match the banks of CEOs in the top quartile of *CEO decision horizon* with banks having similar characteristics but a lower CEO decision horizon score.

Propensity score matched results in Table 6 are broadly consistent with our baseline results in Table 4. The estimated coefficients for the *CEO decision horizon* are positive and statistically significant in the regressions with *Total risk*, *Idiosyncratic risk,* and *Tail risk*. The magnitude of these coefficients is similar to those in Table 4, but the statistical significance is reduced. Moreover, insolvency and systematic risk are not affected by the CEO's decision horizon. Overall, propensity score-matched sample estimates support our earlier findings that CEOs with longer horizons take more risks.

[Insert Table 6 about here]

We address the rest of endogeneity and reverse causality-related concerns by implementing Lewbel's (2012) instrumental variable (IV) regression, which has been extensively used in recent economics and finance literature (see e.g., Emran and Hou, 2013; Cheng and Smyth, 2015; Gong, Xu, and Gong, 2018; Mavis et al., 2020; Hasan, Taylor, and Richardson, 2022). Lewbel's (2012) IV regression circumvents the weak or nonexistent instruments using a heteroscedastic covariance restriction that produces internal instrumental variables utilizing the product of the mean-centered existing exogenous variables and the residuals from the first-stage regression (see, e.g., Dimic, Fatmy, and Vähämaa, 2022).

Table 7 presents the results for the two-stage IV regressions. The table shows that the *CEO decision horizon* has a statistically significant relationship with total, idiosyncratic, and tail risk. The coefficient estimates for each of the three risk measures are significantly higher than our baseline results in Table 4. The Hansen J statistic also suggests that the models do not suffer from an overidentification problem. Overall, Lewbel's (2012) internal instruments used in the two-stage IV regressions confirm our baseline results.

[Insert Table 7 about here]

4. Robustness checks

This section presents several additional tests to ensure the robustness of our baseline findings from Table 4. Table 8 reports the estimated coefficients for the *CEO decision horizon* from 14 different regression setups presented as S1 – S14. The baseline estimates from Table 4 are summarized in the first row as specification S0. All the regressions include the full set of control variables in Table 4 unless specified otherwise, firm and year fixed effects, and robust standard errors clustered by firms.

4.1. Alternative definitions of the main variable of interest

We start the robustness test by introducing two alternative definitions of our main variable of interest. The primary estimates of the CEO career horizon include the median CEO age and tenure. Specification S1 uses the average age and tenure to estimate the *CEO decision horizon*. Virtually unchanged regression results indicate the use of mean, or median does not affect our main findings in Table 4. In the second alternative definition, we use the third quartile values of age and tenure to estimate the *CEO decision horizon* instead of the median values. Graham, Kim, and Leary (2020) define long-tenured CEOs as those with tenure larger than its third quartile. As the yearly third quartile of age ranges from 62 –

64 years in our sample, adjustment by the third quartile of age captures the effect of retirement (see, e.g., Wang and Yin, 2021; Aktas et al., 2021). Thus, the second alternative definition identifies the long-tenured or retirement-age CEOs in our sample. From specification S2, we find no change in our baseline results. The models S1 and S2 combinedly demonstrate that our baseline results remain robust at the alternative adjustment procedure of age and tenure.

In specifications S3 and S4, we separately investigate the effect of the two components of the CEO decision horizon: age and tenure. Using the median adjusted age in model S3, we find that increased career horizons for younger CEOs are associated with higher risk-taking. Interestingly, we find the age component affects the bank's systematic risk in addition to the other three market-based risk measures, and the magnitude of the impact on the idiosyncratic, systematic, and tail risks is about the same. For the median adjusted tenure, we observe from S4 that total, idiosyncratic, and tail risks are affected due to longer expected tenure. Tenure-driven risk-taking behavior has the highest impact on idiosyncratic risk and no effect on systematic risk. In general, the results show age and tenure-driven differences in risk-taking behavior.

4.2. Sub-samples of banks

In the following two robustness tests, we investigate whether our results remain unchanged when we constrain our definition of banks. Most of our firm-year observations, over 95%, come from the depository banking institutes with two-digit SIC code 60, and over 84% belong to commercial banks with the SIC code 6020. Thus, specification S5 presents the re-estimated baseline regression using the sub-sample of banks with two-digit SIC code 60. This sample includes only commercial and savings banks. The sample in S6 includes commercial banks only. The results remain similar to those in the baseline regression. Comparing the coefficients of the total risk for these two sets of banks demonstrates that the CEO's expected career horizon has a marginally higher impact on the commercial bank's risk-taking.

A general assumption about large banks deemed too-big-to-fail (TBTF) is that the government will bail them out if they get into trouble (Berger and Bouwman, 2013). The perceived implicit government guarantee incentivizes their executives to take excessive risk and becomes a potential concern whether these banks drive the main findings. To address this concern, specification S7 uses a sub-sample of banks excluding such big banks. We define banks with more than $100 billion in total assets as TBTF. Again, the results show that the CEO's career horizon is associated with total, idiosyncratic, and tail risk. The magnitude for total risk is lower than that for the baseline regression in S0, indicating smaller banks have a lower risk. Also, the results are statistically significant at the 5 % level, whereas in S0, they are significant at the 1 % level. Thus, excluding the large banks from the sample reduces the relations' sensitivity and strength.

