Executive Board Composition and Bank Risk Taking

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Abstract

Little is known about how socioeconomic characteristics of executive teams affect corporate outcomes. Exploiting a unique dataset, we examine how age, gender, and education composition of executive teams affect bank risk taking. First, we establish that age, gender, and education jointly affect the variability of risk taking. Second, we use difference-in-difference estimations that focus on mandatory executive retirements and find that younger executive teams increase risk taking, as do board changes that result in a higher proportion of female executives. In contrast, if board changes increase the representation of executives holding Ph.D. degrees, risk taking declines.

Keywords: Banks, executives, risk taking, age, gender, education

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I. INTRODUCTION

Corporate governance research has devoted tremendous effort to studying the roles of the board of directors in recent years, and a vast body of literature discusses the composition of the board of directors specifically.[1] Those studies focus on board independence in terms of inside and outside directors (e.g., Hermalin and Weisbach (1988); Fich (2005); Raheja (2005); Linck, Netter, and Yang (2008)), how this composition affects CEO turnover (Weisbach (1988)); the determinants of board size (e.g., Raheja (2005); Boone, Field, Karpoff, and Raheja (2007)), the conditions under which the board is controlled by insiders as opposed to outsiders (Harris and Raviv (2006)), the link between ownership structure and board composition (Denis and Sarin (1999)), and the effect of outside directors on firm performance (e.g., Hermalin and Weisbach (1991); Agarwal and Knoeber (1996); Rosenstein and Wyatt (1997); Klein (1998); Dahya, McConnell, and Travlos (2002); Perry and Shivdasani (2005); Fich and Shivdasani (2006); Dahya and McConnell (2007); Coles, Daniel, and Naveen (2008); Nguyen and Nielsen (2010)). Another group of studies relates board diversity in terms of gender to firm performance (e.g., Farrell and Hersch (2005); Adams and Ferreira (2009); Ahern and Dittmar (2010); Adams and Funk (2011)).

Despite this large volume of research on board composition, economists have given much less consideration to the socioeconomic composition of the firm's top management team, i.e., the inside directors that are charged with the day-to-day running of the business such as the CEO, other senior executives, e.g., the CFO, the COO, and the executives of subdivisions. While a few theoretical and empirical studies report that individual executives matter for firm behavior, especially its strategic direction, its policies with respect to financing, investment, organization,

[1] Adams, Hermalin, and Weisbach (2010) provide an extensive review of the literature on the role of boards of directors in corporate governance. Regulatory attempts to increase outside director representation on corporate boards to increase board independence such as the Sarbanes-Oxley Act in the U.S. and the Cadbury report in the U.K. with the intention to appoint directors with greater monitoring incentives sparked off a large volume of academic research on the effect of outside directors on firm outcomes. However, the evidence for a beneficial effect of outsiders on firm performance has remained far from convincing so far (e.g., Klein (1998); Dahya and McConnell (2007)).

and stock returns and merger decisions (e.g., Rotemberg and Saloner (2000); Bertrand and Schoar (2003); Adams, Almeida, and Ferreira (2005); Malmendier and Tate (2005, 2008)), we are not aware of any study that explores the ramifications arising from the top management team's composition for firm risk-taking behavior.[2,3]

We argue a team perspective is crucial because a firm's executives form a team and interact dynamically with each other in the decision-making process.[4] Theoretical work by Holmstrom (1982) and Bolton and Dewatripont (2005) highlights the importance of moral hazard in multi-agent settings. The individual effort provided by a group member is likely to be influenced by group characteristics that determine the degree of mutual monitoring. In the case of executive boards, this has important consequences for corporate outcomes. Further, we believe that top management team heterogeneity plays a significant role in the decision making of corporate boards. On the one hand, diversity[5] in terms of differences of socioeconomic characteristics of the management team might contribute to a more thorough decision-making process, since heterogeneous board members are influenced by different experiences which enable a more

[2] Recent work by Kahane, Longley, Simmons (forthcoming) shows that cultural diversity in teams positively affects performance. Their study, however, is constrained to an analysis of professional sports players in the National Hockey League (NHL).

