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CEO CHARACTERISTICS AND BANK RISK-TAKING

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ABSTRACT

This thesis relies on a sample of 121 international commercial listed banks from 28 countries over 2014-2018 to examine the associations between observable CEO characteristics and bank risk-taking. It contributes to the existing literature in two ways. First, the author collects a unique hand-collected dataset of various CEO-specific characteristics, including demographics, corporate governance-related attributes, as well as professional and educational background. Secondly, the link between CEO characteristics and bank risk is analyzed in the presence of data on CEO compensation structure, which is rarely considered in previous literature. The study finds no link between most of the examined characteristics and bank risk-taking except for CEO duality and educational background. In line with the recent studies, this paper finds a positive association between CEO duality and bank risk-taking. Contrary to previous findings, the study reports a positive association between CEO holding a doctoral degree and bank risk. The additional analysis also provides weak evidence that CEOs with STEM academic specialization take fewer risks than those with a background in business administration.

Keywords: CEO characteristics, bank risk-taking, risk attitude, corporate governance, compensation structure, long-term incentives

INTRODUCTION

Bank risk-taking gained a lot of academic interest after the global financial crisis of 2007–2010 (Vazquez, Federico 2015; Bhagat, Bolton 2014). Since the crisis, both scholars and policymakers pay increased attention to understanding the drivers of bank risk-taking as it proved to be very important for the stability of the whole financial system and, consequently, for society.

Against this background, an important stream of literature focuses on the association between corporate governance characteristics, including CEO characteristics, and bank risk[1]. The studies in this vein usually consider only a limited number of characteristics related to corporate governance and rarely, if ever, take into account the confounding effects of management compensation. Previous literature also mostly rely on single-country samples that are rarely comprised of homogeneous firms (for instance, only commercial or only investment banks). Possibly, because of the reasons listed above, the findings of the existing empirical literature are inconclusive and contradictory (see detailed discussion of previous findings in Section 1).

The present paper contributes to an existing literature by examining the link between CEO characteristics (such as age, gender, tenure, duality, insider, educational and professional background) and total bank risk in the presence of CEO compensation structure. To accomplish this research aim, the author gathered a hand-collected data on CEO specific characteristics for 121 global commercial listed bank from for 28 developed and emerging countries for which compensation data was available in Eikon database over 2014–2018.

The paper is structured as follows. The first chapter provides insight into the predictions of theoretical literature and reviews related empirical results. The second chapter describes the data, variables, and methodology used. The third chapter presents the empirical results, including a number of robustness checks and a discussion. The final section concludes.

[1] In this study, terms bank risk and bank risk-taking are used interchangeably.

1. THEORETICAL BASICS AND LITERATURE REVIEW

Chief executive officer (CEO) is traditionally viewed as one of the central figures in corporate governance, having the most decision power in organization (Peni 2014). Considering growing literature on significance of CEO heterogeneity for corporate results, still only limited amount of studies investigate the relevance of CEO and top executives characteristics in the context of financial industry (Ngyen *et al.* 2015, 112). Berger *et al.* (2014, 48), Srivastav, Hagendorff (2016, 342) point out, that we have little knowledge about how executive demographic features matter for bank corporate outcomes, including its riskiness. In addition to insight on bank-specific studies, this chapter provide an overview on corporate governance basics, CEO role in corporate governance and firm performance and identifies the CEO characteristics, which could be related to bank risk-taking.

1.1. CEO role in corporate governance and organization performance

It was long hypothized that a particular CEO could affect coporate performance through a unique combination of managerial abilities, leadership skills, personal traits, values and experience (Kaplan *et al.* 2012, 973). However, theoretical views on this subject substantially vary across studies and time. Traditional neoclassical theory assumes that top managers are purely rational individuals, endogeneous in both values and skills and can easily replace one another. Consequently, the theory assumes that CEOs have no significant impact on performance variation across companies. In contrast, agency theory suggests that top executives have substantial power over corporate outcomes. Still, the theory has more focus on corporate governance mechanisms of maximizing shareholders' utility. (Bertrand, Schoar 2003) More recent upper echelons theory proposed by Hambrick and Mason (1984) argues that a particular top executive matters for firm performance. The theory assumes, that upper echelons may affect corporate outcomes through strategic decision-making. The strategic choices are complex in nature and engage managers cognitive skills, reflections and personal values into decision-making process. Thus, managerial characteristics are important determinants of organization

performance. The growing body of studies support this theory, providing empirical evidence on the presence of associations between CEO-specific attributes and corporate outcomes.

1.1.1. Corporate governance basics

Prior literature provides a broad variety of definitions of corporate governance. One group of the definitions focus on corporate behaviour aspects, such as the relationships between managers, shareholders and other stakeholders, functions of board of directors, firm's compensation policy and corporate performance. Another group of definitions gives more consideration to normative framework and its influence on how organizations function, operate and perform. (Claessens, Yurtoglu 2013, 3)

One of the most widely used definitions of corporate governance belongs to Shleifer and Vishny (1997, 737) and focuses on investor's value maximization as a main objective of corporate governance: "corporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment." Claessens and Yurtoglu (2013, 4) propose a broader view on corporate governance, defining it as "a set of mechanisms through which firms operate when ownership is separated from management". They see the main goal of well-established corporate governance in creating maximum value not only for the firm owners and main stakeholders, but to the economy as a whole.

One of the theoretical cornerstones of modern corporate governance practices is the well-known agency theory. The theory defines the nature of the agent-principal problem, emphasizing that hired managers are driven by their own motives and ambitions and therefore, may not always act in the best interests of shareholders. Companies could minimize agency costs and maximize shareholders' wealth by separating management and control functions and delegating supervision power over executives to the board of directors (Jensen, Meckling 1976). The agency theory is also one of the fundamentals of modern established compensation practices. The theory assumes that the interests of managers and shareholders are aligned through the corporate compensation incentives, established by the board in order to stimulate executives to act in the benefit of owners and offer managers a fair pay off for their results (Jensen, Meckling 1976). Another common practice of dealing with agent-owner problem is through the share holdings of executives.

In recent times a lot of consideration has received managerial power theory (MPT). MPT supplements rational-based agency theory with social and psychological aspects (Essen *et al.* 2012, 165). Specifically, MPT assumes that board decision-making, including corporate compensation mechanisms can be influenced by powerful managers (Bebchuk, Fried 2003). Therefore, smaller, thus more efficient and better coordinated boards (Jensen 1993) with higher proportion of independent directors are widely regarded as a way to increase the efficiency of board monitoring and maximise firm value (Pathan 2009; Guthrie *et al.* 2012). In contrast, CEO duality (when CEO also holds the position of Chairman of the board), longer tenure and the status of internally-hired executive are considered by theorists as the indicators of CEO power (Pathan 2009), which could constraint the potential benefits of shareholders.

It is important to note that in reality the essence of agency conflict is highly dependent on organization ownership structure, institutional and legal framework and internal corporate governance patterns (Denis, McConnell 2003; Claessens, Yurtoglu 2013). Legislation and corporate governance regulations are heterogeneous across countries and regions. For instance, most of European countries use two-tier board system, which consists of two separate boards for managing and supervisory directors compared to one-tier board system in the United States. (De Haan, Vlahu 2016, 235). CEO duality is prevailing corporate practice in the United States, it is widely accepted in Japan, while prohibited in Germany (Crossland, Hambrick 2007, 778). Lower concentration of ownership is also more typical for U.S. and U.K. firms, while many European and Asian markets have a large number of firms controlled by a dominant group of shareholders or families. In the latter case shareholders have much better access to information and maintain substantial control over the firm. As a result, the magnitude of agent-principal conflict is much weaker for these kinds of companies. (Claessens, Yurtoglu 2013, 10)

Nevertheless, efficient corporate governance practices could provide significant benefits for both companies and society by establishing better access to cheaper financing, facilitating stronger and consistent performance, maximizing company value and contributing to economic growth (*Ibid.*).

1.1.2. CEO significance for organization performance

Chief Executive is assumed to have substantial authority and weight within the firm, playing one of the key roles in corporate decision-making process and strategic choices. Many former CEOs continue to hold directorship in the company's board after retirement from CEO position. They

also hold the title of the most visible executives in a company. (Peni 2014, 186–190). Nguen *et al.* (2015) investigating market reaction on top executives appointments among U.S. banks document that the changes in share price are especially significant following announcements on CEO appointments. This result indicates the strong belief of investors in CEO's ability to affect future performance.

Despite the prior literature widely acknowledging an important role of chief executive in a firm's corporate governance, his ability to affect corporate results still causes a lot of debates among scholars. In one of the most influential studies on CEO effect, Lieberson and O'Connor (1972) express doubt in significant ability of a CEO to influence corporate outcomes due to internal and external limitations. The authors claim substantially higher importance of firm and industry effects in determining corporate performance. Still, recent studies provide plenty of empirical evidence that CEO matters for firm results.

Crossland and Hambrick (2007) using the sample of U.S. listed companies concludes that about 13% of variance in return on assets (ROA) among firms can be attributed to CEOs. The company, industry and calendar year effects were estimated for 19%, 12% and 4% respectively, while 52% of variance remained unexplained. The study finds that CEO impact on firm performance varies across countries. In particular, examination of relevant samples of German and Japanese firms showed that only 9,4% of variance in ROA can be attributed to CEOs in Germany and 4,6% in Japan. The authors associate these differences with heterogeneity in national culture, dominant ownership structure and governance practices among examined countries. In addition, they find that different estimation methods of CEO impact produce slightly different results.

Mackey (2008) also emphasizes the proper methodology problem in this type of research. He uses a series of sample and methodological corrections and concludes that the CEO effect on corporate outcomes, in particular ROA, was underestimated by previous works. Specifically, he finds that 29.2% of variance in ROA can be accounted for CEO, which is larger compared to industry and firm effects, estimated for 6.2% and 7.9% respectively. In contrast, Fitza (2013) argues that CEO influence on firm performance might be overestimated by previous studies due to inability to separate the real effect of CEO actions and decisions from the fluctuations caused by random factors. However, he still concludes that 3.9 – 5% of corporate results can be purely addressed to CEO leadership.

Quigley and Hambrick (2014) highlight the trend of growing public attention to top managers, specifically CEOs, and document notable increase in CEO significance to firm performance over recent decades. Bertrand and Schoar (2003) find strong association between executive fixed effects and a variety of corporate strategic outcomes among large U.S. firms.

1.1.3. CEO characteristics and corporate performance

Previously mentioned upper echelons theory provides theoretical rationale to executive characteristics significance for firm corporate performance and strategic outcomes. Specifically, theory assumes that executive psychological, demographic and background characteristics might affect corporate results through strategic choices taken by executives. The theory focuses on observable CEO characteristics due to their better measurability. These are age, tenure, educational and functional background, wealth and experience. (Hambrick, Mason 1984) Figure 1 illustrates how personal characteristics of top management can affect corporate performance in accordance to upper echelons theory.

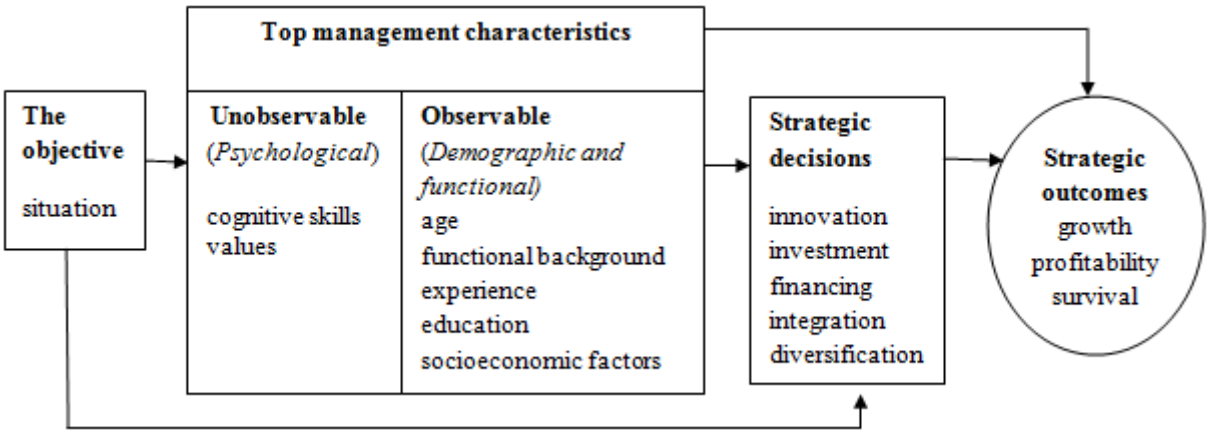

Figure 1. Upper echelons characteristics and strategic outcomes
Source: Hambrick, Mason (1984, 198)

The number of studies on the relationship between CEO characteristics and corporate outcomes has increased significantly during the last decade. However, due to data availability constraints, most of such studies focus on one or two observable CEO features. The vast majority of literature investigates the effect of CEO duality, tenure or gender on firm performance. Fortunately, more and more literature shed light on the relevance of other CEO-level

characteristics to corporate outcomes. Still, this research topic often provides contradictory results.

Previously mentioned classical managerial theories assume the negative effect of powerful CEOs on firm value. The empirical findings on the subject are mixed. Consistent with the theory, Bhagat and Bolton (2008) find that CEO duality is negatively related to firm operating profitability determined by ROA, while having no impact on firm performance measured by Tobin's Q. Similarly, Duru *et al.* (2016) document negative relationship between CEO duality and operating profitability. The negative effect is mitigated with the increasing board independence. Antia *et al.* (2010) emphasizes that the average tenure of Chief executive has decreased significantly over recent decades, from eight to less than four years, pushing CEOs to deliver quick profits in expense of long-term value creation. Dikolli *et al.* (2014) argue that the probability of CEO performance-driven turnover decreases with tenure. The study assumes that moving forward owners become more confident in CEO executive skills and ability to generate returns over time, consequently, the need for CEO monitoring also declines. Interestingly, some scholars include tenure into their models as a measure of executive experience (Belithar, Clark 2012), or even CEO quality (Bhagat, Bolton 2008), computed by dividing CEO tenure by CEO age.

CEO age is often viewed together with the effect of tenure. CEOs with the same tenure, but different age, are likely to differentiate in terms of quality, equity ownership, sensitivity to incentives and their insights to future career prospects (Bhagat, Bolton 2008). Another consideration is that CEO retirement is getting closer with age, which might significantly change the CEO investment horizon. In line with this assumption, Jenter and Lewellen (2015) find that the chances for gainful takeover are higher, then the target firm CEO is closer to common retirement age. Antia *et al.* (2010) document different market responses to various CEO tenure – age combinations. Study argues that market participants tend to undervalue relatively old CEOs with longer tenures in favour of younger short-tenured chief executives. Peni (2014) documents positive association between chief executive age and ROA. At the same time, the study finds that CEO professional experience measured by tenure is much more beneficial for firm value than his life experience defined with age. Therefore, one of the most preferable options for the firm could be a younger CEO with longer tenure on current position.