We complement the TBTF analysis above by excluding the small banks from our analysis. Specification S8 presents the results for baseline regression excluding banks that belong to the bottom quartile of bank size distribution. Although the effect level remains the same for the idiosyncratic and tail risk as in S7, the magnitude and the statistical significance improve for the total risk. In addition, we also find systematic risk to be significantly related to the CEO's career horizon. While CEO decision horizons have a similar impact on idiosyncratic and tail risk across all bank sizes, our results suggest that the CEO's expected career horizon matters more in managing large banks' total and systematic risk.

A small proportion of our sample CEOs are female. Out of 164 individual CEOs in our sample, only four are female. Correspondingly, female CEOs represent only about two percent of our firm-year observations in our sample. This small representation of female CEOs is not suitable for introducing a gender dummy in the baseline regression analysis to control for the gender-based differences in bank risk-taking (see, e.g., Palvia, Vähämaa, and Vähämaa, 2015). Therefore, in specification S9, we present a sub-sample analysis excluding the female CEOs. The results remain virtually similar to the baseline results in S0. The coefficients for the systematic risk is marginally lower for all male sample despite being statistically insignificant.

4.3. Sub-sample periods

Next, we re-estimate the baseline regressions using two truncated sample periods to examine our results' sensitivity to the global financial crisis of 2007–08. Executives' risk-taking was pointed out as a key contributing factor to the outbreak of the crisis. Following the crisis, new rules and regulations, such as the 2010 Dodd-Frank Act, were introduced to limit executive risk-taking (Gande and Kalpathy, 2017). Because of this extra scrutiny, CEO's expected tenure-driven risk-taking may change after the crisis. For the earlier period from 2005-2008, we see from specification S11 that a longer career horizon is associated with higher insolvency risk, total, idiosyncratic, and tail risk. Comparing the results of S10 and S11, we find lower coefficients for the 2009-2020 sample period for all risk measures, indicating the crisis has lessened the expected tenure-driven CEO risk-taking. Also, bank insolvency risk is no longer associated with the CEO's career horizon. Moreover, we observe a CEO's decision horizon is weakly associated with idiosyncratic and systematic risk. Thus, the crisis has changed the nature of the relationship between CEO decision horizon and bank riskiness.

4.4. Alternative model specification

In our regression analysis, we consistently used the bank and year fixed-effects models which are best suited to capture unobserved heterogeneity across banks when the variable of interest has substantial variation over time. Considering the limited time series variation of our main variable of interest *CEO decision horizon*, we employ a random-effects model. The stronger assumptions about the error correlation structure under this model allow for estimating the effect of time-invariant covariates in panel data. The results in S12 show the bank's total, idiosyncratic, and tail risk associated with the CEO's decision horizon. Compared to the coefficients in S0, estimated coefficients from the random effect model are about half in size, and the statistical significance drops to 5% level from 1% level. Even though the magnitude and statistical significance of the coefficients decrease, our main results remain in line with the baseline findings.

To ascertain that the results are not influenced by spurious correlations between the independent variables, specifications S13 and S14 present coefficient estimates using a shorter set of control variables. Specifically, in S13, we drop four of our board characteristics variables: *Board size, Board independence, Board gender diversity,* and *CEO duality*. In addition to the board-specific control variables, we further reduce the number of bank-specific controls in S14. The remaining variables are S*ize*, *Size*^{2}, *Profitability*, *Loans to assets*, C*apital ratio,* and *Loan growth*. We find that the results remain the same for idiosyncratic and tail risks. However, the magnitude of the coefficients for the total risk decreases marginally. Overall, the curtailed set of control variables also confirms our findings.

[Insert Table 8 about here]

5. CEO myopia and bank policies

In this section, we focus on examining whether the CEO's decision horizon is associated with observable differences in bank policies. Following prior literature, we estimate Equation (2) to study CEO compensation, investments, and funding policy as potential channels that propagate executive career horizon-driven bank risk-taking. Specifically, for each policy variable, we estimate the following equation:

$$\text{Bank policy}_{i,t} = \alpha + \beta_1 \text{CEO decision horizon}_{i,t} + \gamma \text{Control variables}_{i,t} + \delta \text{Year}_t + \theta \text{Bank}_i + \varepsilon_{i,t} \quad (3)$$

First, we check whether CEO pay-performance sensitivity (*Delta*) and risk-taking incentives (*Vega*) are related to the CEO decision horizon[3]. Following Core and Guay (2002) and Coles, Daniel, and Naveen (2006), we define executive *Delta* as the dollar change (in $000s) in an executive's bank-specific wealth due to one percentage change in stock price and *Vega* as the change in an executive's bank-specific option holdings in thousand dollars for one percentage change in bank's stock return volatility. In the regression analysis, the natural logarithm of the *Delta* and *Vega* are used.

Table 9 shows that CEO *Delta* is positively associated with the CEO's expected decision horizon, indicating younger or newly joined CEOs have a lower pay-performance sensitivity. In contrast, the same group of executives has higher risk-taking incentives. Despite *Delta* being statistically significant, the relationship with *Vega* is insignificant. Prior studies find executive pay-performance sensitivity can mitigate bank risk to some extent (Gande and Kalpathy, 2017). As the executives have a higher concentration of firm-specific wealth, they become exposed to higher risk than a diversified outside investor and pursue safer strategies to reduce their undiversified personal risk. Thus, the higher *Delta* can inspire older or long-tenured CEOs to take less risk.