[3] Note that standard agency models underscore that managers have discretion they use to affect corporate decisions and advance their own interests. However, such models do not necessarily suggest that corporate outcomes vary with individual executives because such models do not focus on differences among top executives. In contrast, an alternative view in the literature focuses on the match between executives and firms. In these studies, managers do not impose a certain style on the firm, rather, firms deliberately choose certain managers because of their characteristics (Jovanovic (1979)). For instance, a distressed bank may appoint a CEO who has a track record of turning around troubled institutions (for details, see, e.g., Bertrand and Schoar (2003)). The latter strand of literature illustrates the endogeneity of executive board composition and firm performance which we address in our empirical strategy.

[4] Some recent studies discuss group decision-making processes. Adams and Ferreira (2010) report that individuals tend to place riskier bets than groups who arrive at more moderate decisions, reflecting deliberation within groups that leads to better information sharing among members. Their evidence is consistent with results by Adams, Almeida, and Ferreira (2005), who show that firms with powerful CEOs have more variable stock returns.

[5] For a widely-cited survey article see Williams and O'Reilly (1998).

extensive analysis. Similarly, executive boards that are characterized by homogeneity may be more likely to engage in groupthink (Janis (1972, 1982)). This might lead to unbalanced decisions taken at the top management level that affect corporate outcomes, e.g., risk taking. On the other hand, it is possible that a too heterogeneous board complicates communication processes between executives. If individuals come from very different backgrounds, this might harm their cooperation and restrict their ability to decide appropriately.

In this paper, we complement and extend the literature on corporate governance in a number of dimensions. First, we argue that corporate outcomes indeed reflect consensus decisions reached among top executives who may have diverse opinions because of differences originating from each individual executive's socioeconomic background. Collectively, executive boards will therefore exhibit considerable heterogeneity due to individual managers' preferences, risk aversion, skills, education, and opinions. In a first step of our analysis, we document that socioeconomic characteristics of executive teams have important effects on the variability of corporate outcomes by applying Glejser's (1969) heteroskedasticity test. In the second step, we then address the specific question of how socioeconomic characteristics of the executive board in terms of age, gender, and education composition affect risk taking.[6] Unlike previous work, we adopt a different definition for performance and home in on risk taking only. The intuition is that the relevant literature in sociology and economics yields more direct predictions about the associations between the socioeconomic characteristics we focus on here and risk taking than it does for performance in general.

[6] We also considered focusing our analysis on the executive team's work experience. However, such analysis is unlikely to yield additional insights beyond those that we report in this study because age and female gender are highly correlated with work experience (see also Section V.C.). Moreover, defining work experience is difficult because executives with higher education such as Ph.D. degrees have substantially less many years job experience than executives who do not hold a Ph.D. degree. Consequently, measurement problems relating to job experience impede such analysis.

In contrast to previous studies (e.g., Bertrand and Schoar (2003); Fich (2005); Farrell and Hersch (2005)), we do not exclude regulated industries. Instead, we focus exclusively on the banking industry. While restricting the empirical analysis comes at the cost in terms of industry representativeness, our approach has the advantage that the findings are based on a more homogeneous set of firms, and also allows contributing to the scant literature on corporate governance arrangements in banking (e.g., Adams and Mehran (2003); Macey and O'Hara (2003); Caprio, Laeven, and Levine (2007)). This is particularly important against the background of the recent financial crisis. In fact, anecdotal and emerging empirical evidence suggests that poor governance arrangements in banking have far-reaching consequences for society (Hau and Thum (2009)). In banking, corporate governance arrangements differ from those of non-financial firms, reflecting that not only shareholders and debtholders, but also regulators have vested interests. Following major repercussions from the recent financial crisis, a lively debate has ensued among policy makers, regulators, central bankers, and academics about how to improve and reform governance arrangements in banking, and what drives bank risk taking (Laeven and Levine (2009); Kirkpatrick (2009)). While numerous explanations have already been invoked for why banks take excessive risk, e.g., executive pay, moral hazard arising from deposit insurance and too-important-to-fail considerations, our research adds a new dimension to this literature by enhancing the understanding of how socioeconomic factors affect collective decision making about risky project choices in corporate finance in general. Moreover, the empirical regularities we uncover also offer pointers for how to inform the debate about improving governance arrangements in banking in particular, since little is known about the effect of executive board composition on risk taking (Dahya *et al.* (2002)), despite its immediate relevance for policy and regulation.