Another CEO demographic characteristic widely examined by scholars is gender. Barber and Odean (2001) find that males are generally more overconfident than females on the example of their equity trading activities. Adam and Funk (2012) carrying a survey among top managers and directors of Swedish firms document notable gender differences in values. The paper reports that male directors are more concerned with self-enhancement, while female directors put more value on self-transcendence. Peni (2014) using the CEO data on S&P 500 firms finds positive association between female CEOs and firm performance. In line with these findings, Conyon and He (2017) report positive interaction between board gender diversity and performance of U.S. publicly traded companies, with the effect more significant for high performing companies. They suggest that the high-performing firms have better conditions for gaining advantages from females' gender-specific features, such as different decision-making process, values, risk-tolerance, attitude to professional and educational development. Similarly, Flabbi *et al*. (2019) examining data on Italian manufacturing firms identify positive effect of a female CEO on firm performance, but only for the enterprises with a significant share of women among their employees. The authors associate these results with better ability of female CEOs to understand other employees of the same gender, determine their capabilities and needs. Elsaid and Ursel (2018) find that female Chiefs are more likely to stay in CEO position longer than their male counterparts. They suggest that female CEOs are more visible to public, so the companies avoid attracting market and stakeholders' attention with female CEO termination. They also find that female CEOs are more likely to be hired in times of firm distress or poor financial performance.

Other studies focus on other observable CEO-specific characteristics such as CEO business, insider status, education and previous experience. Peni (2014) finds that CEO commitments in outside boards (CEO business) negatively affects company performance. Zhang and Rajagopalan (2010) in exploration of the impact of strategic changes on firm performance in U.S. large manufacturing firms find that the effect is positive in case of slight changes in strategy, but negative in case of greater changes. The magnitude of both positive and negative effects is greater for an outside CEOs. The authors suggest that internally promoted CEOs have greater ability to match these changes with firm capabilities due to better understanding of corporate processes, resources and constraints. In addition, they find that the effect of outside CEOs is not consistent through all their tenure, with moderate positive effect in first three years, but significant negative impact in latter years. Hamori and Koyungu (2015) on the sample of S&P 500 companies conclude that previous CEO experience might be harmful for CEO performance in the new firm due to projection of previous management techniques and strategies to new

organization. In contrast to previous study, they find no evidence that CEO insider or outsider status significantly affect their results at the new place.

Ngyen *et al.* (2015) in examination of market response to announcements on top executives' appointments in U.S. banks find positive interaction between appointee's age, quality of education and experience measured by the number of previous external executive directorships. In addition, the study documented negative market reaction on executive's business, while gender, Master's degree and experience in non-banking sector had no statistically significant effect on share value. The authors assume that investors associate younger executives with higher risk-taking, which could harm long-term growth in shareholder's wealth. King *et al.* (2016) on another sample of U.S. banks find that CEOs with MBA degrees tend to achieve better profitability than their undergraduate colleagues, especially when the bank is engaged in riskier and innovative business strategies. The effect is amplified in the presence of risk-stimulating incentives. The study highlights that both level and quality of education is important for CEO ability to cope with growing complexity, dynamism and riskiness of banking activities. Bernile *et al.* (2017) find that CEOs, who experienced the natural disasters with moderate consequences at their early-life stage are more risk-seeking than their colleagues. In contrast, in case of extremely negative experience, CEOs tend to be more risk-averse and conservative than their peers and are less likely to go bankrupt. The study concludes, that not only experience itself, but its magnitude has an effect on CEO attitude towards risk.

In addition, literature suggests that CEO characteristics might be associated with a wade range of other corporate outputs such as quality of environmental, social and governance (ESG) disclosure (Li *et al*. 2018), research and development (R&D) spendings and innovations (Lin *et al.* 2011), firm successful internalization (Hsu *et al*. 2013).

The examined literature provides numerous evidence that CEO heterogeneity including his observable characteristics might matter for company decision-making process, strategic choices and corporate outcomes with respect to both financial and non-financial industries. The most examined CEO features generally follow the ones proposed by Hambrick, Mason (1984) and include CEO observable characteristics such as age, gender, educational background, previous experience and corporate governance related attributes. The following chapters investigate the literature on relevance of CEO-level characteristics in the context of bank risk-taking.

1.2. Banking sector specifics and risk-taking

Academic studies on bank risk-taking highlight the unique nature of banking business, which involves greater risks compared to non-financial sectors. Business complexity, its opaque nature, difficulties with bank assets valuation, maturity mismatches and lower transparency of financial disclosures, all these factors promote additional sources of risk for the banking industry (Srivastav, Hagendorff 2016; IMF 2014; Becht *et al.* 2011). Agency conflict is especially relevant for banks (IMF 2014, 107), with potential unlimited profits for shareholders and limited losses, backed by government guarantees (Bushman *et al.* 2018, 192).

1.2.1. Banking sector difference from non-financial firms

Academic literature defines banks as financial intermediaries, which transform “short-term liquid deposits”…”into long-term illiquid loans" (Srivastav, Hagendorff 2016, 337). Corporate governance related studies often restrict their samples to non-financial firms due to different nature of financial sector compared to other industries (Mackey 2008; Peni 2014; Jenter, Lawellen 2015). Banking literature provides numerous theoretical support for this assumption. Haan and Vlahu (2016) point out three main differences of banks compared to other firms. First, regulation: as banks are a potential source of systemic risk, the industry is heavily regulated compared to most other sectors. Nevertheless, the unique position allows banks to take higher risks due to cost-shifting to taxpayers. Second, deposits as a main and relatively cheap source of funding. Low cost of capital could increase bank risk appetite. In addition, depositors, backed by goverment guarantees are commonly not involved in active bank monitoring due to low information transparency and time costs. Third, high complexity and opacity of business operations makes risk assessment especially difficult for banks. Based on existing empirical findings, the paper suggests that traditional corporate governance practices, such as smaller boards or higher fraction of independent directors do not work in the context of the banking sector in terms of both performance and risk-taking. This is supported by Becht *et al.* 2011, finding that corporate governance of banks significantly differentiates from other companies. The study emphasizes that banks are highly leveraged business entities, with traditional agency conflict especially relevant not only for agent-principal problem, but also involves conflicting interests of creditors, bondholders and society.

To summarize, banks substantially differentiate from non-financial firms in terms of both business nature and corporate governance with most of its unique features contributing to higher risk. This makes the topic of risk-taking especially relevant in the context of banking industry.

1.2.2. Bank risk-taking

Bank risk-taking might be defined as "policies that increase risk through any of various channels" (Srivastav, Hagendorff 2016, 335). With risk-taking being an integral part of the banking business, banks are exposed to the various types of risk. Srivastav and Hagendorff (2016) classify bank risk into 4 main categories. Namely: market risk, default risk, leverage risk and portfolio risk.

Market risk occurs from adverse market fluctuations, which affect overall bank value as well as the value of its single financial positions. Default risk is associated with bank inability to meet its obligation as a result of both financing and investment decisions. Leverage risk arises from bank capital structure, which does not provide enough capital to finance its operations. While portfolio risk is associated with volatility of returns of bank asset portfolio. (*Ibid*., 335–337) The existing literature uses a wide variety of measures to estimate for different bank risks. Figure 2 provides a short overview on general types of bank risk and its most common proxies.

Prior studies identify the presence of various factors, which contribute to bank risk-taking. These factors can be grouped into 2 main categories: internal firm-specific factors (such as corporate governance mechanisms, bank size, bank type, asset and capital structures, profitability, diversification of business revenues) and external environmental factors, which include industry, country and macroeconomic drivers of bank risk. These are industry concentration, legislative framework, economic cycle, interest and inflation rates. (Baselga-Pascual *et al.* 2015, 138–140)

National legal and regulatory environment is one of the main external factors, which determine banking sector heterogeneity across countries. Barth *et al.* (2013) point out that domestic law frames the range of allowed banking activities. National regulators determine the power of supervisory agencies and audit commissions, establish capital requirements and provide standards of financial disclosures, which affect investors' ability to effectively monitor bank management and performance. In addition, countries have different systems of deposit insurance, which might affect bank willingness to take greater risks.

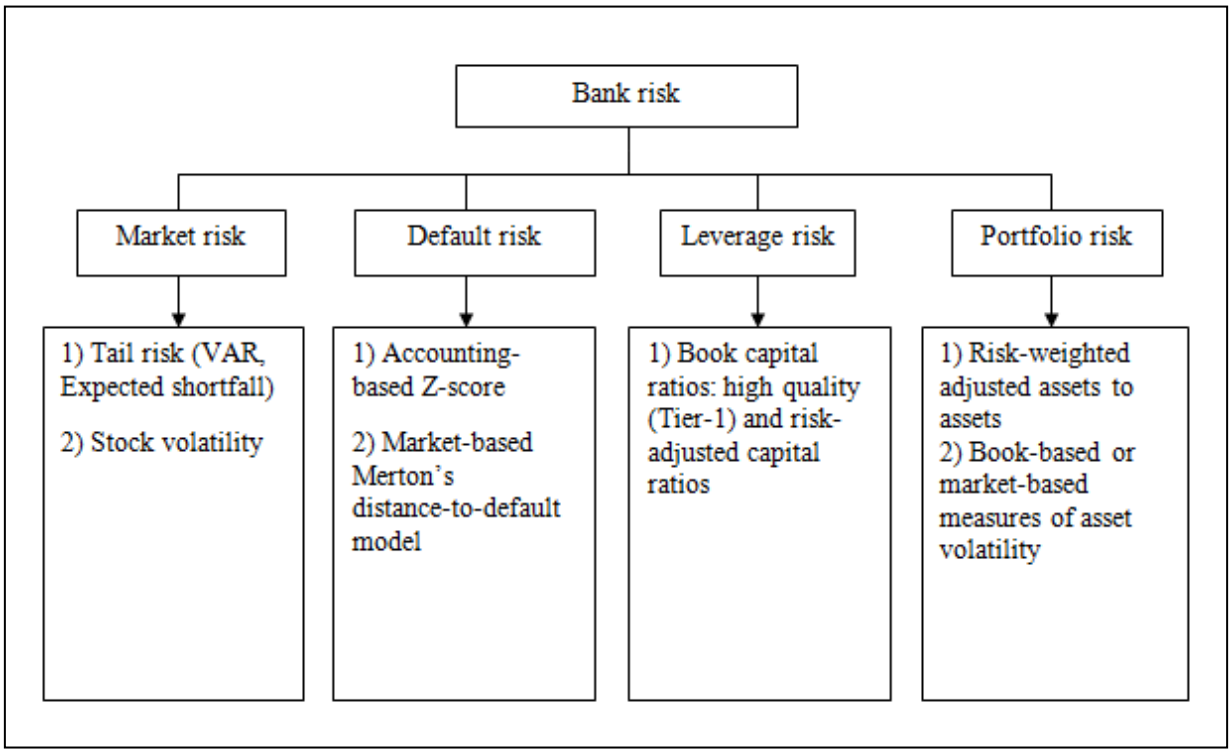

Figure 2. Main types of bank risk and common proxies
Source: Srivastav, Hagendorff (2016, 335–337); author's compilation

Another factor of environment, which could have substantial influence on bank risk profile is the local culture and religiosity. Mollah *et al.* (2017) find that Islamic banks are able to absorb greater risk and produce higher returns, while maintaining higher capital levels compared to conventional banks. The study argues that the success of Islamic banks lies in the fact that their executives, directors and customers share the same values. Adhikari and Agrawal (2016) find that U.S. banks headed from more religious regions are more conservative and produce less risk to the system, experience lower volatility of stock return, hold greater quality assets and have higher z-scores. However, these banks might be undervalued and less profitable in a stable macroeconomic environment. Other studies establish the link between bank risk-taking and the element of individualism in local culture. Illiashenko and Laidroo (2020) find that more individualistic countries are associated with less risk-taking by banks as they are less likely to expect support from their social environment in case of bad scenario realization compared to collectivistic countries.

In addition, classical macroeconomic factors significantly affect the level of bank risk. Delis and Kouretas (2010) find that the periods of low interest rates put pressure on banks, pushing them

towards accepting higher risk in order to deliver the desired level of returns to its shareholders. Risk increases with the higher proportion of non-traditional financial instruments to bank total assets and decreases with higher level of equity. This is in line with the conclusion of Baselga-Pascual *et al.* (2015), who find that bank willingness to take risk increases in times of lower interest and higher inflation rates as well as during economic distress. In addition, the paper argues, that the bank risk is higher in markets with lower concentration of banking sector.

One of the most examined firm-specific factors, which has received a lot of attention in the context of the recent financial crisis due to so called "to too big to fail" (TBTF) problem is bank size. Farag, Mallin (2018, 1542) argue that larger firms are less exposed to total and firm-specific risks, while exhibit higher systematic risks. Berger *et al.* (2014) find that larger banks have lower portfolio risk as a consequence of stronger charter value and capital ratios. Minton *et al.* (2014) suggest that bank risk policy is affected by bank size. Specifically, they argue that larger banks bear lower risks benefiting from better diversification and larger government protection. Thus, large banks can afford higher risk-taking compared to smaller banks. Bhagat *et al.* (2015) document positive relationship between bank size and its risk appetite. Paper identifies increased leverage as a main catalyst of bank excessive risk-taking. In similar vein, Vazquez and Federico (2015), conclude that during financial crisis of 2007 large international banks were more exposed to solvency risk as a result of being overleveraged, while smaller domestic banks were more likely to fail due to lack of liquidity. Hag and Heaney (2012) find positive association between bank size and systematic and total risk. They conclude that large banks are more likely to take greater risks using the advantage of their "too big too fail" status. In addition, the level of bank risk varies depending on its main activity and ownership structure. Bhagat *et al.* (2015) find that investment banks are associated with higher risk appetite than commercial banks, while Delgado *et al*. (2007) find substantial differences in activities profile and corporate governance between commercial and savings banks.

IMF (2014) in its research on corporate governance and bank risk-taking identify 4 main groups of factors, which could be related to bank risk appetite. Specifically, board characteristics such as board independence, CEO duality and financial expertise of directors, risk management practices, bank compensation policy and ownership-related issues. The existing literature on the links between board characteristics, ownership structure and bank risk-taking provide contradictory results (Aebi *et al.* 2012; IMF 2014; Lu, Boateng 2018; Altunbaş *et al.* 2020), while stronger risk management is commonly associated with less risk-taking (Aebi *et al.* 2012,

Ellul, Yerramilli 2013). The relationship between bank willingness to take higher risk and remuneration practices is reviewed in the next chapter of the present paper.

1.3. CEO characteristics and bank risk-taking

Limited research has been done on the relationships between CEO characteristics and bank risk-taking. Although the body of such literature is growing due to increasing information availability and interest in socio-psychological aspects of corporate governance, it is useful to note that the proxies of different CEO characteristics as well as bank risk-taking vary across studies and so far academic evidence on the subject is mixed.

1.3.1. CEO characteristics and bank risk

Agency theory assumes that managers are driven by their own risk preferences and may not be willing to take the optimal level of risk needed for firm value maximization (Jensen, Meckling 1976). Together with MPT it suggests that the indicators of CEO power are negatively related to firm risk. However, the empirical findings on this subject from the banking sector are rather mixed. In line with the theory, Fortin *et al.* (2010) document that banks with powerful CEOs determined through CEO shares ownership took less risk prior to the 2007 economic crisis. Similarly, Pathan (2009) finds negative association between bank risk-taking and CEO power, indicated by insider CEO, who is also a Chairperson. In addition, the study reports that smaller powerful boards contribute to higher risk-taking. In contrast, empirical findings of Altunbaş *et al.* (2020) suggest positive relationship between CEO power and bank risk-taking. The paper finds no significant evidence that higher representation of independent directors or board size can mitigate the effect of a powerful CEO. In this case, the authors implement a 4-component CEO power index, consisting of CEO tenure, duality, ownership and CEO's network size. Similarly, Lu and Boateng (2018) using the sample U.K. banks find positive association between CEO duality and credit risk. Muller-Kahle and Lewellyn (2011) find that the higher fraction of directors holding multiple chairs in the outside organizations is associated with higher risk-taking.