In contrast, a higher CEO *Vega* is found to lead to riskier investment policies, and inversely riskier banks adopt compensation structures embedded with higher *Vega* to incentivize executive risk-taking (Bai and Elyasiani, 2013). However, the change in CEO compensation structure following the global financial crisis, specifically the reduced use of options grants, can contribute to lower executive risk-taking incentives (Ahmed, Davydov, Vähämaa, 2022). This may also explain why CEO *Vega* is not significantly associated with CEO's decision horizon. Overall, we find executive compensation as a potential policy channel that explains the relationship between CEO decision horizon and bank risk-taking.

Next, we study how bank leverage and non-deposit funding ratios are associated with CEO's expected tenure in office. Owners' limited liability in a highly leveraged publicly listed firm can lead to excessive risks at the expense of the creditors (Jensen and Meckling, 1976; Galai and Masulis, 1976). Banks being highly leveraged severely suffered from this problem. For this reason, we test if the bank leverage is associated with the CEO decision horizon. We measure *Leverage* as the

[3] We thank Lalitha Naveen for sharing their programs for computing delta and vega.

sum of long and short-term debt divided by the book value of assets. The result from Table 9 shows no significant relation between executives' career horizon and bank leverage, indicating the bank ownership structure does not have any expected tenure-related effect on managerial risk-taking.

Unlike customer deposits, short-term non-deposit funding is not covered by deposit insurance. Thus, during a stressed period, creditors have the incentive to withdraw their financing more rapidly than depositors and cause a potential liquidity crisis or a bank run. Therefore, over-reliance on short-term non-deposits can reduce bank stability (Demirguc-Kunt and Huizinga, 2010). Following Demirguc-Kunt and Huizinga (2010), we define *Non-deposit funding* as short-term liability divided by the total asset in excess of the stockholder's equity, where the short-term liability is obtained by subtracting total stockholders' equity, long-term debt, and total customers' deposits from total assets. Using the logarithm of the ratios in the regression analysis, we find CEO's career horizon is not related to the funding structure. Thus, the bank funding structure is less likely to moderate the relationship between CEO's career horizon and bank risk-taking.

We follow on to investigate two risky bank policies: non-interest income share and loan growth. *Non-interest income* is the proportion of total income generated from non-interest-related activities such as fees and commissions, trading gains, and foreign exchange activities. Prior studies find that a higher degree of involvement in non-traditional banking activities makes banks riskier because interest income is more stable than other income sources such as investment banking, venture capital, and trading activities (see, e.g., DeYoung and Roland, 2001; Stiroh and Rumble, 2006; and Brunnermeier, Dong, and Palia, 2020). We do not find any significant association between non-interest income share and CEO decision horizon.

Bank asset growth significantly contributes to bank insolvency (Rossi, 2010), and banks that grew more rapidly until 2006 performed more poorly in the financial crisis of 2007–08 (Fahlenbrach, Prilmeier and Stulz, 2012). Adhiraki and Agrawal (2016) argue that riskier strategies adopted by banks to maintain higher growth levels offset the diversification benefits associated with increased bank size. Measuring *Loan growth* as the annual growth in total loans, we find a significant positive relationship between bank risk and CEO career horizon. Thus, CEOs with a longer expected tenure in the office pursue higher loan growth.

Finally, we study the link between banks' asset quality and CEO decision horizon. For this, we use write-downs and risk-weighted assets. *Write-downs* is the provision for loan losses scaled by total loans, and *Risk-weighted assets* is banks' risk-weighted assets calculated by weighting each type of asset relative to its risk divided by total assets. The *Write-downs* is the expected losses based on the bank's assessment, while *RWA* indicates a bank's relative riskiness deriving from its asset classes from the regulator's perspective. Table 9 shows CEO's career horizon has no significant impact on *Write-downs* and is negatively related to the risk-weighted assets, suggesting banks with older or long-tenured CEOs pursue more risky business ventures. The result for the *Loan growth* and *Risk-weighted assets* shows CEOs with longer and shorter horizons pursue risky policies differently. While CEOs with longer expected tenures ultimately increase bank risk levels through their growth strategies, their peers with shorter expected tenures do not contemporaneously affect bank risk-level through their actions.

[Insert Table 9 about here]

6. Conclusion

This paper investigates the extent of the relationship between the expected CEO career horizon and firm risk-taking in the context of the banking industry. Executives' decision horizons are limited to their expected tenure. On the contrary, firms' longevity goes beyond the CEOs' career horizon. This mismatch of decision horizons between executives and firms gives rise to an agency problem where CEOs tend to adopt a more myopic view in their decision-making. A myopic CEO can opt out of risky ventures in favor of less risky investment opportunities to smoothen firms' riskiness for the remainder of his/her expected tenure. Because of this myopic behavior, CEOs with longer expected career horizons are likely to be positively associated with bank risk-taking.

Using the data of large U.S. banks belonging to the S&P 1500 index over the sample period 2005-2020, this study finds that the CEO decision horizon is positively associated with market-based risk measures total, idiosyncratic, and tail risk. Further analysis shows the positive relationship is due to the CEOs with the shortest expected tenure significantly reducing bank risk-taking, which is more in magnitude than their counterparts with longer expected tenure increase bank risk. We also find weaker evidence that CEOs in the top and bottom quartile of expected decision horizon respectively increase and decrease the bank's systematic risk. In addition, the level of risk reduction from older or long-tenured CEOs is higher than their younger or newly appointed counterparts' contribution to risk-taking. In general, our results suggest that shorter expected tenure in the office fosters myopic behavior and that longer expected tenure increases bank risk-taking.