We analyze this question in the context of a system of corporate governance with two-tier boards. In two-tier systems, the executive board, which is chaired by the CEO, runs the corporation, takes most of the decisions relating to the day-to-day operations, and reports to the supervisory board which is designated with the monitoring role equivalent to the role of non-executive directors in the one-tier system found in Anglo-Saxon economies. The supervisory board appoints and dismisses members of the executive board on behalf of shareholders, and also sets executives' remuneration. Members of the executive board must not be members of the supervisory board and vice versa to avoid conflicts of interest (Dittmann, Maug, and Schneider (2010)).[7] Thus, examining the effect of executive board composition on risk taking in the context of a two-tier system of boards offers the benefit of a clear distinction between inside directors, i.e., executives that are responsible for running the firm, and outside directors that sit on the supervisory board.

This clear distinction is significant in the context of risk taking. In their analysis of the board's role as advisor and monitor of management, Adams and Ferreira (2007) show that increasing board independence in a one-tier system reduces the CEO's propensity to disclose information to the non-executive directors to avoid interference into management decisions. This has direct implications for risk taking because CEO and top management decisions are less well informed since the board cannot effectively perform its advisory role providing input on alternative project choices. Instead, in the two-tier system, Adams and Ferreira (2007) conclude that the CEO does not face trade-offs in disclosing information to the supervisory board. Since the supervisory board's interests are aligned with those of shareholders, monitoring of the executive board is more intensive, suggesting, on balance, less risk taking in a two-tier system of boards.[8] To that extent, our research therefore also extends the emerging literature on the design of corporate board structures (for a review, see, e.g., Khanna, Kogan, and Palepu (2006)). In the aftermath of several spectacular scandals such as Enron, Worldcom, Tyco, and Parmalat, some studies called into question the efficiency of one-tier boards and advocate mandating two-tier boards (Adams and Ferreira (2007); Gillette *et al.* (2008)). While the literature surprisingly focuses almost exclusively

7 In practice, however, many supervisory board members are either former executive board members or have close ties to the executive board.

8 Adams and Ferreira (2007, p. 242) find that increasing the independence of supervisory boards "unambiguously increases shareholder value". Gillette, Noe, and Rebello (2008), in their experimental comparison of different board structures around the world, find two-tiered boards adopt institutionally preferred policies more frequently but are also more conservative in their investment decisions.

on the one-tier system, it is not necessarily the dominant one. Internationally, there is considerable variation in board structures: Austria, Belgium, China, Croatia, Czech Republic, Denmark, Estonia, Georgia, Germany, the Netherlands, Indonesia, Latvia, Mauritius, Poland, Spain, and Taiwan all rely on two-tier boards, whereas Bulgaria, Finland, France, and Switzerland allow either one-tier or two-tier boards (Denis and McConnell (2003); Adams and Ferreira (2007)).[9]

In our research, we focus on Germany, a country where two-tier boards are legally mandated (Kaplan (1994); Gorton and Schmid (2004)). Beyond the relevance of two-tier boards in an international context, many similarities exist between the German banking system and those in other countries such as Austria, Switzerland, Spain, and France. These nations also have small numbers of large internationally active financial institutions, but tend to be dominated by small and medium-sized banks that provide financing for firms and households (Puri, Rocholl, and Steffen (2011)), suggesting that the findings from this study transcend the German economic context. In addition, there is no reason to believe that socioeconomic determinants only affect executives' collective decisions in two-tier board systems. Consequently, the inferences we draw also may apply to top managers operating in one-tier board systems such as the U.S.