The effect of executive age on bank risk-taking is also not fully determined by academic literature. Although in ordinary life younger people are more prone to risky decisions while older people may favour quiet life (Yim 2013), in managerial specific literature executive age and

tenure are often considered as the factors, which contribute to increase in CEO overconfidence. As overconfident CEOs tend to underestimate involved risks, CEO age and tenure supposed to be positively associated with bank risk-taking. (Ho *et al.* 2016) In contrast, Berger *et al.* (2014) find that presence of younger executives on board is associated with greater risk-taking by banks. In line with this finding, Muller-Kahle and Lewellyn (2011) report that a higher proportion of younger shorter-tenured executives contributed to higher risk-taking with respect to recent financial crisis on the sample from U.S. subprime lending industry. Yim (2013) finds that younger CEOs are more likely to engage in acquisitions followed by significant and lasting increase in compensation. In contrast, Ho *et al.* (2016) documents positive association between age of bank CEO and overconfidence, which could contribute to higher risk-taking. Acrey *et al.* (2011) find certain evidence that older long-tenured CEOs are likely to become short-term oriented closer to retirement. Thus, they are more likely to take risky decisions in order to get quick profits.

Significant amounts of research on bank corporate governance investigates gender-specific differences in attitudes toward risk. Such studies often provide contradictory results. Although it is a highly recognized opinion that women are generally more risk averse compared to men (Eckel, Grossman 2002, 282), managerial research suggests that top executives may substantially differentiate from the general population. Adam and Funk (2012) based on the survey among CEOs and directors of Swedish firms find that female directors differ from average women in terms of both values and risk-aversion. Furthermore, they less appreciate traditions and are slightly more risk-oriented than their male counterparts. The study suggests that this might be driven by the fact that females have to make riskier career and life choices compared to males in order to get their chair on board. In addition, the paper assumes that there might be a difference in risk-aversion between female insider and outsider appointees. The outside female directors might be more changes-oriented and risk-loving. They also suggest that female directors might differentiate across countries as a response to differences in a cost of pursuing a succesful career for women, determined by the local institutional environment. Sapienza *et al.* (2009) find that women who choose riskier financial careers are likely to be much less risk-averse compared to the average female in the population. The study suggests that difference in risk attitudes among females might be addressed to concentration of testosterone. Similarly, Adams and Ragunathan (2015) find that females choosing banking career might be very different from the average female population in both traits and risk preferences. Still, they identify different behavioural patterns among males and females, with females having more chairs in auditing and monitoring

committees. Also, female directors are generally younger, have less previous directorship experience and shorter tenures on current positions compared to their male colleagues. Study finds that only 0.6% of female directors in bank boards perform executive functions. Palvia *et al.* (2015) find that female CEOs and Chairwomen have larger representation in smaller banks.

The empirical findings on the effect of gender on bank risk are also mixed. Berger *et al.* (2014) find that bank risk increases with the higher proportion of female executives in board, however the result is only marginally statistically significant. Adams and Ragunathan (2015) find no association between higher female representation in board and bank risk. At the same time they find a positive impact of board diversity on bank performance in crisis times. The authors suggest that due to higher career constraints for women in banking industry, the quality and talent of female directors is higher compared to men. Also, gender diversity in values, approaches and decision-making could provide additional benefits in crisis times. Sila *et al.* (2016) on a subsample of U.S. bank holding companies find no evidence that higher proportion of females on board have any statistically significant link with bank equity risk. Comparing these results with the prior findings on the main sample of firms, with financial and utility industries excluded, the paper suggests that there is no significant difference between female directors in financial industry and other sectors.

In contrast, Muller-Kahle and Lawellyn (2011) find that a higher proportion of females on board of financial firms contribute to less risky choices. Palvia *et al.* (2015) find that U.S. commercial banks led by female CEOs or Chairs are associated with more conservative capital structure. Although the study finds no effect of CEO or Chairperson gender on the probability of bank failure in general, it still documents that the effect is significant and negative for little banks. Faccio *et al.* (2016) on a general sample of European companies with financial firms included find negative relationship between female CEOs and firm risk. Namely, proportion of debt, volatility of returns and probability of failure. However, the study finds that females are associated with lower efficiency in capital allocation. The authors assume that between-gender heterogeneity might be caused by different responses to corporate incentives, higher risk of unemployment and social expectations that women face. Belucci *et al.* (2010) using a dataset on Italian bank credit provisions to small business entities finds that female loan officers are more likely to put constraints on loan availability to new borrowers compared to male officers. The authors link the results to the fact that females are less overconfident and more risk-averse in nature compared to males.

Minor number of studies shed light on the effect of executives' education and professional background on bank risk. Berger *et al.* (2014) on the sample of German banks find that a higher fraction of directors with PhD is associated with lower portfolio risk, however the result was not consistent among all employed measures. Minton *et al.* (2014) find that the higher proportion of independent directors with financial expertise in U.S. bank boards increases bank risk appetite in terms of both market risk and total risk, while decreases risk-weighted core capital ratios. The study assumes that directors with financial expertise are seeking to maximize shareholders' welfare by encouraging greater risk-taking. This strategy tends to produce slightly better returns in times of economic growth, but significantly underperform during crises. IMF (2014) identifies that CEOs with career background in investment banking are positively related to bank risk, while CEO experience in retail banking or risk management has a negative link with bank risk taking. The paper suggests that this findings might indicate the significance of bank risk culture.

Table 1 summarizes examined literature on CEO and top management characteristics in the context of bank risk-taking.

1.3.2. CEO compensation

As mentioned, agency theory is one of the main theoretical considerations behind today's compensation policies (IMF 2014, 106). The main goal of compensation is to align the interests of shareholders' (principals) with the interests of managers (agents), thus, maximize shareholders' value and minimize agency and monitoring costs (Jensen Mackling 1976). However, compensation incentives may not only promote shareholders' value growth, but also facilitate excessive risk-taking. This is especially valid for the banking sector, where profits and risks are tightly connected with each other. Moreover, theories assume that the potential capital gains of bank shareholders are unlimited, while possible losses are limited with government guarantees (Srivastav, Hagendorff 2016, 338). Therefore, it might be in the interests of shareholders to promote potentially highly profitable risky decisions, as in case of failure the costs of excessive risk-taking may be shifted to tax-payers.

Table 1. Summary of the prior studies on CEO characteristics and bank risk-taking

Authors (year)	Sample, period	Explanatory variable	Sign	Risk measures
Pathan (2009)	U.S. commercial banks, 1997-2004	CEO power (internally-hired CEO, who is also a Chair)	–	total, idiosyncratic, and systematic risk
Belucci *et al.* (2010)	Italian banks, 2004-2006	female loan officers	–	credit availability
Fortin *et al.* (2010)	U.S. BHCs, 2006	CEO power (share ownership)	–	standard deviation of daily share returns
		CEO base salary	–	
		CEO bonuses, stock options	+	
		concentrated ownership by outside shareholders	+	
Acrey *et al.* (2011)	U.S. banks, 2004-2008	CEO tenure	+	default risk, risky activities
		CEO age	+	
		bonuses	none	
		un-exercisable options	–	
Muller-Kahle, Lewellyn (2011)	U.S. financial institutions, 1997-2005	outside director business	+	specialization is supreme lendings
		director tenure	–	
		female directors on board	–	
Belithar, Clark (2012)	FTSE 250 financial firms, 2000-2008	CEO age	+	total volatility, idiosyncratic volatility, systematic volatility, Z-score
		CEO tenure	–	
		CEO education	–	
		CEO experience	–	
		CEO wealth	+	
Berger *et al.* (2014)	German banks, 1994-2010	executive' age	–	portfolio risk
		executive's education (Ph D)	–	
		female directors on a board	+	
Minton *et al.* (2014)	U.S. banks, 2003-2008	financial expertise of independent directors	+	total risk, levage risk, real-estate loans
Adams, Ragunathan (2015)	U.S. commercial banks & BHCs, 2003-2010	female directors on a board	none	origin risk, default risk, idiosyncratic risk, tail risk, market risk, engagement in risky activities
Palvia *et al.* (2015)	U.S. commercial banks, 2007-2010	female CEO	–	capital ratios, default risk
		female Chairperson	–	
Lu, Boateng (2018)	U.K. banks, 2000-2014	CEO duality	+	credit risk
		CEO total pay	+	
		board independence	+	
		board size	–	
		female directors on a board	–	
Altunbaş *et al.* (2020)	U.S. banks, 1998-2015	CEO power index	+	default risk, systematic risk systemic risk

Source: author's compilation based on the reviewed literature

Notes:

1. „+" – positive association, „–" – negative association, „none" – no significant association
2. *FTSE* – Financial Times Stock Exchange
3. *BHC* – Bank holding company

This is especially the case for large systemically important financial institutions (TBTF). After the escalation of 2007 financial crisis, banks were widely accused by society, regulators and media in establishing compensation incentives, which encouraged excessive risk-taking by top management (Fortin *et al.* 2010, 892). This has also attracted the interest of academics and the number of studies investigating the effect of compensation on bank risk taking activities has been growing.

Figure 3 illustrates the different types and elements of executive compensation structure. Executive compensation can be divided into fixed part and variable, performance-based part. Fixed compensation usually consists of salary and might be accompanied by long-term benefits such as fixed pension. Variable compensation is typically determined by cash bonuses, stocks and options. Performance-based compensation is devided into immediate compensation and deferred in time. Performance-based compensation in certain cases can be affected by so-called clawbacks, then previously given reward might be reviewed in the presence of newly occurred developments. It is worth noting that historically profitability and market return indicators have been used to determine the amount of variable compensation. These metrics are often not risk-adjusted and do not count for different types of bank long-term risks. (IMF, 2014, 108).

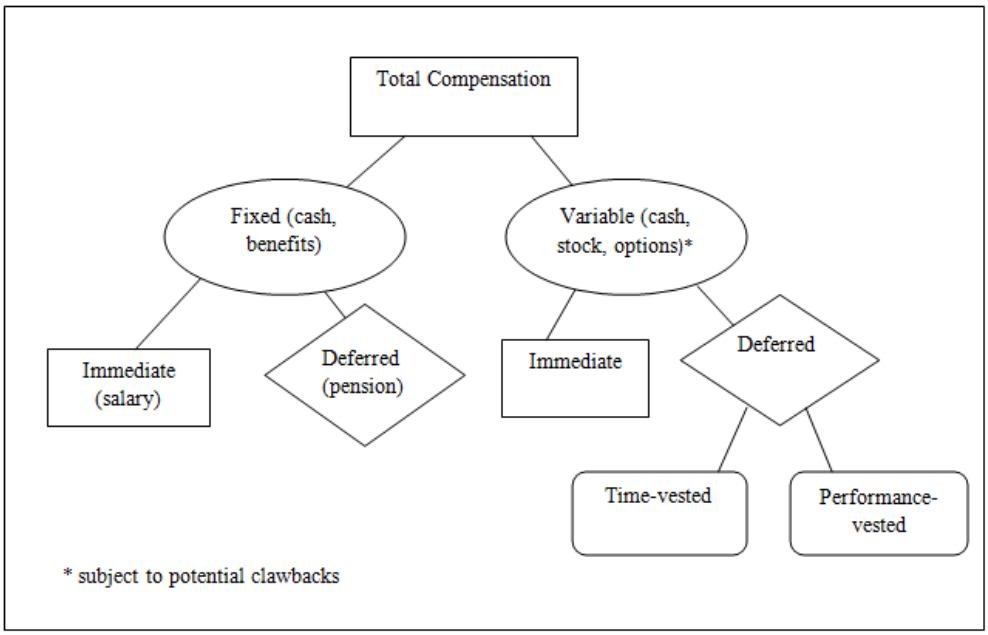

Figure 3. Types of compensation
Source: IMF (2014, 108)

Thus, it might be assumed that different elements of compensation can have different impact on bank risk-taking. Specifically, higher proportion of fixed compensation can decrease the level of bank risk, immediate bonuses and deferred short-term incentives can contribute to excessive risk-taking by producing quick profits in expense of future value, while long-term incentives may promote a well-balanced relation between reasonable level of risk and long-term value creation.

Interestingly, empirical findings on top executive compensation structure and its impact on bank risk-taking ex post economic crisis are mixed. In line with the agency theory, Fortin *et al.* (2010) find negative link between CEO salary and bank risk-taking, while positive impact of cash bonuses and stock options on bank risk. Hagendorff and Vallascas (2011) argue that equity-based compensation, especially stock options significantly increased bank risk before the crisis of 2007 and contributed to overall financial system vulnerability. Kim *et al.* (2010) find that equity-based compensation can encourage share price manipulations by top managers. Bhagat and Bolton (2014) also find that executive compensation structure is one of the main determinants of bank risk-taking. They suggest that executive incentive compensation should be composed only from restricted stocks and options, which can be sold or executed after termination of 2-4 years since executive's last working day in his position. IMF (2014) finds that stock option grants are positively related to bank risk-taking, however, this type of compensation is not widespread outside the U.S. In contrast, the proportion of restricted stocks have negative link with bank risk. In contrast, Acrey *et al.* (2011), Fahlenbrach and Stulz (2009) find no significant association between CEO compensation, its elements and heterogeneity in bank risk-taking.

1.3.3. Hypotheses

Based on the examined literature, the following hypotheses have been built:

H1: CEO characteristics related to CEO power (CEO duality, tenure, insider status) are negatively associated with bank risk-taking;

H2: Female gender of a CEOs is negatively associated with bank risk;

H3: CEO age is negatively related to bank risk-taking;

H4: CEO background in financial industry is positively associated with bank risk;

H5: Higher level of CEO education is negatively related to bank risk-taking;

H6: Previous experience as CEO is positively related to bank risk-taking.

Table 2 summarises the findings in Chapter 1 by listing the direction of the expected associations between the CEO-level characteristics and bank risk-taking.

Table 2. Expected associations between the explanatory variables and bank risk

Variable	Variable full description	Expected sign
Age	age of CEO	–
Gender	female CEO	–
Duality	CEO duality	–
Tenure	CEO tenure	–
Insider	CEO insider	–
CEO_exp	previous CEO experience	+
BankORfin	finance as CEO main career background	+
Education	CEO level of education	–
Specialization	CEO academic degree specialization	+ for finance
Pay.to.assets	proportion of total compensation to bank total assets	+
Lti.share	proportion of long-term incentives to total compensation	–

Source: author's elaboration
Notes:
„+" – positive association, „–" – negative association, „none" – no significant association

2. DATA AND METHODOLOGY

2.1. Data

The study examines CEO-level data on the sample of international listed commercial banks for the period 2014–2018. The sample has been restricted to commercial banks only as their activity profile differs from that of investment and savings banks (Baselga-Pascual *et al. 2015)*. The research focuses on listed banks due to the data availability concerns.