Despite the increase of market-based risk measures with the expected CEO tenure, our regression analysis does not find any evidence that CEO's expected career horizon has any impact on bank insolvency risk. Furthermore, when we study the effect of age and tenure separately, we find both the increase of age and tenure increase myopic behavior. However, the magnitude and pattern of impact vary. CEO age affects both bank-specific idiosyncratic and systematic risk, whereas tenure-driven risk-taking is limited to idiosyncratic risk. The robustness test results suggest that the CEO's expected career horizon matters more in managing large banks' total and systematic risk than smaller banks. Following the global financial crisis of 2007–08, the expected career horizon-driven risk-taking has decreased. We also find CEO pay-performance sensitivity and bank loan growth as the possible policy channel that propagates the expected tenure-driven bank risk-taking.

Overall, we find CEO's expected tenure has an important impact on bank risk-taking. The results of this paper are particularly important for the CEO recruitment process to find a suitable candidate for the top executive position, given the bank's characteristics. The results also help bank stakeholders like shareholders and competitors understand the changes in strategies over a CEO's tenure. Finally, it will enable supervisory bodies to fine-tune their supervisory focuses and activities over the different stages of a CEO's tenure to improve the stability and soundness of the financial institutions as well as the banking industry.

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Table 1: Descriptive statistics

	Mean	Std. Dev.	Min	25th	Median	75th	Max	Obs.
<u>*Bank risk measures:*</u>								
ZScore	60.36	60.43	-1.38	21.09	43.64	80.91	763.46	1506
Total risk	0.36	0.22	0.10	0.22	0.27	0.41	1.60	1535
Idiosyncratic risk	0.27	0.18	0.09	0.17	0.21	0.30	1.39	1535
Market beta	1.23	0.41	-0.07	0.97	1.19	1.43	3.30	1535
Tail risk	0.05	0.03	0.01	0.03	0.04	0.06	0.27	1535
<u>*Main variables of interest:*</u>								
CEO decision horizon	-3.60	13.06	-49.00	-10.00	-1.00	5.00	28.00	1535
CEO age	58.56	7.31	34.00	54.00	58.00	63.00	83.00	1535
CEO tenure	10.85	8.16	1.00	5.00	9.00	15.00	42.00	1535
<u>*Bank- specific control variables:*</u>								
Total assets	94217	350525	533	5324	10763	26822	3384757	1535
Profitability	0.01	0.01	-0.15	0.01	0.01	0.01	0.16	1535
Non-performing loans	0.01	0.02	0.00	0.00	0.01	0.01	0.40	1535
Loans to assets	0.63	0.16	0.01	0.58	0.67	0.74	0.95	1535
Deposit ratio	0.85	0.12	0.12	0.81	0.88	0.93	1.00	1535
Capital ratio	0.13	0.05	0.05	0.11	0.12	0.14	0.97	1535
Non-interest income	0.25	0.17	-0.68	0.13	0.22	0.32	1.00	1535
Loan growth	0.11	0.20	-0.54	0.01	0.07	0.15	2.02	1535
<u>*Board-specific control variables*</u>								
Directors numbers	11.72	2.73	5.00	10.00	12.00	13.00	22.00	1514
Board independence	0.87	0.07	0.57	0.83	0.89	0.92	1.00	1502
Board gender diversity	0.15	0.10	0.00	0.08	0.14	0.21	0.50	1514
CEO duality	0.58	0.49	0.00	0.00	1.00	1.00	1.00	1535

The table reports summary statistics of the key variables used in our empirical analysis. Five bank risk variables used here are: *ZScore* is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. *CEO age* is the incumbent chief executive's age in years, and *CEO tenure* is the number of years since she occupied the office. The bank-specific control variables are defined as follows: *Total assets* is the bank's total assets in million US dollars, *Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Directors numbers* is the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 2: Correlations

	ZscoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Zscore					
Total risk	0.35***				
Idiosyncratic risk	0.39***	0.96***			
Market beta	0.11***	0.44***	0.34***		
Tail risk	0.33***	0.98***	0.94***	0.43***	
CEO decision horizon	0.09***	0.00	0.00	0.01	0.00
CEO age	-0.12***	-0.09***	-0.09***	-0.03	-0.08***
CEO tenure	-0.16***	-0.03	-0.02	-0.01	-0.02
Size	-0.06**	-0.13***	-0.24***	0.21***	-0.09***
Size^2	0.12***	0.10***	0.12***	-0.13***	0.08***
Profitability	-0.32***	-0.35***	-0.40***	-0.17***	-0.35***
Non-performing loans	0.40***	0.44***	0.45***	0.23***	0.43***
Loans to assets	0.01	0.01	0.10***	-0.07***	0.00
Deposit ratio	-0.04*	-0.01	0.03	0.01	-0.01
Capital ratio	0.02	-0.08***	-0.12***	-0.03	-0.08***
Non-interest income	0.06**	-0.04	-0.12***	0.11***	-0.03
Loan growth	-0.11***	-0.14***	-0.10***	-0.12***	-0.15***
Directors numbers	-0.11***	-0.03	-0.12***	0.18***	-0.02
Board independence	0.01	-0.04	-0.08***	0.14***	-0.03
Board gender diversity	-0.04*	-0.10***	-0.16***	0.08***	-0.08***
CEO duality	-0.02	-0.08***	-0.11***	-0.03	-0.08***