We use unique data from the German central bank, the Deutsche Bundesbank, to match executives to banks. The specific advantage of our data set is that it contains complete and detailed information about executives' age, gender, and education to construct indicators of the composition of the executive board for the period 1994-2010 for 19,750 bank-executive years in 1,817 banks.

Exploiting exogenous changes in board composition arising from mandatory executive retirements for identification, we use difference-in-difference estimation techniques in combination with matching methods that also account for mean reverting dynamics in our risk measures to

[9] One-tier boards can be found in Australia, Brazil, Canada, Egypt, India, Italy, Japan, Malaysia, Norway, Philippines, Singapore, South Africa, South Korea, Sweden, Thailand, Turkey, U.S., Ukraine, United Kingdom, and Zimbabwe.

consider the endogeneity of board composition (Hermalin and Weisbach (1988, 1998); Adams, Hermalin, and Weisbach (2010)).

By way of preview, we establish in our initial analysis that the variability of bank risk taking is affected by the executive board's socioeconomic composition. To the best of our knowledge, this is a novel result in the literature. In further analyses, we use difference-in-difference estimation to identify in which direction executive board characteristics affect risk taking in the banking sector. Here we obtain three key results: First, banks take on more risk if they are managed by younger executives. Second, female board members tend to increase risk taking. A more detailed exploration suggests that this result reflects that female executives have less expertise on the executive level than their male counterparts, and we obtain this result despite the fact that we control for executives' age which is highly correlated with experience. Third, raising the proportion of executives with Ph.D. degrees reduces risk taking. Our findings are insensitive to a vast array of robustness tests in which we use alternative risk measures and employ alternative samples that exclude loss-making banks, merged banks, and use banks from alternative control groups. The results are also confirmed in a final placebo test where we pretend that the board change occurred two periods before it actually took place and do not find significant effects on risk taking.

The remainder of the paper is organized as follows. In Section II, we develop our hypotheses about the effect of the socioeconomic characteristics of banks' executive boards on risk taking. Section III introduces our dataset, including descriptive statistics about the evolution of the composition of the top management teams over time, and provides a brief synopsis of the German banking sector. Our econometric approach is discussed in Section IV. We report on our hypothesis tests and several robustness checks in Section V. Concluding remarks are presented in Section VI.

II. HYPOTHESIS DEVELOPMENT

In this section, we develop our hypotheses.

A. Executive board composition and corporate outcomes

The starting point of our research is the consideration that executive board composition influences corporate decision making. Both characteristics of individual executives and top management team heterogeneity are important determinants of board behavior. This idea finds support in work by Graham, Harvey, and Puri (2008) and Adams and Ferreira (2009), who find that characteristics and preferences are of significant importance for board decisions and firm outcomes. As a consequence, we anticipate being able to document that bank risk taking is affected by board composition. We now turn to a more detailed description of how individual board characteristics can affect risk taking.

B. Executive board age composition and risk taking

Our first line of enquiry is concerned with the effect of the executive board's age composition on risk taking.

Conventional wisdom as well as empirical evidence suggest that risk taking decreases with an individual's age. In terms of investment behavior, Campbell (2001) reports a weakly negative age effect on participation in equity investments. Examining risk attitudes of households, Bucciol and Miniaci (forthcoming) also find that risk tolerance declines in age, and survey evidence by Sahm (2007) and Grable, McGill, and Britt (2009) indicates that older individuals are less risk tolerant. Grable *et al.* (2009) attribute this result to an increase in attained knowledge of risk and risky situations relative to younger people. Agarwal, Driscoll, Gabaix, and Laibson (2009) complement this literature by analyzing lifecycle patterns in financial decisions relating to credit behavior. They report that younger individuals tend to make more mistakes than older people, e.g., they are less able to adequately value properties, they suboptimally use credit card balances, and they pay excessively high fees. Overconfidence (i.e., too low risk perception/assessment) also plays a role. Russo and Schoemaker (1992) and Gervais and Odean (2001) suggest inexperience in younger individuals causes misattribution of success resulting in an upward revision of their perceived ability to control risk. Over time, however, people better assess their abilities and their risk tolerance decreases. Survey evidence on self-ratings about executives also suggests that mature executives are less keen to take risk than their younger counterparts (MacCrimmon and Wehrung (1990)).