The main dataset has been obtained from Eikon database. Following Tapver *et al.* (2020) the sample was restricted to (1) bank size: banks with total assets more than 25 billion euros; (2) banks with return on assets >-5% and <5%; (3) banks with net loan to assets >5%; (4) banks from Africa, Central America, Caribbean, Middle East, and South America were excluded due to missing or incomplete data. The initial sample contained 285 banks from 38 countries for the period 2009–2018. The restrictions were applied to increase the chances of finding relevant information on CEO compensation and individual attributes. Then, the dataset was supplemented by hand-collected data on missing CEO-level characteristics using publicly available data sources such as Bloomberg, LinkedIn and official websites of the selected banks. During the second stage, the banks with missing CEO observations were eliminated from the sample. Due to scarce information on compensation before 2014, the sample was limited to the period 2014–2018. Next, the episodes of CEO turnovers were identified. Totally 34 instances of CEO change were detected. However, the complete data before and after the change was available only for less than 10 instances. Therefore, it was decided to leave only CEOs for the years of which there is more data. As a result, there is no CEO changes in the final sample.

The final sample consists of 121 bank-CEOs for the period 2014–2018 from North America, Europe, South Asia and Oceania. In total, sample comprises commercial banks from 28 countries, with about 22% of them headquatered in the U.S. Therefore, the present sample is biased toward U.S. banks. However, if we devide the sample by geographic regions, than the highest number of observations belongs to Europe (43.8% including Russia and Turkey)

followed by Asia-Pacific region (29.75% including Australia), while North America countries account for 26.45% of all observations. Table 3 represents sample division by year and country. The panel dataset is highly unbalanced, with the highest numbers of observations belong to the years 2015–2017. The main limitation of the present study is scarce compensation data. The final dataset includes: a) only 91 banks for which usable compensation data is present for at least 1 year over 2014–2018; b) 82 banks with at least 2 years of data; c) only 7 banks with 5 years of data. The number of observations for each variable by year is presented in Appendix 2.

Table 3. Sample division by country and year

		Banks		Observations						
Abbr.	Country	nr	%	2014	2015	2016	2017	2018	total	%
AU	Australia	5	4.13	3	5	5	5	5	23	4.12
CA	Canada	7	5.79	4	7	6	6	5	28	5.02
GB	Great Britain	8	6.61	5	7	8	8	7	35	6.27
US	United States	25	20.66	24	24	25	24	22	119	21.33
ID	Indonesia	3	2.48	3	3	3	3	3	15	2.69
IN	India	9	7.44	9	9	9	8	7	42	7.53
MY	Malaysia	7	5.79	5	6	7	7	7	32	5.73
PH	Philippines	2	1.65	2	2	2	2	2	10	1.79
SG	Singapore	3	2.48	3	3	3	3	3	15	2.69
TH	Thailand	5	4.13	5	5	5	5	5	25	4.48
TR	Turkey	4	3.31	4	4	4	4	4	20	3.58
VN	Vietnam	2	1.65	2	2	2	2	2	10	1.79
RU	Russia	2	1.65	2	2	2	2	2	10	1.79
AT	Austria	2	1.65	2	2	2	1	1	8	1.43
BE	Belgium	1	0.83	0	0	1	1	1	3	0.54
CH	Switzerland	4	3.31	3	4	4	4	4	19	3.41
DE	Germany	3	2.48	1	2	3	3	3	12	2.15
DK	Denmark	2	1.65	2	2	2	2	2	10	1.79
ES	Spain	5	4.13	4	5	5	5	5	24	4.30
FR	France	3	2.48	2	3	3	3	3	14	2.51
GR	Greece	1	0.83	1	1	1	1	1	5	0.90
IE	Ireland	2	1.65	2	2	2	2	1	9	1.61
IT	Italy	6	4.96	6	6	6	6	5	29	5.20
NL	Netherlands	2	1.65	2	2	2	2	2	10	1.79
NO	Norway	1	0.83	1	1	1	1	1	5	0.90
PT	Portugal	2	1.65	2	2	2	1	1	8	1.43
SE	Sweden	3	2.48	1	1	3	2	2	9	1.61
PL	Poland	2	1.65	2	2	2	2	1	9	1.61
	Total:	121	100	102	114	120	115	107	558	100

Source: author's calculations

For the purposes of conducting cross-sectional analysis, more precisely described in Section 2.4.1, the panel data for each bank was averaged across all available years and cross-sectional dataset was formed in addition to already excisting panel dataset. When averaging, 3 missing

values were allowed meaning that if the bank had less than 2 years of observations, it was dropped from cross-section. As the cross-sectional analysis has been chosen as a main econometric method in this paper, the further sample statistics refers to cross-sectional dataset as the primary one.

2.2. Variables

2.2.1. Dependant variables

Following Illiashenko and Laidroo (2020) the study uses three proxies to estimate for bank risk-taking. Two accounting-based risk measures include accounting-based z-score (*LnZs*) and standard deviation of return on assets (*LnσRoa*). Market-based risk proxy is represented by market-based z-score (*LnMkt*). It is important to note that the calculation steps for dependent variables differ for panel and cross-sectional datasets, which is reflected in Equations 1–3.

The accounting-based z-score is one of the most widely used risk metrics in banking literature. The z-score estimates for the risk of default. One of its main advantages over a variety of other metrics is relative simplicity, while reportedly similar efficiency. Z-score proved to be efficient estimator in case of complex business models, which is especially benefitial in the context of commercial banks. As a disadvantage, similar to other accounting-based measures, the accuracy of predicitibility of this indicator highly depends on the quality of official financial reporting. (Chiaramonte *et al.* 2015)

Accounting-based z-score is computed by dividing the sum of the return on assets (*ROA*) and equity to total asset ratio (*ETA*) by standard deviation of return on assets (*σROA*). Defined in a such way, higher z-score value indicates higher distance to default. To reduce its skewness, the natural logarithm of the z-score has been taken following previous studies (Laeven, Levine 2009; Illiashenko, Laidroo 2020). For the purpose of easier interpretation the z-score has been further multiplied by negative 1. Thus, the higher the value of such measure, the greater the bank risk.

$$LnZs_{it} = \ln\left(\frac{\mathrm{ROA}_{it}+\mathrm{ETA}_{it}}{\sigma ROA_{it}}\right) \times (-1), \quad (1)$$

where
ROA_{it} – return on assets for bank *i* for a given year *t*,

ETA_{it} – equity to total asset ratio for bank *i* for a given year *t*,
$\sigma ROAA_{it}$ – standard deviation of ROA for a bank *i* for 3 years (current and 2 previous years)

For cross-sectional dataset:
ROA_i – return on assets for bank *i*, average over sample period
ETA_i – equity to total asset ratio for bank *i*, average over sample period
$\sigma ROAA_i$ – standard deviation of ROA for a bank *i* across the sample period

Market-based z-score has been used as a market-implied measure of bank risk. Market-based risk indicators have a set of advantages over accounting-based metrics, due to higher frequency of data available, being not dependent upon accuracy of financial statements and forward-oriented. On the other hand, market-based measure of bank risk is subject to the state of market efficiency and transparency (Chiaramonte *et al.* 2015). The indicator has been calculated as the average daily stock returns plus 1 devided by the standard deviation of daily stock returns over the present year. The natural logarithm of the market-based z-score was multiplied by negative one for the purpose of straightforward interpretation.

$$LnMkt_{it} = \ln\left(\sum_1^n \frac{\mathrm{AVRT_{it}}+1}{\sigma RET_{it}} \times \frac{1}{n}\right) \times (-1), \quad (2)$$

where
$AVRT_{it}$ – average daily stock return for a stock of bank *i* during the given year *t, ;*
σRET_{it} – standard deviation of daily stock returns for a bank *i* during the given year *t;*
n – number of years in the sample period.

For cross-sectional dataset:
Mkt_i – averaged across sample period

Finally, standard deviation of ROA is calculated as natural logarithm of the standard deviation of bank return on assets. The full calculation procedure follows the same steps and logic as the previous two risk variables (Illiashenko, Laidroo 2020).

$$Ln\sigma ROA_{it} = \ln(\sigma ROAA_{it}), \quad (3)$$

where
$\sigma ROAA_{it}$ – standard deviation of ROA for a bank *i* for 3 years (current *t* and 2 previous years)

For cross-sectional dataset:
$\sigma ROAA_i$ – standard deviation of return on assets of bank *i* over a sample period.

2.2.2. CEO characteristics variables

The list of variables that characterize a CEO includes most characteristics that could presumably affect bank risk-taking, derived from the literature review from the first Chapter. In order to get bank-specific CEO characteristics, the first useful step is to identify bank CEO. In case of cross-country study this might be challenging, as CEO titles vary across countries. For example, CEO traditionally called a chairman or a general manager in China, chairman of managerial board or speaker in Germany, president in Japan (Crossland, Hambrick 2007; Farag, Mallin 2018). Therefore, in the process of gathering data, the following titles have been used as a substitude for clearly defined CEO: chairman of managerial board, general manager, president.

The list of explanatory variables includes CEO characteristics related to corporate governance (*Tenure*, *Duality*, *Insider*), demographic attributes (*Gender* and *Age*), as well as professional (*CEO_exp*, *BankORfin*) and educational background characteristics (*Education*, *Specialization*).

The first set of CEO variables includes corporate-governance related characteristics. CEO tenure is taken as one of the indicators of CEO power following Berger *at al.* (2014) and as a proxy of CEO experience on current position. It is measured in years on current position starting from date of CEO appointment. CEO duality is another metric of CEO power (Pathan, 2009). It is a binary variable, which takes value of 1 if the CEO is also a Chairman of the board and 0 otherwise. Insider is a binary variable that equals 1 in case CEO was promoted within the firm or previously held the chair(s) on the bank boards and 0 otherwise (Pathan, 2009).

CEO gender is a dummy variable that takes the value of 1 in case if CEO is female and 0 if male. CEO age is measured in years on the end of the calendar year.

Taking into consideration the study of Hamori and Koyungu (2015) and the fact that to the best of author's knowledge, chief executive's previous experience on CEO position has not been earlier explored with respect to financial firms, the set of explanatory variables includes this metric as well *(CEO_exp)*. The variable takes value of 1 in case if bank CEO has previously worked on the same position in a current bank or in any orther firm. In case CEO has no such pervious experience, variable takes value 0. Following Minton *et al.* (2014) and for the purpose of data accuracy, the study consider bank CEO previous career primarly in finance sector as a proxy of CEO financial expertise *(BankORfin)*. The variable equals to 1 in case CEO career path

mainly goes through financial sector enteprises and 0 if CEO is taken from another industry, the latter can be considered as a professional chief executive.

Finally, 2 education metrics have been incorporated into research. There are different ways to account for level of education: by a number of academic qualifications (Belghitar, Clark 2012), postgraduate degrees (Farag, Mallin 2018) or either PhD or master's degree (Berger *et al.* 2014; Nguyen *et al.* 2015). This thesis follows King *et al.* (2016) and employ a set of dummy variables, which represent bachelor's, master's and doctoral degrees. In addition, the study adds academic specialization variables, as degree in finance could provide CEO with additional financial expertise while degree in business administration could contribute to CEO managerial skills. Due to substantial variety of different majors and for the purpose of further statistical analysis, the specializations have been grouped into 5 main categories: business, finance, economics, law and other, STEM (Science Technology Engineering and Math).

2.2.3. Bank-level controls and CEO compensation

To account for compensation, the study uses 2 variables: (1) total compensation to bank assets (*Pay.to.assets*) and (2) long-term incentives to total compensation (*Lti.share*).

Compensation data has been gathered using Eikon standartized view. The main benefit of this option is that it provides the unified overview on remuneration data across companies, which is especially relevant in case of cross-country study. On the other hand, it does not specify information on different remuneration components. Eikon standartized view devides total compensation for fiscal year into 6 main groups: salary, bonuses, other annual compensation (included into total annual compensation category), restricted stock awards, long-term incentive plan and all other compensation. For the purpose of comparability and due to the fact that some compensation elements are not widespread outside the U.S. (e.g. restricted stock awards, long-term incentive plan) and thus, increase the number of missing observations, the study construct 2 compensation variables. *Lti.share* is calculated as the sum of restricted stock awards, long-term incentive plan and all other compensation elements divided by fiscal year total compensation. Thus, it indicates the most motivating part of CEO remuneration. *Pay.to.assets* is a ratio of fiscal year total compensation to bank total assets multiplied by 1000 for better visibility. Since the compensation data is given in the local currency of the country of bank origin while the financial data is in EUR, the author manually collected currency exchange data and converted banks' total

assets into the local currency for the purpose of calculating the ratio between total compensation and bank assets.

In selecting relevant bank-level controls, the study follows Illiashenko and Laidroo (2020). The list of controls includes the following: bank size (*Size*), growth of bank's assets (*Growth*), interest revenue margin (*Int.marg.rev*), income diversity (*Inc.div*) and funding structure (*Fund.div*). See Appendix 1 for variable definitions.

2.3. Descriptive statistics

Table 4 shows the discriprive statistics for the cross-section data. As noted previosly, the number of observations varies between the variables. Most importantly, number of missing values for compensation variables is quite large and effectively reduces the sample from about 110–115 banks (for which there is a data on both CEO-level and bank-level characteristics) to about 75–80. The descriptive statistics for the cross-section data by countries is presented in Appendix 3.

Table 4. Summary statistics for the examined variables

Variable	Nr. of observations	Mean	Standard deviation	Min	P25	P75	Max
LnZs	113	-4.18	0.83	-6.38	-4.85	-3.64	-2.10
LnσRoa	113	-6.56	0.90	-8.85	-7.20	-5.83	-4.62
LnMkt	117	0.413	0.41	-0.54	0.176	0.64	1.96
Age	121	56.47	6.25	37.00	52.50	60.00	81.50
Tenure	121	5.994	5.76	1.07	2.38	7.60	33.99
Lti.share	83	0.60	0.29	0.00	0.42	0.87	0.94
Pay.to.assets	76	0.01	0.01	0.00	0.00	0.02	0.04
Size	115	18.64	1.31	16.74	17.52	19.65	21.52
Growth	114	0.07	0.08	-0.12	0.02	0.11	0.32
Inc.div	115	0.31	0.13	0.03	0.22	0.40	0.67
Int.marg.rev	115	0.63	0.19	0.02	0.47	0.75	0.96
Fund.div	115	0.68	0.14	0.11	0.64	0.78	0.87
Duality	121	0.15	0.35	0	0	0	1
Gender	121	0.05	0.22	0	0	0	1
Insider	121	0.75	0.43	0	1	1	1
CEO_exp	121	0.38	0.49	0	0	1	1
BankORfin	121	0.99	0.09	0	1	1	1
Education	119	1.67	0.60	1	1	2	3
Specialization	118	2.04	1.22	1	1	3	5

Source: author's calculations

The average bank CEO in the sample is male, 56 years old, holding is position for 7 years (might be biased due to old, co-founder CEOs), promoted from inside the banks, without previous experience on CEO position and holds master's degree in business administration. The sample CEOs are relatively old. The youngest CEO is 37 years old, while the oldest is 81. Females chief executives are underrepresented in the sample and account only for 5% of all CEOs. This is in line with Adams and Ragunathan (2015), who find that female directors are very pourly represented on executive positions in banking industry. Overall, it is possible to conclude the present sample banks are rather conservative in their personnel policy and tend to hire on CEO position experienced individuals, who has already proved themselves within the banks.