The table reports pairwise correlations for the variables used in the empirical analysis. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. *CEO age* is the incumbent chief executive's age in years, and *CEO tenure* is the number of years since she occupied the office. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, *Size*^{2} is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 3: Univariate tests

	Low	Middle	High	High - Low	t-stat
ZscoreInverse	-3.73	-3.76	-3.46	0.27**	2.03
Total risk	-1.14	-1.22	-1.14	0.00	-0.03
Idiosyncratic risk	-1.42	-1.48	-1.41	0.01	0.20
Market beta	1.24	1.19	1.25	0.02	0.35
Tail risk	-3.10	-3.18	-3.11	-0.01	-0.19

This table reports the mean values of the five bank risk measures for the top and bottom terciles formed based on CEO decision horizon scores and the difference in the means for the low and high terciles. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4: CEO decision horizon and bank risk-taking

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Main variable of interest:					
CEO decision horizon	0.005	0.004***	0.004***	0.003	0.004***
	(0.67)	(2.83)	(2.78)	(1.12)	(2.78)
Bank-specific control variables:					
Size	-0.481*	0.149***	0.078	0.306***	0.208***
	(-1.70)	(3.31)	(1.50)	(4.43)	(4.34)
$Size^2$	-0.164	0.020	0.042	-0.106**	0.028
	(-1.46)	(0.72)	(1.30)	(-2.61)	(0.97)
Profitability		-4.483***	-6.340***	-4.198**	-4.957***
		(-3.97)	(-5.11)	(-2.58)	(-4.03)
Non-performing loans	20.824***	5.965***	7.396***	3.223***	6.515***
	(5.38)	(7.34)	(7.56)	(2.64)	(7.72)
Loans to assets	0.407	0.146	0.124	0.180	0.117
	(0.85)	(0.90)	(0.78)	(0.95)	(0.69)
Deposit ratio	0.193	0.479***	0.441***	0.581***	0.491***
	(0.40)	(3.57)	(3.11)	(2.93)	(3.45)
Capital ratio		-0.053	-0.082	0.373	-0.038
		(-0.19)	(-0.27)	(0.96)	(-0.14)
Non-interest income	-0.116	0.136	0.173	0.034	0.167
	(-0.21)	(1.12)	(1.15)	(0.18)	(1.28)
Loan growth	0.110	-0.071**	-0.044	-0.073	-0.109***
	(0.84)	(-2.11)	(-1.21)	(-1.43)	(-2.86)
Board-specific control variables:					
Board size	-0.094	0.019	0.014	-0.002	0.024
	(-0.36)	(0.41)	(0.28)	(-0.02)	(0.46)
Board independence	0.478	-0.178	-0.285*	0.083	-0.227
	(0.56)	(-1.12)	(-1.69)	(0.32)	(-1.32)
Board gender diversity	-0.148	-0.152	-0.254**	0.099	-0.153
	(-0.26)	(-1.40)	(-2.05)	(0.65)	(-1.40)
CEO duality	0.247**	0.008	0.004	-0.007	-0.008
	(2.26)	(0.31)	(0.15)	(-0.20)	(-0.29)
Constant	-5.455***	-2.115***	-2.221***	0.393	-4.102***
	(-5.40)	(-9.90)	(-10.12)	(1.09)	(-18.55)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1475	1502	1502	1502	1502
Adjusted R^2	0.682	0.881	0.853	0.656	0.869

This table reports the baseline regression results using Equation (1) for our alternative bank risk measures. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, *Size*^{2} is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5: CEO decision horizon quartiles and bank risk-taking

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Main variable of interest:					
Bottom quartile	0.166	-0.063***	-0.074***	-0.058*	-0.069***
	(1.24)	(-3.12)	(-2.96)	(-1.83)	(-3.36)
Top quartile	0.097	0.044*	0.047*	0.045*	0.050**
	(1.04)	(1.83)	(1.75)	(1.76)	(1.99)
Bank-specific control variables:					
Size	-0.535*	0.148***	0.076	0.306***	0.206***
	(-1.83)	(3.31)	(1.45)	(4.64)	(4.34)
Size^2	-0.180	0.021	0.042	-0.106***	0.028
	(-1.60)	(0.73)	(1.30)	(-2.64)	(0.98)
Profitability		-4.546***	-6.423***	-4.235**	-5.020***
		(-4.05)	(-5.20)	(-2.60)	(-4.09)
Non-performing loans	20.989***	5.923***	7.344***	3.183**	6.470***
	(5.41)	(7.29)	(7.48)	(2.61)	(7.57)
Loans to assets	0.515	0.140	0.116	0.175	0.111
	(1.10)	(0.86)	(0.72)	(0.93)	(0.66)
Deposit ratio	0.092	0.477***	0.441***	0.581***	0.489***
	(0.19)	(3.55)	(3.08)	(2.94)	(3.45)
Capital ratio		-0.079	-0.113	0.350	-0.066
		(-0.28)	(-0.39)	(0.88)	(-0.24)
Non-interest income	-0.159	0.126	0.162	0.026	0.156
	(-0.29)	(1.05)	(1.09)	(0.13)	(1.19)
Loan growth	0.130	-0.073**	-0.046	-0.076	-0.111***
	(1.02)	(-2.17)	(-1.26)	(-1.48)	(-2.93)
Board-specific control variables:					
Board size	-0.058	0.024	0.020	0.001	0.029
	(-0.22)	(0.51)	(0.40)	(0.01)	(0.56)
Board independence	0.615	-0.182	-0.290*	0.072	-0.232
	(0.75)	(-1.14)	(-1.69)	(0.28)	(-1.35)
Board gender diversity	-0.178	-0.144	-0.246*	0.107	-0.144
	(-0.32)	(-1.33)	(-1.97)	(0.71)	(-1.31)
CEO duality	0.241**	0.005	0.000	-0.008	-0.011
	(2.31)	(0.20)	(0.01)	(-0.23)	(-0.42)
Constant	-5.578***	-2.104***	-2.205***	0.395	-4.093***
	(-5.52)	(-9.92)	(-10.18)	(1.10)	(-18.57)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1475	1502	1502	1502	1502
Adjusted R^2	0.684	0.882	0.854	0.658	0.870