These considerations suggest our ***Age hypothesis***.

HI. Age hypothesis: Risk taking decreases in board age.

C. Executive board gender composition and risk taking

Our second hypothesis about the effect of executive board's composition on risk reflects a growing debate in the economics and finance literature about gender and its effect on economic outcomes (e.g., Croson and Gneezy (2009)). [10]

Risk-taking behavior with respect to investment decisions and gender differences has been investigated by Barsky, Juster, Kimball, and Shapiro (1997), Jianakoplos and Bernasek (1998), Sundén and Surette (1998), and Agnew, Balduzzi, and Sundén (2003). The consensus in these studies is that women are more risk averse in financial decision making. This finding seems attributable to the observation by Barber and Odean (2001) and Niederle and Vesterlund (2007) who consider women to be less overconfident than their male counterparts. Since overconfident managers invest less into information acquisition, they make poorer investment decisions (Goel and Thakor (2008)).[11]

A separate, but also burgeoning literature analyzes the effects of gender in the context of corporate governance arrangements. These studies do not fully support these results obtained for individual investment decisions. While Farrell and Hersch (2005) find an inverse link

[10] Croson and Gneezy (2009) offer a review of the literature but do not discuss the numerous studies in labor economics where a substantial body of literature is concerned with gender pay gaps and job market outcomes. For instance, Blackaby, Booth, and Frank (2005) find evidence for a promotions and pay gap in U.K. academia, and McDowell, Singell, and Ziliak (1999) and Ginther and Hayes (1999) report similar findings for the U.S.

[11] Malmendier and Tate (2008) show that overconfident CEOs overpay for target companies in decisions that result in value-destroying mergers.

between firm risk and female directors, Adams and Funk (2011) show that female directors are more prone to take risks than men. The effect of female board representation on profitability and firm value is also negative (Adams and Ferreira (2009); Ahern and Dittmar (2010)). This result suggests female directors engage in excessive monitoring that decreases shareholder value (Almazan and Suarez (2003); Adams and Ferreira (2007)), and that women make poorer investment decisions since they face bigger obstacles than men obtaining information about investment projects (Bharat, Narayan, and Seyhun (2009)).

Only two studies focus on gender differences in banking, but this research is limited to loan officers and does not examine bank executives. Agarwal and Wang (2009) and Beck, Behr, and Güttler (2009) show that default rates for loans originated by female loan officers tend to be lower than for those originated by male loan officers. The possibility that female bank executives have less outside options (Olivetti and Petrongolo (2008)) and the evidence that women have strong monitoring incentives (Almazan and Suarez (2003)) suggests bank risk is likely to decrease if more female executives are present. However, there is also evidence for negative effects on corporate outcomes arising from female board representation. Ahern and Dittmar (2010) find that female directors negatively influence firm value in Norway and attribute this result to the significantly lower job experience of women.[12] Since the effect of female executives is a priori unclear, we formulate two alternatives for our ***Female risk hypothesis***.

HIIa. Female risk-reduction hypothesis: A higher representation of female executives reduces risk taking.

HIIb. Female risk-increasing hypothesis: A higher representation of female executives increases risk taking.

D. Executive board education composition and risk taking

[12] Their study focuses on the introduction of a gender quota in 2003 that required 40% of firms' directors to be female.

Next, we develop a hypothesis about the effect of educational attainment on risk taking since a growing number of studies discuss the links between educational background and individual investment behavior on the one hand, and corporate officer's education on firm performance on the other hand.