Table 5. Descriptive statistics for time-invariant CEO characteristics

Variable		Frequency	Distribution, %	Cumulative, %
Gender	male	115	95.04	95.04
	female	6	4.96	100.00
Duality	only CEO	103	85.12	85.12
	CEO and chair	18	14.88	100.00
Insider status	outsider CEO	30	24.79	24.79
	insider CEO	91	75.21	100
Previous CEO experience	without prev. experience	75	61.98	61.98
	with prev. experience	46	38.02	100.00
Main career background	other	1	0.83	0.83
	finance	120	99.17	100.00
Education	bachelor's	48	40.34	40.34
	master's	63	52.94	93.28
	PhD	8	6.72	100.00
Specialization	business	57	48.31	48.31
	economics	23	19.49	67.80
	finance	20	16.95	84.75
	Law and other	13	11.02	95.76
	STEM	5	4.24	100.00

Source: author's calculations
Notes:
1. *STEM* – Science Technology Engineering and Math

In the context of the present sample, the study finds CEO duality relevant only for U.S. banks. This generally follows the information provided by Crossland, Hambrick (2007) and De Haan, Vlahu (2016). It might show that many countries try to limit the power concentrated in chief executive's hands by prohibiting CEO duality. In addition, this condition allows to assume that CEO might have more influence and power in the United States than for example in Europe, which is in line with the findings of Crossland and Hambrick (2007).

The correlation matrix is presented in Appendix 4. It can be seen that dependent variables are positively correlated, as intended. Correlation between accounting-based risk measures is above 0.9, as ROA is one of the primary components of both *LnZs* and *LnσRoa.* Correlation between accounting- and market-based measures of bank total risk is high enough: 0.44–0.52. These results are close to Illiashenko Laidroo (2020). In addition, correlation in range 0.40–0.60 is observed between some of the bank control variables, such as *Size* and *Inc.div*, *Growth* and *Int.marg.rev*, *Growth* and *Fund.div*, as well as between *Tenure* and *Age* (0.55), while *Duality* is relatively highly correlated with *Int.marg.rev (0.62)* and *LTI.share* (0.46). The latter might be explained by the fact that in this sample both duality and long-term incentives are more frequent for the U.S. banks. Still, most of the correlation coefficients are in range 0–0.7, thus, multicolliniarity does not exceed reasonable level for future analysis (Lu, Boateng 2018). The correlation coefficient above 0.7 for independent variables can be observed only between *Pay.to.assets* and *Size* (-0.81) and between *Lti.share* and *In.marg.rev* (0.71).

2.4. Methodology

The study investigates the link between CEO characteristics and bank risk-taking in the presence of the control for CEO compensation using both cross-section and panel data over 2014–2018. As a main method of analysis the paper uses cross-sectional regression with averaged data over the years 2014–2018. This approach has several benefits. First, it helps to increase the number of observations for an individual bank available for the cross-sectional analysis and overcome the problem of heavily unbalanced panel data. Second, it allows for the estimation of the time-invariant CEO characteristics. Third, and most importantly, yearly accounting-based measures of bank total risk might be biased, while averaging the data over a sample period provides a better proxy for the bank risk (Illiashenko, Laidroo 2020).

The panel regression using fixed effect model is used as a part of robustness analysis and includes interaction terms between time-variant CEO compensation variables and time-invariant CEO characteristics. The choice in favour of fixed effect (FE) model for the panel data analysis was made, as FE approach helps to investigate the effects within the bank. In addition, it better complements the main methodology (cross-sectional regression) than random-effect (RE) approach, as RE model can be viewed as a stack of cross-sectional regressions. All the calculations were performed using Stata software.

2.4.1. Cross-sectional regression

The study estimates the following specification using OLS and cross-section data :

$$Risk_i = f(Bank\ controls_i;\ Compensation_i;\ CEO\ characteristics_i) \quad (4)$$

where

i – denotes bank;
$Risk_i$ – risk proxy for bank$_i$, includes either *LnZs, LnMkt* or *LnσRoa;*
Bank Controls$_i$ – include bank $_i$ *Size, Growth, Int.marg.rev, Inc.div, Fund.div;*
Compensation$_i$ – includes either *Lti.share* or *Pay.to.assets;*
CEO characteristics$_i$ – includes the following variables based on statistical significance: *Age, Gender, Tenure, Duality, Insider, CEO_exp, Education* and *Specialization.*

CEO characteristics used for the modeling do not include *BankORfin* variable as in the final sample all CEOs for whom the compensation data are present, have *BankORfin* equals to one. Thus, there is no variation in the variable.

The testing procedure includes multi-stage modeling. The CEO characteristics variables are added one by one due to a small number of observations and strong correlation between the variables in this group (see data in Appendix 4). Finally, only CEO characteristics that are statistically significant in one by one models, are included into the final specification. Each specification is rerun 3 times using different proxies of bank risk.

The full procedure is as follows. At the first stage, the model specifications include only bank-level controls and compensation variables (Appendixes 5–6). The variables, which are statistically significant in at least one of the examined models are left in the regression specificiation for the next stages. At the second stage, a set of models are run, in which CEO characteristics variables are added one-by-one to the predictors that proved to be statistically siginificant in the first stage (Appendixes 7–9). The final specification includes combination of bank-level controls and CEO characteristics variables that were statistically significant at the first and second stages (Table 6).

2.4.2. Panel data

Next, the present study takes the advantage of having panel data. The common set of advantages of panel data includes: a) more precise estimation of model parametres; b) better ability to detect the individual behavoural pattern; c) better control over omitted variables; d) ability to capture for dynamic links over time (Hsiao 2007). Unfortunately, in the context of the present sample,

the panel data is heavily unbalanced, which reduces the accuracy of estimates. The next limitation of panel data is that it does not include episodes of a change of a CEO, thus, the data on CEO characteristics is time-invariant. Given its time-invariant nature, the data on CEO characteristics cannot be reasonably used in panel data specification. However, it is possible to investigate how interactions between CEO compensation components and other CEO characteristics are linked to bank risk by including their interaction term into the models.

For this purpose, the study relies on the following baseline model specification (using OLS):

$$\text{Risk}_{it} = f(Bank\ controls_{it};\ Compensation_{it};\ \text{Compensation}_{\text{it}} \times \text{CEO characteristic}_{\text{i}}) \quad (5)$$

where

Bank Controls, *Compensation* and *CEO characteristics* – vectors of predictors that include the same selection of variables as used in cross-section specification.

The regression results and robustness analysis are presented in the next Chapter.

3. EMPIRICAL FINDINGS

This section is organized as follows. First, it presents the results of regression analysis using cross-section data. Second, the results of regression analysis using panel data are discussed. The third subsection presents the results of robustness analysis. The section concludes with a discussion of the results obtained in all three previous subsections.

3.1. Cross-section analysis

This section, first, briefly describes how the main specification is constructed based on the stages described in section 2.4.1. Then, it presents the main results based on the final specification.

The cross-sectional regressions are analyzed with ordinary least squares (OLS) method. Tables in Appendix 5–6 report the regression results following the first stage of analysis described in section 2.4.1. Results show that coefficient estimates for bank-level characteristics (*Size*, *Growth*, *Int.marg.rev* and *Fund.div*) become statistically significant at least in one of the models. The inclusion of proxies for CEO compensation (*Lti.share* and *Pay.to.assets*) substantially inprove the explanatory power of the model as judged by the increase in adjusted R-squared. However, it appears that in the case of all three alternative dependent variables, the models that include only *Lti.share* as a proxy of CEO compensation are superior to the models that include both proxies. Therefore, the list of control variables used in the second stage of the analysis include all previously described bank-level controls and *Lti.share* as a proxy of CEO compensation.

Appendixes 7–9 show the regression results for the association between single CEO characteristic and bank risk in the presence of controls described above. The analysis finds that statistically significant association is present only in the case of four variables *Duality, Insider, Education* and *Specialization,* specifically, holding doctoral degree in comparison to bachelor's degree and majoring in *STEM* compared to business administration. *Duality* and *Education* are the only two CEO characteristics, which appear to be statistically significant for all 3 risk proxies in one-by-one models. For *LnMkt*, also *Insider* and *Specialization 5 (STEM)* becomes

statistically significant at 10 percent level. The coefficient estimate for *Insider* is negative, while positive for *STEM* major. Therefore, the final specification includes bank-level controls, *LTI.share* as a proxy of CEO compensation, *Duality, Insider* and *Education*. The final model does not include *Specialization* variable, as it is not statistically significant at the final modeling stage.

The regression results for the final specification are reported in Table 6.

Table 6. Regression results for final specification

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Size	0.073	(0.83)	0.037	(1.18)	0.068	(0.86)
Growth	1.897	(1.12)	0.469	(0.89)	3.086*	(1.82)
Inc.div	-2.201***	(-2.82)	-0.549*	(-1.75)	-2.161***	(-2.76)
Fund.div	-1.522	(-1.49)	-0.543	(-1.51)	-1.255	(-1.46)
Int.marg.rev	0.425	(0.49)	0.317	(1.03)	1.097	(1.38)
Lti.share	-0.677	(-1.41)	-0.735***	(-3.58)	-0.768*	(-1.94)
Duality	0.690***	(2.68)	0.161*	(1.90)	0.846***	(3.60)
Insider	-0.095	(-0.36)	-0.166*	(-1.87)	-0.112	(-0.46)
Master's	-0.115	(-0.67)	-0.140*	(-1.99)	-0.093	(-0.53)
PhD	0.631**	(2.42)	0.301*	(1.96)	0.782***	(3.10)
Intercept	-4.037*	(-1.87)	0.539	(0.87)	-7.066***	(-3.93)
N	78		80		78	
R^2	0.260		0.450		0.398	
Adjusted R^2	0.150		0.370		0.308	

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

With respect to the final specification, *Duality* is statistically significant for all three dependent variables and associated with increase in bank total risk. Similarly, *Education* variable (doctoral degree compared to bachelor's degree) is positively and significantly associated with all examined risk proxies (*LnZs, LnMkt, LnσRoa)* at 5 percent, 10 percent and 1 percent levels respectively. The result is unexpected, as earlier studies have rather provided evidence of the opposite link (Berger *et al*. 2014). The proportion of long-term incentives to total pay (*Lti.share*) is negative and significant for *LnMkt* and *LnσRoa* at 1 percent and 10 pecent levels. Among bank controls, income diversity (*Inc.div*) is significantly and negatively linked with all three risk proxies, while bank *Growth* is positively associated with *LnσRoa* with statistical significance at

10 percent level. The signs of coefficient for *Growth* variable looks logical, while *Inc.div.* was rather expected to be positively linked with bank risk (Illiashenko, Laidroo 2020).

To verify the accuracy of the results obtained from the final specifications, the series of econometric test on the validity of basic OLS assumptions were performed. These includes White's test for heteroscedasticity, Durbin-Watson and Breusch-Godfrey tests for autocorrelation, Jarque-Bera test for normality of residuals and Ramsey Reset test for model specification. The tests results suggest that the final model corresponds to main OLS assumptions. Still, to account for possible model imperfections the results are reported with robust standard errors.

3.2. Panel data analysis

Appendixes 9–13 summarize the panel regression results for the submodels, which include different combinations of interactions between CEO characteristics and proportion of long-term incentives to total compensation (*Lti.share*). The submodels were run separately for each proxy of bank risk. The panel specifications do not include *Size* variable, as there are perfect collinearity between *Size* and *Growth* variables (with next year *Size*). The tables show that almost all examined interactions appeared to be statistically insignificant, except interactions with education-related variables, specifically *Specialization.* The final panel model includes bank controls, *Lti.share*, interactions between *Lti.share* and CEO academic attributes, and bank fixed effects (which are not reported for brevity). Table 7 presents the results for final panel specification with FE model.

It can be seen that the interaction between academic specializations and proportion of long-term incentives becomes statistically significant for market-based z-score as dependent variable. The coefficients of interactions between CEO degree in economics, STEM or Law and other soft sciences with *Lti.share* is negative and statistically significant compared to business administration at 5, 1 and 10 percent respectively. As for the bank controls, bank growth (*Growth*) is positively and significantly linked with *LnZs* and *LnσRoa* at 1 percent level (corresponds to the results of Illiashenko, Laidroo 2020), while estimate coefficient for *Int.marg.rev* is positive and significant for the market-based risk proxy *LnMkt.*

Table 7. Panel regressions with interactions between CEO education-related variables and long-term incentives

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Growth	1.986***	(0.52)	-0.0218	(0.12)	1.921***	(0.52)
Inc.div	-1.429	(1.97)	-0.407	(0.84)	-1.080	(2.01)
Fund.div	-1.156	(1.99)	-0.0949	(0.54)	-0.960	(1.89)
Int.marg.rev	-1.345	(3.62)	2.991**	(1.37)	-0.768	(3.66)
Lti.share	-0.820	(1.81)	0.257	(0.21)	-0.938	(1.74)
Master's × Lti.share	1.777	(1.70)	-0.330	(0.29)	1.956	(1.66)
PhD × Lti.share	-1.781	(2.60)	0.718	(0.89)	-1.744	(2.63)
Economics × Lti.share	0.542	(1.79)	-0.836**	(0.37)	0.680	(1.81)
Finance × Lti.share	-1.712	(1.14)	-0.457	(0.28)	-1.720	(1.13)
Law and other × Lti.share	-0.824	(1.88)	-0.467*	(0.27)	-0.720	(1.82)
STEM × Lti.share	-3.874	(2.39)	-0.868***	(0.21)	-3.722	(2.43)
Intercept	-2.301	(2.495)	-1.367*	(0.69)	-5.319**	(2.50)
N		254		251		254
R^2		0.149		0.095		0.145
Adjusted R^2		0.110		0.053		0.106
F-statistic		6.52***		51.12***		6.16***

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

The Hausman test for the final specification shows that RE model is preferable. However, due to the reasons stated in section 2.4, the study decides in favour of FE model. The p-values of F-test for the panel regressions are less than 0.05, thus, models have explanatory power. The models testing with Modified Wald test for groupwise heteroskedasticity in Stata identifies the presence of heteroskedasticity. Thus, all panel regressions are estimated with robust standard errors.

3.3. Robustness analysis

To control for the reliability of the results presented in the previous sections, the study performs the series of robustness checks. The robustness analysis performed to ensure the validity of main results, specifically, to test if coefficient estimates of key variables in the main regression hold in case of changes in the regression specification. (Lu, White 2014). In this section, robustness analysis for cross-section and panel specifications presented separately.

3.3.1. Cross-section robustness check

To ensure that the results are not driven by a particular country or region, two robustness checks have been performed. First, using region fixed effects and second, by exclusing observations from the United States as the U.S. dominates the sample in terms of observations.

As the low numbers of bank-observations by country does not allow to reliabily test for country effects, the countries were grouped into regions. Based on geographical location, cultural background, dominant institutional environment and market development all the countries were roughly devided into 3 groups: Anglo-American (AAM), European (EU) and Emerging markets (EM). Anglo-American countries include United States, Canada, Australia and Great Britain. European region consists of European Union countries and Swiss, Emerging market group includes all the remaining countries mainly from South Asia and also two boundary countries, namely Russia and Turkey. The division of countries by region is shown in Appendix 14.

Table 8. Bank-CEO observations by region

	Region	Frequency	Percentage (%)	Cumulative %
AAM	Anglo-American region	45	37.19	37.19
EM	Emerging markets	36	29.75	66.94
EU	European region	40	33.06	100.00
Total:		121	100.00	100.00

Source: author's calculations

As can be seen from table 9, the main cross-sectional findings hold for the most of examined CEO characteristics with each key variable remains statistically significant for at least one of the risk metrics and the sign of their coefficient estimates remains unchanged.

In addition, to check that the results are not biased due to overrepresentation of U.S. banks in the sample, the final models were rerun excluding the observations of U.S. bank. The results are summarized in the table 10. Although, in the absence of the U.S. banks the study is unable to check for *Duality* (as it is not present outside the U.S.), it can be seen, that the results for *Lti.share*, *Insider* and *Education* (PhD) are in line with the main regressions.