This table reports the differences in bank risk-taking for CEOs with the longest and the shortest expected decision horizon. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variables of interest, *Bottom quartile,* and the *Top quartile,* are dummy variables that take the value of one when *CEO decision horizon* belong to the bottom and top quartiles of its distribution, where *decision horizon* is the sum of the median-adjusted CEO tenure and age. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, $Size^2$ is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 6: Propensity score matching

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Main variable of interest:					
CEO decision horizon	0.006	0.004**	0.004**	0.003	0.004*
	(0.82)	(2.12)	(2.29)	(0.70)	(1.96)
Bank-specific control variables:					
Size	-0.583	0.236***	0.179***	0.369***	0.275***
	(-1.59)	(3.71)	(2.65)	(3.27)	(4.04)
Size^2	-0.153	0.075*	0.104**	-0.055	0.074*
	(-0.79)	(1.93)	(2.58)	(-0.87)	(1.85)
Profitability		-4.297***	-6.118***	-2.471	-4.348***
		(-3.17)	(-4.11)	(-1.41)	(-2.80)
Non-performing loans	15.492***	5.335***	6.764***	4.411***	6.129***
	(3.56)	(4.70)	(4.90)	(4.07)	(5.15)
Loans to assets	-0.309	0.258	0.222	0.305	0.275
	(-0.49)	(0.96)	(0.81)	(1.02)	(1.02)
Deposit ratio	-0.189	0.477***	0.465***	0.521**	0.540***
	(-0.32)	(2.98)	(2.65)	(2.04)	(3.00)
Capital ratio		-0.142	-0.264	0.084	-0.184
		(-0.33)	(-0.54)	(0.19)	(-0.43)
Non-interest income	-0.377	0.183	0.309	-0.228	0.100
	(-0.51)	(1.07)	(1.53)	(-0.92)	(0.55)
Loan growth	0.302	-0.122**	-0.090*	-0.122*	-0.166***
	(1.59)	(-2.52)	(-1.71)	(-1.66)	(-2.92)
Board-specific control variables:					
Board size	-0.082	0.011	0.019	-0.070	0.025
	(-0.21)	(0.14)	(0.22)	(-0.56)	(0.31)
Board independence	0.441	-0.279	-0.263	-0.128	-0.327
	(0.33)	(-1.14)	(-0.98)	(-0.35)	(-1.16)
Board gender diversity	-0.144	-0.167	-0.250	0.066	-0.230
	(-0.16)	(-0.81)	(-1.04)	(0.29)	(-1.07)
CEO duality	0.216	0.058	0.060	0.050	0.045
	(1.47)	(1.31)	(1.24)	(0.81)	(1.09)
Constant	-4.536***	-2.106***	-2.416***	0.845	-4.171***
	(-3.11)	(-6.88)	(-7.60)	(1.51)	(-13.01)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	736	754	754	754	754

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Adjusted R^2	0.704	0.850	0.823	0.644	0.838

The table reports the estimates of Equation (1) based on a propensity score matched sample of banks. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, $Size^2$ is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 7: Instrumental variable regressions

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Main variable of interest:					
CEO decision horizon	-0.001	0.012***	0.010***	0.001	0.010**
	(-0.10)	(3.72)	(3.30)	(0.08)	(2.28)
Bank-specific control variables:					
Size	-0.500*	0.070	0.016	0.170**	0.095*
	(-1.87)	(1.37)	(0.34)	(2.07)	(1.70)
Size^2	-0.168	0.002	0.021	-0.110**	0.004
	(-1.58)	(0.09)	(0.76)	(-2.41)	(0.16)
Profitability		-4.339***	-6.259***	-4.317***	-4.766***
		(-4.24)	(-5.53)	(-2.81)	(-4.18)
Non-performing loans	20.896***	6.060***	7.474***	3.376***	6.712***
	(5.73)	(7.93)	(8.22)	(2.86)	(8.31)
Loans to assets	0.414	0.140	0.129	0.178	0.109
	(0.91)	(0.99)	(0.93)	(1.04)	(0.72)
Deposit ratio	0.169	0.460***	0.428***	0.470**	0.438***
	(0.36)	(3.58)	(3.27)	(2.21)	(3.07)
Capital ratio		0.008	-0.047	0.486	0.009
		(0.03)	(-0.16)	(1.60)	(0.03)
Non-interest income	-0.132	0.054	0.084	-0.024	0.045
	(-0.25)	(0.48)	(0.65)	(-0.14)	(0.37)
Loan growth	0.124	-0.064*	-0.034	-0.046	-0.094**
	(1.01)	(-1.91)	(-1.00)	(-0.86)	(-2.48)
Board-specific control variables:					
Board size	-0.076	0.001	0.008	-0.007	0.008
	(-0.29)	(0.03)	(0.16)	(-0.08)	(0.15)
Board independence	0.549	-0.332**	-0.383**	-0.066	-0.367**
	(0.72)	(-2.15)	(-2.52)	(-0.27)	(-2.23)
Board gender diversity	-0.150	-0.207*	-0.285**	-0.030	-0.243**
	(-0.28)	(-1.92)	(-2.37)	(-0.21)	(-2.22)
CEO duality	0.227**	0.037	0.028	-0.022	0.016
	(2.13)	(1.28)	(0.96)	(-0.55)	(0.55)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	1475	1502	1502	1502	1502

	ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
Adjusted R^2	0.360	0.846	0.799	0.534	0.842
Hansen J-statistic	31.177	25.552	27.459	24.932	28.207

This table reports Lewbel's (2012) heteroscedasticity-based instrumental variable regression results. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, *$Size^2$* is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 8: Robustness tests

		ZScoreInverse	Total risk	Idiosyncratic risk	Market beta	Tail risk
S0	Baseline results from Table 4	0.005	0.004***	0.004***	0.003	0.004***
		(0.67)	(2.83)	(2.78)	(1.12)	(2.78)
S1	Alternative definition 1	0.005	0.004***	0.004***	0.003	0.004***
		(0.67)	(2.82)	(2.76)	(1.11)	(2.75)
S2	Alternative definition 2	0.005	0.004***	0.004***	0.003	0.004***
		(0.68)	(2.85)	(2.78)	(1.12)	(2.79)
S3	Age component	-0.000	0.006**	0.007**	0.007**	0.007**
		(-0.04)	(2.46)	(2.13)	(2.01)	(2.48)
S4	Tenure component	0.013	0.006***	0.008***	0.002	0.006**
		(1.09)	(2.65)	(2.99)	(0.50)	(2.49)
S5	Depository financial institutes	0.005	0.003***	0.004***	0.003	0.004***
		(0.68)	(2.73)	(2.63)	(1.17)	(2.67)
S6	Commercial banks	0.006	0.004***	0.004***	0.003	0.004**
		(0.84)	(2.75)	(2.64)	(1.17)	(2.41)
S7	Excluding TBTF banks	0.004	0.003**	0.004**	0.003	0.004**
		(0.56)	(2.48)	(2.29)	(1.10)	(2.50)
S8	Excluding small banks	-0.003	0.004***	0.004**	0.006***	0.004**
		(-0.31)	(2.86)	(2.20)	(3.60)	(2.60)
S9	Excluding female CEOs	0.004	0.004***	0.004***	0.002	0.004***
		(0.62)	(2.77)	(2.84)	(0.97)	(2.63)
S10	Sub-sample: 2009 - 2020	0.008	0.003**	0.003*	0.003*	0.003**
		(1.09)	(2.19)	(1.75)	(1.71)	(2.09)
S11	Sub-sample: 2005 - 2008	0.107*	0.047***	0.058***	0.046	0.056**
		(1.73)	(3.29)	(3.47)	(1.65)	(2.37)
S12	Random effects model	0.006	0.002**	0.002**	0.001	0.002**
		(1.20)	(2.21)	(2.54)	(0.43)	(1.99)
S13	Excluding board controls	0.003	0.003**	0.004**	0.002	0.004***
		(0.35)	(2.45)	(2.47)	(1.03)	(2.72)
S14	Constrained controls	0.004	0.003**	0.004**	0.002	0.004***
		(0.48)	(2.34)	(2.40)	(1.00)	(2.66)

The table reports the estimated coefficients for the *CEO decision horizon* from 10 different regression setups. Specification S0 presents the baseline estimates from Table 4. Five bank risk variables used here are: *ZScoreInverse* is the inverse of the natural logarithm of *ZScore*, which is the insolvency risk calculated by adding the bank's return on assets (ROA) to its capital to assets ratio (CAR) and dividing the sum by the standard deviation of ROA, *Total risk* is the natural logarithm of the annualized standard deviation of daily stock return over the fiscal-year, *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression over the fiscal-year, *Market beta* is the coefficient of the market index from the market model, and *Tail risk* is the natural logarithm of the average of five percent worst daily returns over the fiscal year multiplied by -1. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. All the variables except the dummy variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 9: CEO decision horizon and bank operating strategies