Table 9. Cross-sectional regression results for final specification with region dummies

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Size	0.074	(0.85)	0.032	(1.03)	0.073	(0.93)
Growth	2.044	(0.97)	0.667	(1.04)	2.405	(1.27)
Inc.div	-2.166***	(-2.81)	-0.387	(-1.16)	-2.463***	(-3.09)
Fund.div	-1.429	(-1.18)	-0.384	(-1.02)	-1.699	(-1.60)
Int.marg.rev	0.320	(0.27)	0.120	(0.34)	1.648	(1.55)
Lti.share	-0.656	(-1.05)	-0.791***	(-3.21)	-0.769	(-1.37)
Duality	0.694**	(2.56)	0.145*	(1.70)	0.852***	(3.45)
Insider	-0.106	(-0.39)	-0.194**	(-2.13)	-0.048	(-0.19)
Master's	-0.109	(-0.66)	-0.125*	(-1.80)	-0.129	(-0.76)
PhD	0.620**	(2.24)	0.298*	(1.86)	0.810***	(3.27)
Reg2 (EM)	-0.058	(-0.16)	-0.183	(-1.49)	0.391	(1.13)
Reg3 (EU)	0.028	(0.07)	-0.043	(-0.33)	-0.023	(-0.06)
Intercept	-4.071*	(-1.85)	0.686	(1.10)	-7.172***	(-3.85)
N	78		80		78	
R^2	0.261		0.466		0.413	
Adjusted R^2	0.124		0.370		0.305	

Source: author's calculations

Notes:

1. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Table 10. Cross-sectional regression results for final specification excluding U.S. observations

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Size	0.069	(0.68)	0.060	(1.54)	0.042	(0.48)
Growth	0.453	(0.18)	0.061	(0.07)	1.973	(0.78)
Inc.div	-2.185**	(-2.36)	-0.366	(-0.89)	-2.144**	(-2.33)
Fund.div	-1.471	(-1.43)	-0.501	(-1.24)	-1.153	(-1.32)
Int.marg.rev	-0.309	(-0.29)	-0.210	(-0.53)	0.342	(0.33)
Lti.share	-0.439	(-0.80)	-0.680***	(-3.18)	-0.620	(-1.36)
Duality	0	0	0	0	0	0
Insider	-0.160	(-0.47)	-0.217*	(-1.87)	-0.185	(-0.58)
Master's	0.040	(0.17)	-0.155	(-1.66)	0.060	(0.27)
PhD	0.749**	(2.07)	0.436**	(2.39)	0.864**	(2.34)
Intercept	-3.721	(-1.66)	0.302	(0.44)	-6.328***	(-3.56)
N	53		55		53	
R^2	0.267		0.561		0.264	
Adjusted R^2	0.114		0.473		0.110	

Source: author's calculations

Notes:

1. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

3.3.2. Panel data

Panel data robustness testing includes final models with dropped U.S. observations as well as models with lagged compensation variables.

First, to assess whether the main finding from panel regression are not driven by the U.S. banks, similarly to cross-section, U.S. observations were excluded from the panel data. From table 11, it can be seen that regression outcomes for the key variables are almost identical with the core regression. The only notable difference for U.S. banks-free sample, is that the interaction between degree in Finance and *Lti.share* becomes statistically significant instead of *Economics* × *Lti.share* interaction term.

Table 11. Regression results for final specification with interactions, excluding U.S.

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Growth	2.962**	(1.18)	-0.290	(0.47)	2.751**	(1.16)
Inc.div	-3.979	(2.71)	-1.089	(1.32)	-3.553	(2.75)
Fund.div	-1.141	(2.03)	-0.508	(0.63)	-0.869	(1.94)
Int.marg.rev	0.411	(4.19)	3.468**	(1.59)	0.906	(4.23)
Lti.share	-1.226	(1.97)	0.286	(0.21)	-1.361	(1.90)
Master's × Lti.share	2.005	(1.92)	-0.287	(0.33)	2.235	(1.87)
PhD × Lti.share	-0.564	(1.75)	1.171	(0.81)	-0.508	(1.76)
Economics × Lti.share	0.794	(1.93)	-0.669	(0.40)	0.930	(1.92)
Finance × Lti.share	-1.609	(1.01)	-0.529*	(0.30)	-1.662	(1.00)
Law and other × Lti.share	-0.0401	(2.06)	-0.564*	(0.28)	0.0665	(2.00)
STEM × Lti.share	-3.693	(2.55)	-0.914***	(0.19)	-3.535	(2.61)
Intercept	-2.843	(2.23)	-0.800	(0.57)	-5.979***	(2.23)
N	162		160		162	
R^2	0.168		0.132		0.162	
Adjusted R^2	0.107		0.067		0.100	
F-statistic	6.08***		62084.95***		5.40***	

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Finally, as the studies on executive's remuneration often incorporate lagged compensation variables as it is an obvious subject to endogeneity, the panel model is tested using *Lti.share* lags. Following previous studies (Vallascas, Hagendorff, 2013) and taking into account short study sample, this paper uses *Lti.share* lagged 1 year. The results are summarized in table 12.

In case of 1-year *Lti.share* lag, the interaction between Finance major and proportion of long-term incentives becomes positively and significantly associated with both *LnZs* and *LnσRoa* at 1 percent level. For *LnMkt*, only interaction between STEM and *Lti.share* remains significant with still negative coefficient estimate. Interestingly, this is the only panel regression, where *Lti.share* separately becomes significant. The link with *LnZs* is negative at 0.1 level.

Table 12. Regression results for final panel specification using 1-year lagged compensation

	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Growth	1.500***	(0.52)	0.208	(0.16)	1.451***	(0.53)
Inc.div	-5.940***	(2.18)	0.392	(0.64)	-6.497***	(2.23)
Fund.div	-2.049	(2.92)	-0.752	(0.70)	-1.889	(3.05)
Int.marg.rev	1.703	(1.71)	-0.523	(0.39)	1.880	(1.78)
Lti(lag1)	-1.153*	(0.66)	0.043	(0.35)	-1.041	(0.64)
Master's × Lti(lag1)	0.678	(0.69)	0.205	(0.38)	0.592	(0.68)
PhD × Lti(lag1)	0.962	(0.71)	0.615	(0.63)	0.889	(0.71)
Economics × Lti(lag1)	-1.201	(1.29)	-0.237	(0.40)	-0.629	(1.34)
Finance × Lti(lag1)	1.817***	(0.60)	0.291	(0.28)	1.787***	(0.60)
Law and other × Lti(lag1)	0.324	(0.45)	-0.325	(0.48)	0.343	(0.48)
STEM × Lti(lag1)	0.499	(0.93)	-1.261***	(0.27)	0.355	(0.96)
Intercept	-2.140	(2.08)	0.985*	(0.50)	-4.630**	(2.16)
N		243		240		243
R^2		0.128		0.094		0.122
Adjusted R^2		0.087		0.050		0.080
F-statistic		18.67***		9.50***		8.76***

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.
3. *Lti(lag1) – Lti.share* lagged 1 year *(t-1)*

Taken together, the results suggest that the interaction between *STEM* and *Lti.share* remains consistently statistically siginificant and only in the case of *LnMkt* as a dependent variable.

3.4. Discussion

First of all, it is useful to note that the present study is subject to several important limitations, including scarce data availability, possible omitted variables (typical for these types of studies), relatively short sample period, and, correspondingly, the absence of cases of CEO changes in the data. In addition, due to the small number of observations the study does not fully control for possible differences between countries. This is a concern as banks in different countries are

subject to different legislative and institutional framework, accounting standards, reporting requirements and educational systems. While the author does her best to eliminate the possible effect of these shortcoming, the study conclusions reported below should be taken with caution.

Likewise, it is important to note, that the results of the present study do not necessarily imply causality as it is difficult to overcome endogeneity problem in this type of studies (IMF 2014; Aebi *et al.* 2011). For example, more aggressive banks may choose CEOs with higher risk tolerance, who better match their risk prefernces. Or banks with higher risk profile would like to hire female CEOs as they expect that more risk-averse female chief would better keep bank risks under control. This may lead to an observation that female CEOs are likely to take higher risks, which is not exactly the case. Given limited nature of the present research, the endogeneity problem should be taken into account while interpreting results. Thus, the results of the current thesis indicate the links between examined variables, rather than uncover causal relationship.

When it comes to the main results, first of all and as expected, the proportion of long-term incentives in total compensation negatively related to bank risk. This result is in line with theoretical expectations and supported by numerous empirical findings (for example, IMF 2014; Bhagat, Bolton 2014). Secondly, with respect to the present sample, only CEO duality and doctoral degree compared to undergraduate degree appear to be statistically significant in the context of examined risk measures. The results also indicate that CEO academic specialization also plays a role, however, these results are less robust. The study finds no or weak evidence of significance of other CEO characteristics for bank risk-taking.

The regression results report positive association between CEO duality and bank risk-taking. This contradicts CEO power hypothesis based on agency theory and MPT and findings of Pathan (2009), but consistent with empirical evidence provided by more recent studies (Lu, Boateng 2018; Altunbaş *et al.* 2020). However, the results are not perfectly comparable, as Pathan consider CEO duality together with the effect of insider CEO, while Altunbaş *et al.* use CEO duality as one of the four components of CEO power index. The only study, which examine purely CEO duality is of Lu and Boateng. However they observe bank credit risk in their paper compared to total risk measures examined in this study. The results seem to suggest that less constraint CEO tend to take greater risks.

In contrast with previous studies (Berger *et al.* 2014; Belghitar, Clark 2012), cross-sectional analysis finds positive link between doctoral degree and bank risk. The results, however, are not fully comparable, as in contrast to this paper Berger *et al.* investigate executive's PhD degree in relation to portfolio risk, while Belghitar and Clark measure CEO education by the sum of his academic and professional degrees. Still, there are at least two possible explanations. First, the number of banks with CEOs who holds doctoral degree is quite small, therefore, the results in the present study might be driven by the properties of the available data. Secondly, it might be the case that the results are different because the present study controls for compensation structure. It is not inconceivable that CEOs with specialized knowledge are more likely to respond to complex incentive structure by increasing the bank risk as they are in the position to take the risks that are better rewarded. Assuming reverse causality, it is possible to conclude that banks with higher risk profile are more likely to look for CEOs with more nuanced and specialized knowledge.

As per author's knowledge, CEO academic major has not been previously examined in the context of bank risk. The results are inconclusive. Coefficient estimates for CEO major become statistically significant only in panel regressions, where the effect of CEO major is present only as an interaction term between major and *Lti.share*. While the result is not very robust (statistical significance is largely present only in the case of market-based z-score as a dependent variable), it nevertheless, indicates a possibility for a causal link between CEO major and bank risk (since it is significant in the specification with lagged interaction). The result indicate that CEOs with more specialized background (STEM) take fewer risks comparing to CEOs who have business administration background. This might indicate that CEOs with STEM specialization can better understand and take advantage of complex compensation structure.

CONCLUSION

The last financial crisis has shown that banks might engage in excessive risk-taking, which could contribute to global macrofinancial instability and damage bank performance in a long run. Thus, the proper understanding of the drivers of bank risk-taking is important. In recent time a growing amount of literature investigates the relevance of top managers for corporate outcomes. However, only limited amount of the studies examine this topic in the context of bank risk-taking. In addition, these studies often provide mixed results. It might be suggested, that conflicting empirical results might be caused by several factors including not taking into account CEO compensation structure, differences in bank types and a single-country samples.

The aim of this paper was to explore the associations between various CEO-level characteristics and bank risk-taking on the sample of international commercial listed banks in the presence of CEO compensation structure. The study seeks to find the answer on the following research question: Which of different CEO characteristics have an association with bank risk-taking?

For this purpose, the study consider various CEO characteristics, including corporate governance related features (tenure, duality, internally promoted CEO), demographic attributes (age and gender), as well as professional (previous CEO experience, main career path) and educational background (academic degree and specialization).

To test the associations, this study examines the sample of 121 banks-CEOs for the years 2014–2018 from 28 countries located in North America, Europe and Asia-Pacific regions. Due to the data characteristics and limitations, the study uses cross-sectional regression with averaged data across all available years estimated by OLS method as a main model for the analysis. Main analysis is supplemented by panel regression analysis using bank fixed effect model that examines the interactions between compensation and CEO characteristics. In order to verify the validity of the key outcomes, the series of robustness checks have been conducted.

Empirical results show that with respect to the present sample, only CEO duality (positive association), and CEO education (positive association with PhD degree comparing to undergraduate degree) in the case of the main cross-section analysis or STEM major (comparing to business administration) in the case of supplementary panel regressions have statistically significant association with bank risk-taking. In line with previous studies and expectations, the share of long-term incentives in total compensation has a negative association with bank risk-taking. Overall, most of the hypotheses related to CEO specific characteristics have been rejected. Similarly to previous studies, the results slightly vary among different risk proxies.

Due to the limited data availability, the present study has a number of important limitations and just as in the case of majority of similar studies does not identify causality due to endogeneity concerns. Thus, the present findings should be taken and interpreted with caution.

The results suggest that the presence of compensation proxies is likely to affect the link between CEO characteristics and bank risk. Therefore, future studies should benefit from including such proxies into account and improving upon the present study in the number of observations.

KOKKUVÕTE

TEGEVJUHI KARAKTERISTIKUD JA PANGA RISKIVÕTMINE

Viimane finantskriis näitas, et pangad võivad minna kaasa liigse riskivõtmisega, mis võib soodustada globaalset makromajanduslikku ebastabiilsust ja kahjustada panga tulemuslikkust pikaajalises perspektiivis. Seega, asjakohane arusaam panga riskivõtmise mõjuteguritest on oluline. Viimasel ajal kasvav hulk kirjandust uurib tippjuhtide osatähtsust ettevõtte tulemustele. Ometi, ainult piiratud arv uuringuid vaatlevad antud teemat panga riskivõtmise konktekstis. Lisaks, need uurimused esitavad tihti vastuolulisi tulemusi. Võib eeldada, et vastuolulised empiirilised tulemused on põhjustatud mitmetest teguritest, sealhulgas tegevjuhi tasustamise struktuuriga mitte arvestamisega, pangatüüpide erinevustest ja ühe riigi valimitest.

Selle töö eesmärgiks oli uurida seoseid erinevate tegevjuhi karakteristikute ja panga riskivõtmise vahel rahvusvaheliste noteeritud kommertspankade kontekstis arvestades tegevjuhi tasustamise struktuuri. Töö otsib vastust järgmisele uurimisküsimusele: Millised tegevjuhi karakteristikud on seotud panga riskivõtmisega?

Seoste testimiseks käesolevas töös uuriti valimit, mis koosneb 121 panga-tegevjuhist ja katab 28 Põhja-Ameerika, Euroopa ning Aasia ja Vaikse Ookeani riiki ajavahemikus 2014-2018. Andmete omadustest ja piirangutest tulenevalt, kasutati uuringus põhimudelina ristandmetel põhineva regressiooni koos keskmistatud andmetega, mille hindamiseks kasutati vähimruutude meetodit. Põhianalüüs on täiendatud paneelregressiooni analüüsiga kasutades panga fikseeritud efektiga mudelit, mis testib interaktsioone tegevjuhi tasustamise ja tema karakteristikute vahel. Selleks, et kontrollida võtmetulemuste usaldusväärsust, töös viiakse läbi mitmeid täiendavaid teste kasutades erinevaid mudelite spetsifikatsioone.

Empiirilised tulemused näitavad, et uuritava valimi kontekstis, ainult tegevjuhi kahel toolil istumisel (*Duality,* positiivne seos) ja tema haridusel (doktorikraad, positiivne seos võrreldes bakalaureusekraadiga) ristandmete analüüsi korral ning tehnilistel erialadel *(STEM,* võrreldes

kõrgkooli kraadiga ärijuhtimises*)* täiendava paneelregressiooni korral on statistiliselt oluline seoses panga riskivõtmisega. Kooskõlas varasemate uuringute ja ootustega, pikaajaliste tasustamise komponentide (*long-term incentives*) osakaal kogutasus on negatiivselt seotud panga riskivõtmisega. Kokkuvõttes, enamik hüpoteese tegevjuhi karakteritikute kohta on ümber lükatud. Sarnaselt eelnevate uuringutega, varieeruvad tulemused kergelt erinevate riskimõõdikute vahel.

Seoses andmete piiratud kättesaadavusega, on käesoleval tööl mitmed olulised piirangud nagu enamikel saranastel uuringutel, töö ei tuvasta põhjuslikkust võimalike endogeensuse probleemide tõttu. Seega, käesolevaid tulemusi tuleb käsitleda ja intepreteerida ettevaatlikkusega.

Tulemused eeldavad, et tasustamise mõõdikute arvestamine tõenäoliselt võib mõjutada seoseid tegevjuhi karakteristikute ja panga riski vahel. Seega, tulevased uurimused võiksid saada kasu nende kaasamisest uuringusse ja täiustada käesolevat tööd suuremate vaatluste arvuga.

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APPENDICES

Appendix 1. Variable definitions

Variables	Definitions	Explanation
Dependent variables		
LnZs	reversed natural logarithm of accounting-based z-score	see equation (1)
LnMkt	reversed natural logarithm of market-based z-score	see equation (2)
LnσRoa	natural logarithm of standard deviation of ROA	see equation (3)
CEO characteristics		
Age	age of CEO	in years, on the end of calendar year
Gender	gender of CEO	1 if female, 0 if male
Duality	duality of CEO	1 if CEO and Chair, 0 if only CEO
Tenure	tenure on current position	in years, on the end of calendar year
Insider	insider CEO	1 if CEO is promoted internally, 0 otherwise
CEO_exp	previous CEO experience	1 if CEO has previous experience in Chief executive position, 0 otherwise
BankORfin	CEO main career background	1 if finance or banking, 0 if another sector
Education	CEO degree of education	1 if bachelor's, 2 if master's, 3 if PhD
Specialization	CEO academic specialization	1 if business, 2 if economics, 3 if finance, 4 if law or other 5 if STEM
CEO compensation variables		
Lti.share	proportion of CEO long-term incentives to his total compensation	(restricted stock awards + long-term incentive plan + all other compensation) /fiscal year total compensation
Pay.to.assets	relative size of CEO compensation to bank total assets	(fiscal year total compensation/bank total assets)×1000
Size	bank size	natural logarithm of bank total assets
Bank control variables		
Growth	growth	growth of total assets, year-over-year
Inc.div	income diversity	non-interest income/ (interest income + non-interest income)
Int.marg.rev	interest marginal revenue	net interest income/interest income
Fund.div	funding structure	deposits/total assets

Source: author's elaboration

Appendix 2. Number of observations by variable and year

Variable	2014	2015	2016	2017	2018
Tenure	80	92	98	94	87
Duality	80	103	115	115	106
Gender	80	103	115	115	106
Age	80	92	98	94	87
Insider	80	103	115	115	105
Ceo_exp	80	103	115	115	105
BankORfin	80	103	115	115	105
Education	79	101	113	113	103
Specialization	76	100	112	112	102
Size	100	107	112	91	86
Inc.div	100	107	112	107	86
Int.marg.rev	100	107	112	107	86
Fund.div	100	107	112	91	86
Growth	100	107	112	91	84
LnMkt	97	109	110	106	98
LnσRoa	100	111	112	107	86
LnZs	100	107	112	91	84
Lti.share	51	67	83	78	20
Pay.to.assets	50	64	78	60	11

Source: author's calculations

Appendix 3. Descriptive statistics by country (selected variables), cross-section

Country	N	lnσRoa	LnZs	LnMkt	Size	Inc.div	Int.marg.rev	Fund.div	Growth
US	25	-6.16	-4.07	0.32	18.50	0.32	0.88	0.74	0.13
IN	9	-6.04	-3.70	0.66	17.97	0.17	0.34	0.74	0.15
CA	7	-7.62	-4.86	-0.17	19.52	0.37	0.64	0.69	0.07
GB	7	-6.86	-4.15	0.40	19.72	0.28	0.64	0.63	0.00
AU	5	-7.43	-4.89	0.17	19.66	0.21	0.45	0.66	0.03
IT	5	-6.25	-3.81	1.00	18.56	0.44	0.63	0.59	0.01
MY	5	-7.09	-4.83	-0.03	17.87	0.30	0.45	0.77	0.03
TH	5	-6.30	-4.18	0.31	17.81	0.34	0.66	0.75	0.10
CH	4	-7.57	-5.03	-0.14	17.22	0.31	0.68	0.72	0.06
ES	4	-6.63	-4.04	0.75	19.35	0.36	0.61	0.72	0.03
TR	4	-5.40	-3.29	0.74	18.11	0.24	0.45	0.59	0.02
FR	3	-7.57	-4.54	0.54	21.20	0.61	0.47	0.43	0.02
ID	3	-5.53	-3.85	0.40	17.69	0.19	0.71	0.75	0.15
SE	3	-7.39	-4.64	0.28	19.37	0.37	0.60	0.41	0.00
SG	3	-7.49	-5.23	0.00	19.39	0.38	0.64	0.73	0.09
AT	2	-6.17	-3.60	0.79	18.87	0.31	0.68	0.73	-0.01
DE	2	-6.36	-3.69	0.80	18.81	0.32	0.62	0.66	-0.02
NL	2	-6.70	-3.88	0.38	20.21	0.16	0.39	0.64	-0.02
PH	2	-6.99	-4.86	0.24	17.41	0.29	0.76	0.81	0.13
PL	2	-6.32	-4.31	0.56	17.38	0.36	0.72	0.76	0.05
PT	2	-7.24	-4.60	1.09	17.82	0.46	0.50	0.76	-0.03
RU	2	-5.06	-2.93	0.17	18.24	0.18	0.43	0.71	0.13
VN	2	-5.54	-2.88	0.61	17.36	0.20	0.44	0.80	0.21
BE	1	-5.70	-2.24	1.21	19.02	0.05	0.02	0.11	-0.12
DK	1	-7.11	-4.14	0.33	19.96	0.40	0.53	0.31	0.02
GR	1	-5.37	-3.47	1.54	18.00	0.20	0.66	0.77	-0.04
IE	1	-7.66	-5.70	1.04	18.55	0.25	0.70	0.62	-0.02
NO	1	-6.83	-4.39	0.34	19.45	0.27	0.60	0.43	-0.01

Appendix 3 continues

Country	Lti.share	Pay.to.assets	Gender	Age
US	0.84	0.02	0.04	59.08
IN	0.22	0.01	0.22	58.39
CA	0.88	0.00	0.00	55.36
GB	0.68	0.01	0.13	55.88
AU	0.60	0.01	0.00	52.10
IT	0.56	0.01	0.00	57.41
MY	0.31	0.01	0.00	55.33
TH	NaN	NaN	0.00	57.80
CH	0.53	0.02	0.00	55.63
ES	0.43	0.00	0.00	56.28
TR	NaN	NaN	0.00	51.75
FR	0.42	0.00	0.00	55.17
ID	NaN	NaN	0.00	60.33
SE	0.36	0.01	0.67	58.33
SG	0.87	0.00	0.00	60.00
AT	0.49	0.01	0.00	64.50
DE	0.49	0.01	0.00	52.00
NL	0.26	0.00	0.00	55.25
PH	NaN	NaN	0.00	57.00
PL	0.44	0.02	0.00	60.75
PT	0.02	0.01	0.00	60.50
RU	NaN	NaN	0.00	44.50
VN	NaN	NaN	0.00	43.25
BE	0.00	0.00	0.00	50.00
DK	NaN	NaN	0.00	52.00
GR	NaN	NaN	0.00	69.00
IE	0.20	NaN	0.00	51.75
NO	0.05	0.00	0.00	56.00

Source: author's calculations

Notes:

1. NaN – no data.

Appendix 4. Correlation matrix, cross-section

Variable	LnσRoa	LnZs	LnMkt	Size	Growth	Inc.div	Int.marg.rev	Fund.div
LnσRoa	1.00	0.92	0.44	-0.16	0.30	-0.21	0.28	0.13
LnZs	0.92	1.00	0.53	-0.06	0.09	-0.24	0.03	-0.05
LnMkt	0.44	0.53	1.00	-0.05	-0.22	-0.17	-0.27	-0.23
Tenure	0.09	0.01	-0.09	-0.19	0.39	-0.10	0.17	0.19
Duality	0.46	0.26	-0.03	-0.15	0.37	0.04	0.62	0.32
Gender	0.10	0.11	0.09	-0.06	0.08	0.01	-0.14	-0.15
Age	0.07	-0.06	-0.10	-0.08	0.14	0.10	0.32	0.26
Insider	-0.15	-0.18	-0.35	0.07	0.04	0.35	0.17	0.05
CEO_exp	0.13	0.23	0.08	0.07	0.18	-0.27	-0.09	0.01
Education	0.08	0.09	0.13	0.32	-0.15	0.00	-0.12	-0.06
Specialization	-0.02	0.02	0.12	0.14	-0.07	0.21	0.01	-0.10
Size	-0.16	-0.06	-0.05	1.00	-0.39	0.42	-0.17	-0.51
Inc.div	-0.21	-0.24	-0.17	0.42	-0.11	1.00	0.26	-0.28
Int.marg.rev	0.28	0.03	-0.27	-0.17	0.43	0.26	1.00	0.42
Fund.div	0.13	-0.05	-0.23	-0.51	0.53	-0.28	0.42	1.00
Growth	0.30	0.09	-0.22	-0.39	1.00	-0.11	0.43	0.53
Lti.share	0.09	-0.09	-0.54	0.12	0.36	0.22	0.71	0.33
Pay.to.assets	0.20	0.08	0.05	-0.81	0.38	-0.27	0.39	0.41
Variable	LTI.share	Pay.to.assets	Tenure	Duality	Gender	Age	Insider	CEO_exp
LnσRoa	0.09	0.20	0.09	0.46	0.10	0.07	-0.15	0.13
LnZs	-0.09	0.08	0.01	0.26	0.11	-0.06	-0.18	0.23
LnMkt	-0.54	0.05	-0.09	-0.03	0.09	-0.10	-0.35	0.08
Tenure	0.15	0.12	1.00	0.32	0.03	0.55	0.02	0.12
Duality	0.46	0.22	0.32	1.00	-0.05	0.34	0.00	-0.13
Gender	-0.16	-0.04	0.03	-0.05	1.00	-0.02	0.01	-0.06
Age	0.17	0.00	0.55	0.34	-0.02	1.00	0.09	-0.09
Insider	0.24	0.09	0.02	0.00	0.01	0.09	1.00	-0.40
CEO_exp	0.00	-0.08	0.12	-0.13	-0.06	-0.09	-0.40	1.00
Education	-0.12	-0.44	0.00	-0.03	0.00	0.17	-0.21	0.03
Specialization	-0.10	0.10	-0.04	0.04	-0.10	-0.13	-0.01	-0.08
Size	0.12	-0.81	-0.19	-0.15	-0.06	-0.08	0.07	0.07
Inc.div	0.22	-0.27	-0.10	0.04	0.01	0.10	0.35	-0.27
Int.marg.rev	0.71	0.39	0.17	0.62	-0.14	0.32	0.17	-0.09
Fund.div	0.33	0.41	0.19	0.32	-0.15	0.26	0.05	0.01
Growth	0.36	0.38	0.39	0.37	0.08	0.14	0.04	0.18
Lti.share	1.00	0.07	0.15	0.46	-0.16	0.17	0.24	0.00
Pay.to.assets	0.07	1.00	0.12	0.22	-0.04	0.00	0.09	-0.08

Appendix 4 continues

Variable	Education	Specialization
LnσRoa	0.08	-0.02
LnZs	0.09	0.02
LnMkt	0.13	0.12
Tenure	0.00	-0.04
Duality	-0.03	0.04
Gender	0.00	-0.10
Age	0.17	-0.13
Insider	-0.21	-0.01
CEO_exp	0.03	-0.08
Education	1.00	-0.01
Specialization	-0.01	1.00
Size	0.32	0.14
Inc.div	0.00	0.21
Int.marg.rev	-0.12	0.01
Fund.div	-0.06	-0.10
Growth	-0.15	-0.07
Lti.share	-0.12	-0.10
Pay.to.assets	-0.44	0.10

Source: author's calculations

Appendix 5. Cross-sectional regression with bank controls

	(1)		(2)		(3)	
	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Size	-0.0981	(-1.29)	-0.0719**	(-2.34)	-0.133	(-1.64)
Growth	0.874	(0.76)	-1.621***	(-2.69)	1.990*	(1.70)
Inc.div	-1.135	(-1.55)	-0.0836	(-0.26)	-1.223	(-1.56)
Fund.div	-1.015	(-1.11)	-0.0956	(-0.28)	-0.820	(-0.98)
Int.marg.rev	-0.215	(-0.49)	-0.284	(-1.37)	0.516	(1.15)
Intercept	-1.220	(-0.68)	2.115***	(3.25)	-3.590*	(-1.98)
N	112		114		112	
R^2	0.0819		0.153		0.135	
Adjusted R^2	0.0386		0.113		0.0946	

Source: author's calculations

Notes:

2. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
3. Robust standard errors reported in parentheses.