	Delta	Vega	Non-deposit funding	Leverage	Non-interest income	Loan growth	Write-downs	Risk-weighted assets
Main variable of interest:								
CEO decision horizon	-0.021***	0.045	-0.004	-0.004	-0.000	0.002***	-0.000	-0.001**
	(-3.28)	(1.48)	(-1.12)	(-1.16)	(-0.49)	(2.66)	(-1.12)	(-2.01)
Bank-specific control variables:								
Size	0.625**	1.459**	0.166	-0.161	-0.078**	0.102*	0.003**	-0.020
	(2.30)	(2.17)	(0.80)	(-1.05)	(-2.38)	(1.95)	(2.43)	(-0.70)
$Size^2$	-0.255**	0.435	0.068	0.035	-0.030*	-0.018	-0.001	-0.017
	(-2.05)	(1.17)	(0.60)	(0.58)	(-1.69)	(-0.64)	(-1.37)	(-1.38)
Profitability	17.916***	15.860	-2.807	-2.026	1.914***	0.910	-0.584***	0.210
	(4.58)	(1.65)	(-1.17)	(-1.20)	(3.33)	(0.86)	(-9.26)	(0.66)
Non-performing loans	-10.296***	-27.816***	-1.225	0.770	0.570*	-2.991***	0.183***	0.206
	(-2.87)	(-2.93)	(-0.57)	(0.50)	(1.87)	(-4.46)	(4.18)	(0.74)
Loans to assets	0.740	-0.430	0.588	1.235***	-0.096*	0.191*	0.014***	0.731***
	(1.14)	(-0.28)	(1.21)	(3.18)	(-1.87)	(1.94)	(2.95)	(10.23)
Deposit ratio	0.025	1.053	-3.633***	-6.552***	0.096	-0.158	0.010*	-0.027
	(0.04)	(0.78)	(-5.34)	(-12.97)	(1.32)	(-1.10)	(1.85)	(-0.27)
Capital ratio	0.400	-5.702	0.747	-0.402	-0.097	-0.250	0.024***	-0.380***
	(0.30)	(-1.36)	(0.89)	(-0.83)	(-0.81)	(-1.05)	(3.48)	(-3.10)
Non-interest income	0.076	-1.556	0.408	-0.227		0.296**	0.016***	0.041
	(0.11)	(-0.79)	(0.75)	(-0.78)		(2.51)	(4.58)	(0.50)
Loan growth	-0.069	-0.283	0.087	0.042	0.033**		-0.003**	-0.029***
	(-0.45)	(-0.55)	(0.78)	(0.78)	(2.26)		(-2.61)	(-2.62)
Board-specific control variables:								
Board size	0.088	1.283	0.052	-0.016	-0.056***	0.168***	0.002	0.008
	(0.34)	(1.59)	(0.31)	(-0.18)	(-2.71)	(3.35)	(1.44)	(0.36)

	Delta	Vega	Non-deposit funding	Leverage	Non-interest income	Loan growth	Write-downs	Risk-weighted assets
Board independence	-1.404	1.340	-0.004	0.154	0.034	-0.062	-0.002	0.069
	(-1.01)	(0.35)	(-0.01)	(0.46)	(0.35)	(-0.35)	(-0.36)	(0.94)
Board gender diversity	-0.027	1.064	0.984***	0.291	-0.054	-0.134	-0.003	-0.020
	(-0.04)	(0.53)	(2.90)	(1.04)	(-1.12)	(-1.45)	(-0.99)	(-0.39)
CEO duality	0.116	0.212	0.016	0.018	-0.005	-0.004	-0.000	-0.003
	(0.91)	(0.56)	(0.22)	(0.44)	(-0.44)	(-0.25)	(-0.47)	(-0.36)
Constant	5.865***	-1.382	0.540	2.805***	0.309***	-0.298	-0.013*	0.166
	(4.06)	(-0.31)	(0.57)	(4.93)	(3.12)	(-1.37)	(-1.93)	(1.35)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1171	924	1502	1502	1502	1502	1490	1469
Adjusted R^2	0.891	0.694	0.758	0.897	0.900	0.263	0.796	0.819

This table reports the changes in bank strategies with the change in CEO decision horizon. The dependent variables are define as: *Delta* is the natural logarithm of the dollar change in thousand dollars in an executive's bank-specific wealth due to one percentage change in stock price, *Vega* is the logarithm of the change in an executive's bank-specific option holdings in thousand dollars for one percentage change in bank's stock return volatility, *Leverage* is the natural logarithm of the sum of long and short-term debt divided by the book value of assets, *Non-deposit funding* is the natural logarithm of the short-term liability divided by the total asset in excess of the stockholder's equity, where the short-term liability is obtained by subtracting total stockholders' equity, long-term debt, and total customers' deposits from total assets, *Non-interest income* is the proportion of total income generated from the non-interest related activities such as fees and commissions, trading gains, and foreign exchange activities, *Loan growth* as the annual growth in total loans, *Write-downs* is the provision for loan losses scaled by total loans, and *Risk-weighted assets* is banks' risk-weighted assets calculated by weighting each type of asset relative to its risk divided by total assets. The main variable of interest *CEO decision horizon* is the sum of the median-adjusted CEO tenure and age. The bank-specific control variables are defined as follows: *Size* is the natural logarithm of total assets, $Size^2$ is the orthogonal squared term of *Size, Profitability* is the return on assets (ROA), *Non-performing loans* is the ratio of non-performing loans to total loans, *Loans to assets* is the percentage of net loans to total assets, *Deposit ratio* is the total customer deposits scaled by the sum of total deposits and short- and long-term debt, *Capital ratio* is the ratio of tier 1 or core capital to risk-weighted, *Non-interest income* is the proportion of total income generated from the non-interest related activities, and *Loan growth* is the annual growth in total loans. The board-specific control variables are: *Board size* is the natural logarithm of the number of board members, *Board independence* is the number of non-executive directors divided by the total number of board members, *Board gender diversity* is the proportion of female directors on the board, and *CEO duality* is a dummy variable that takes the value of one when the CEO is also the board chair and zeroes otherwise. All the variables except the dummy variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors clustered by firms for all models. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.