Appendix 6. Cross-sectional regression with bank controls and CEO compensation

	(4)	(5)	(6)	(7)	(8)	(9)
Variable	LnZs	LnMkt	LnσRoa	LnZs	LnMkt	LnσRoa
Size	0.045 (0.45)	0.015 (0.48)	0.052 (0.56)	-0.013 (-0.09)	-0.004 (-0.08)	-0.024 (-0.18)
Growth	1.264 (0.79)	0.114 (0.22)	2.452 (1.50)	1.240 (0.77)	0.128 (0.25)	2.463 (1.48)
Inc.div	-2.099** (-2.50)	-0.584* (-1.84)	-2.138** (-2.53)	-2.112** (-2.40)	-0.555* (-1.68)	-2.152** (-2.43)
Fund.div	-1.125 (-0.95)	-0.431 (-1.07)	-0.812 (-0.77)	-1.237 (-0.99)	-0.411 (-0.94)	-0.981 (-0.86)
Int.marg.rev	1.295* (1.78)	0.553* (1.92)	2.210*** (3.32)	1.492* (1.72)	0.591 (1.62)	2.442*** (3.08)
Lti.share	-0.740 (-1.51)	-0.788*** (-3.43)	-0.883** (-2.10)	-0.766 (-1.49)	-0.823*** (-3.18)	-0.877* (-1.97)
Pay.to.assets	–	–	–	-9.463 (-0.60)	-3.664 (-0.58)	-12.60 (-0.84)
Intercept	-4.242* (-1.72)	0.631 (0.93)	-7.57*** (-3.49)	-3.084 (-0.98)	1.008 (0.88)	-6.048** (-2.04)
N	79	81	79	76	77	76
R^2	0.116	0.299	0.218	0.116	0.296	0.219
Adjusted R^2	0.0425	0.242	0.153	0.0247	0.225	0.138

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 7. Cross-sectional results of different specifications for LnZs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Age	-0.001 (-0.07)	–	–	–	–	–	–	–
Female	–	0.276 (1.01)	–	–	–	–	–	–
Duality	–	–	0.639** (2.48)	–	–	–	–	–
Tenure	–	–	–	-0.009 (-0.78)	–	–	–	–
Insider	–	–	–	–	-0.169 (-0.64)	–	–	–
CEO_exp	–	–	–	–	–	0.224 (1.20)	–	–
Master's	–	–	–	–	–	–	-0.060 (-0.33)	–
PhD	–	–	–	–	–	–	0.669*** (2.32)	–
Economics	–	–	–	–	–	–	–	0.240 (1.02)
Finance	–	–	–	–	–	–	–	0.147 (0.57)
Law and other	–	–	–	–	–	–	–	0.071 (0.26)
STEM	–	–	–	–	–	–	–	0.093 (0.28)
Intercept	-4.2** (-1.65)	-4.5** (-1.71)	-3.8* (-1.67)	-4.1** (-1.66)	-4.1** (-1.68)	-4.1** (-1.67)	-4.4** (-1.82)	-4.6** (-1.94)
N	79	79	79	79	79	79	78	77
R^2	0.116	0.124	0.180	0.120	0.121	0.133	0.180	0.165
Adjusted R^2	0.0291	0.0372	0.0993	0.0330	0.0348	0.0471	0.0853	0.0383

Source: author's calculations

Notes:

1. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 8. Cross-sectional results of different specifications for LnMkt

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Age	0.002 (0.27)	–	–	–	–	–	–	–
Gender	–	0.031 (0.26)	–	–	–	–	–	–
Duality	–	–	0.152* (1.81)	–	–	–	–	–
Tenure	–	–	–	-0.000 (-0.04)	–	–	–	–
Insider	–	–	–	–	-0.152* (-1.69)	–	–	–
CEO_exp	–	–	–	–	–	0.014 (0.21)	–	–
Master's	–	–	–	–	–	–	-0.098 (-1.32)	–
PhD	–	–	–	–	–	–	0.338*** (2.87)	–
Economics	–	–	–	–	–	–	–	0.145 (1.47)
Finance	–	–	–	–	–	–	–	-0.061 (-0.71)
Law and other	–	–	–	–	–	–	–	0.114 (1.12)
STEM	–	–	–	–	–	–	–	0.247* (1.93)
Intercept	0.544 (0.79)	0.601 (0.85)	0.742 (1.18)	0.634 (0.93)	0.775 (1.22)	0.642 (0.95)	0.406 (0.57)	0.618 (0.94)
N	81	81	81	81	81	81	80	79
R^2	0.300	0.299	0.318	0.299	0.322	0.299	0.396	0.364
Adjusted R^2	0.232	0.232	0.252	0.231	0.257	0.232	0.328	0.270

Source: author's calculations

Notes:

1. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 9. Cross-sectional results of different specifications for LnσRoa

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa
Controls	yes	yes	yes	yes	yes	yes	yes	yes
Age	0.006 (0.40)	–	–	–	–	–	–	–
Gender	–	0.322 (1.14)	–	–	–	–	–	–
Duality	–	–	0.802*** (3.38)	–	–	–	–	–
Tenure	–	–	–	-0.009 (-0.85)	–	–	–	–
Insider	–	–	–	–	-0.215 (-0.86)	–	–	–
CEO_exp	–	–	–	–	–	0.061 (0.33)	–	–
Master's	–	–	–	–	–	–	-0.027 (-0.14)	–
PhD	–	–	–	–	–	–	0.828*** (2.72)	–
Economics	–	–	–	–	–	–	–	0.245 (1.03)
Finance	–	–	–	–	–	–	–	0.143 (0.59)
Law and other	–	–	–	–	–	–	–	0.062 (0.24)
STEM	–	–	–	–	–	–	–	-0.421 (-1.40)
Intercept	-7.8*** (-3.51)	-7.9*** (-3.41)	-7.0*** (-3.76)	-7.4*** (-3.39)	-7.4*** (-3.45)	-7.5*** (-3.52)	-7.6*** (-3.49)	-8.1*** (-3.89)
N	79	79	79	79	79	79	78	77
R^2	0.219	0.227	0.311	0.221	0.226	0.219	0.288	0.272
Adjusted R^2	0.142	0.151	0.243	0.145	0.150	0.142	0.206	0.162

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 10. Panel regression with bank controls and CEO compensation

	(1)		(1)		(1)	
	LnZs		LnMkt		LnσRoa	
Variable	coef.	std. error	coef.	std. error	coef.	std. error
Growth	1.899***	(0.51)	-0.069	(0.11)	1.827***	(0.50)
Inc.div	-1.205	(1.94)	-0.175	(0.78)	-0.792	(2.01)
Fund.div	-0.684	(2.13)	-0.522	(0.52)	-0.496	(2.05)
Int.marg.rev	-0.540	(3.21)	2.711**	(1.20)	-0.128	(3.22)
Lti.share	-0.449	(0.57)	-0.093	(0.18)	-0.408	(0.57)
Intercept	-3.194	(2.44)	-1.016*	(0.60)	-6.132**	(2.45)
N	262		259		262	
R^2	0.093		0.051		0.085	
Adjusted R^2	0.075		0.033		0.067	

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 11. Results for panel regressions with interactions (LnZs)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs	LnZs
Growth	1.746 *** (0.53)	1.914 *** (0.52)	1.887 *** (0.52)	1.742 *** (0.53)	1.867 *** (0.53)	1.907 *** (0.53)	1.863 *** (0.53)	2.030 *** (0.52)
Inc.div	-1.478 (1.84)	-1.483 (2.02)	-1.337 (1.996)	-1.649 (1.94)	-1.664 (2.02)	-1.663 (2.04)	-1.188 (1.93)	-1.469 (1.94)
Fund.div	2.094 (2.76)	-0.510 (2.21)	-0.526 (2.22)	2.279 (2.78)	-0.674 (2.211)	-0.851 (2.09)	-0.860 (2.10)	-0.829 (2.11)
Int.marg.rev	-3.417 (3.15)	-0.167 (3.10)	-0.429 (3.22)	-3.035 (3.12)	0.146 (3.28)	0.055 (3.35)	-1.415 (3.42)	-1.701 (3.50)
Lti.share	3.192 (3.22)	-0.762 (0.70)	-0.467 (0.59)	-1.077 (0.77)	0.657 (0.74)	-0.746 (0.75)	-1.437* (1.21)	0.313 (0.99)
Age× Lti.share	-0.083 (0.06)	–	–	–	–	–	–	–
Female× Lti.share	–	1.253 (1.09)	–	–	–	–	–	–
Duality× Lti.share	–	–	-0.584 (0.53)	–	–	–	–	–
Tenure× Lti.share	–	–		-0.0171 (0.15)	–	–	–	–
Insider× Lti.share	–	–	–	–	-1.396 (0.95)	–	–	–
Ceo_exp× Lti.share	–	–	–	–		0.811 (1.14)	–	–
Master's× Lti.share	–	–	–	–	–	–	1.644 (1.30)	–
PhD× Lti.share	–	–	–	–	–	–	-1.963 (2.88)	–
Economics× Lti.share	–	–	–	–	–	–	–	0.210 (2.02)
Finance× Lti.share	–	–	–	–	–	–	–	-1.330 (1.35)
Law and other × Lti.share	–	–	–	–	–	–	–	-2.238** (1.01)
STEM× Lti.share	–	–	–	–	–	–	–	-4.213** (1.77)
Intercept	-2.316 (2.44)	-3.331 (2.38)	-3.201 (2.45)	-2.832 (2.40)	-3.458 (2.44)	-3.347 (2.41)	-2.349 (2.45)	-2.324 (2.55)
N	242	261	261	242	261	261	257	254
R^2	0.110	0.098	0.094	0.106	0.098	0.095	0.11	0.14
Adjusted R^2	0.088	0.076	0.072	0.083	0.077	0.073	0.084	0.104

Source: author's calculations

Notes:

1. *, **, *** – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 12. Results for panel regressions with interactions (LnMkt)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt	LnMkt
Growth	-0.053 (0.11)	-0.048 (0.11)	-0.041 (0.11)	-0.046 (0.11)	-0.050 (0.11)	-0.047 (0.11)	-0.026 (0.11)	-0.029 (0.12)
Inc.div	-0.501 (0.87)	-0.420 (0.84)	-0.416 (0.83)	-0.598 (0.85)	-0.423 (0.83)	-0.383 (0.85)	-0.478 (0.84)	-0.383 (0.83)
Fund.div	-0.519 (0.79)	-0.415 (0.51)	-0.449 (0.51)	-0.491 (0.83)	-0.435 (0.51)	-0.411 (0.51)	-0.245 (0.51)	-0.158 (0.52)
Int.marg.rev	3.171 ** (1.44)	2.924 ** (1.27)	2.894 ** (1.24)	3.178 *** (1.46)	2.930 *** (1.26)	2.849 ** (1.27)	3.133 *** (1.34)	3.002 *** (1.28)
Lti.share	-0.798 (2.20)	-0.183 (0.21)	-0.142 (0.18)	-0.407 (0.30)	-0.051 (0.23)	-0.118 (0.24)	-0.0635 (0.24)	0.054 (0.24)
Age× Lti.share	0.011 (0.04)	–	–	–	–	–	–	–
Female× Lti.share	–	0.197 (0.31)	–	–	–	–	–	–
Duality× Lti.share	–	–	0.129 (0.08)	–	–	–	–	–
Tenure× Lti.share	–	–	–	0.047 (0.05)	–	–	–	–
Insider× Lti.share	–	–	–	–	-0.104 (0.30)	–	–	–
Ceo_exp× Lti.share	–	–	–	–	–	-0.068 (0.29)	–	–
Master's× Lti.share	–	–	–	–	–	–	-0.286 (0.32)	–
PhD× Lti.share	–	–	–	–	–	–	0.606 (0.92)	–
Economics× Lti.share	–	–	–	–	–	–	–	-0.782** (0.34)
Finance× Lti.share	–	–	–	–	–	–	–	-0.536** (0.25)
Law and other × Lti.share	–	–	–	–	–	–	–	-0.161 (0.30)
STEM× Lti.share	–	–	–	–	–	–	–	-0.812*** (0.28)
Intercept	-1.243 (0.77)	-1.107* (0.63)	-1.109* (0.62)	-1.267 (0.77)	-1.114* (0.63)	-1.087* (0.62)	-1.346* (0.69)	-1.324** (0.63)
N	241	258	258	241	258	258	254	251
R^2	0.063	0.057	0.057	0.067	0.056	0.056	0.073	0.089
Adjusted R^2	0.039	0.035	0.034	0.043	0.033	0.033	0.046	0.055

Source: author's calculations

Notes:

1. ∗, ∗∗, ∗∗∗ – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 13. Results for panel regressions with interactions (LnσRoa)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa	LnσRoa
Growth	1.685*** (0.52)	1.848*** (0.52)	1.825*** (0.52)	1.683*** (0.52)	1.801*** (0.52)	1.842*** (0.52)	1.798*** (0.52)	1.970*** (0.51)
Inc.div	-1.099 (1.89)	-1.152 (2.06)	-1.002 (2.04)	-1.301 (1.98)	-1.329 (2.06)	-1.338 (2.08)	-0.812 (1.98)	-1.118 (1.98)
Fund.div	2.150 (2.66)	-0.283 (2.13)	-0.317 (2.13)	2.346 (2.69)	-0.457 (2.13)	-0.647 (1.99)	-0.629 (2.01)	-0.602 (2.02)
Int.marg.rev	-2.952 (3.15)	0.322 (3.09)	0.0442 (3.23)	-2.559 (3.12)	0.625 (3.29)	0.550 (3.36)	-0.877 (3.45)	-1.191 (3.54)
Lti.share	3.164 (3.25)	-0.759 (0.68)	-0.442 (0.59)	-1.069 (0.76)	0.702 (0.73)	-0.734 (0.74)	-1.506 (1.17)	0.309 (0.98)
Age× Lti.share	-0.081 (0.06)	–	–	–	–	–	–	–
Female× Lti.share	–	1.356 (1.11)	–	–	–	–	–	–
Duality× Lti.share	–	–	-0.526 (0.54)		–	–	–	–
Tenure× Lti.share	–	–	–	-0.004 (0.15)	–	–	–	–
Insider× Lti.share	–	–	–	–	-1.420 (0.95)	–	–	–
Ceo_exp× Lti.share	–	–	–	–	–	0.856 (1.14)	–	–
Master's× Lti.share	–	–	–	–	–	–	1.786 (1.27)	–
PhD× Lti.share	–	–	–	–	–	–	-1.883 (2.90)	–
Economics × Lti.share	–	–	–	–	–	–	–	0.316 (2.13)
Finance× Lti.share	–	–	–	–	–	–	–	-1.299 (1.34)
Law and other × Lti.share	–	–	–	–	–	–	–	-2.249** (1.01)
STEM× Lti.share	–	–	–	–	–	–	–	-4.096** (1.77)
Intercept	-5.208** (2.45)	-6.303*** (2.39)	-6.172** (2.46)	-5.742** (2.42)	-6.426** (2.44)	-6.317** (2.42)	-5.368** (2.47)	-5.321** (2.56)
N	242	261	261	242	261	261	257	254
R^2	0.102	0.092	0.087	0.098	0.092	0.089	0.105	0.129
Adj. R^2	0.079	0.071	0.065	0.075	0.070	0.067	0.080	0.097

Source: author's calculations

Notes:

1. "*, **, ***" – statistical significance at 10 percent, 5 percent, and 1 percent levels.
2. Robust standard errors reported in parentheses.

Appendix 14. Sample division by region for cross-section

Abbr.	Country	Region	Frequency	Distribution, %
AU	Australia	AAM	5	4.13
CA	Canada	AAM	7	5.79
GB	Great Britain	AAM	8	6.61
US	United States	AAM	25	20.66
ID	Indonesia	EM	3	2.48
IN	India	EM	9	7.44
MY	Malaysia	EM	7	5.79
PH	Philippines	EM	2	1.65
SG	Singapore	EM	3	2.48
TH	Thailand	EM	5	4.13
TR	Turkey	EM	4	3.31
VN	Vietnam	EM	2	1.65
RU	Russia	EM	2	1.65
AT	Austria	EU	2	1.65
BE	Belgium	EU	1	0.83
CH	Switzerland	EU	4	3.31
DE	Germany	EU	3	2.48
DK	Denmark	EU	2	1.65
ES	Spain	EU	5	4.13
FR	France	EU	3	2.48
GR	Greece	EU	1	0.83
IE	Ireland	EU	2	1.65
IT	Italy	EU	6	4.96
NL	Netherlands	EU	2	1.65
NO	Norway	EU	1	0.83
PT	Portugal	EU	2	1.65
SE	Sweden	EU	3	2.48
PL	Poland	EU	2	1.65
Total AAM:			45	37.19
Total EM:			36	29.75
Total EU:			40	33.06
Total:			121	100.00

Source: author’s calculations

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