Several studies associate education with risk-taking behavior in household money matters. Carducci and Wong (1998) and Grable (2000) demonstrate that higher educational attainment increases individuals' propensity to take risk in everyday financial decisions, and Christiansen, Schröter Joensen, and Rangvid (2008) show that higher education also increases participation in stock market investments. Bucciol and Miniaci (forthcoming), in contrast, do not find significant correlations between education and risk attitudes of households.

Evidence on the effect of inside, i.e., executive, directors' educational background on firm financing policies is presented by Graham and Harvey (2001). Their survey evidence underscores executives with MBA degrees more frequently use sophisticated project valuation techniques and tend to rely more on the CAPM for estimating cost of capital than executives without such degrees. Intuitively, the use of more sophisticated techniques should reduce firm risk.[13] However, Bertrand and Schoar (2003) report that executives with MBAs tend to be more aggressive, and run more levered firms, suggesting MBA graduates engage in riskier firm policies.[14] Based on these two conflicting views in the literature, we formulate two alternative variations of the ***Education hypothesis.***

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13 We do not claim that the use of sophisticated techniques in banks (e.g. VaR or Credit Risk Models) necessarily depends on education. We would rather suggest that these tools do already exist (due to regulatory requirements) and education influences if and how executives understand them, and how they are able to translate the outcome of these tools into adequate management decisions.

14 A related strand of literature examines how non-executive directors' financial expertise affects firm outcomes. DeFond, Hann, and Hu (2005) show that stock markets respond positively to the appointment of non-executive directors with financial expertise, and Dionne and Triki (2005) find financially knowledgeable non-executives improve firms' hedging and risk management policies. Similarly, Güner, Malmendier, and Tate (2008) report that directors with financial expertise have significant influence on firms' financing policies and acquisition strategies. For banks, Fich and Fernandes (2009) report that a lack of financially experienced non-executives

HIIIa. Positive education hypothesis: Better educated executives engage in less risk taking.

HIIIb. Negative education hypothesis: Better educated executives engage in greater risk taking.

In Table I, we provide an overview about our three hypotheses.

[Table I: HYPOTHESES]

III. DATA

This section introduces our dataset.

A. Data

For the empirical analysis, we match managers with bank-specific data to track the movements of individual managers between banks over time for the period 1994 - 2010. Our approach accounts for the fact that firm-specific effects are correlated with manager characteristics, which requires a separation of manager characteristics from bank fixed effects (Bertrand and Schoar (2003)). To do so, we combine two data sets from the Deutsche Bundesbank. The first data set is a novel data set that provides detailed information about the entire population of executive managers at banks in Germany. This file contains the identity and selected biographical information of all top managers such as the CEO, CFO, COO, and the managers of subdivisions such as the chief loan officer, the chief internal auditor, and the chief risk officer that are active in a function required to be reported to the supervisory authority by the Banking Act. The German Banking Act stipulates a set of criteria, e.g., adequate theoretical and practical knowledge of the banking business, as well as managerial expertise, which ought to be met before a candidate can be appointed to an executive position, and the appointment

correlates positively with the failure of financial institutions during the financial crisis, suggesting the absence of financial expertise reflects poor ability to monitor risky activities. Consequently, international efforts that aim to curtail bank risk taking embrace the idea that banks should have directors with sufficient knowledge of banking activities to enable effective governance (Basel Committee on Banking Supervision (2006)).

requires prior approval by the regulator.[15] In line with these mandatory requirements, we define an executive as an individual who is a member of the executive board. Since this database also contains information about the employment history of each executive with different banking firms, we can then match the manager data to the second data set which provides bank-specific information filed annually with the regulatory authority for 19,750 bank-year observations.

B. Sample Construction

We first provide a brief overview about the German banking sector, where three different types of banks operate: Private banks, public sector banks, and credit cooperatives. While all these banks are universal banks, these types of institutions differ in terms of ownership structure (Brunner, Decressin, Hardy, and Kudela (2004)). The private bank pillar contains large nationwide banks, and regional banks. The larger private banks are organized as joint-stock companies whereas their smaller counterparts are partnerships, private limited companies or even sole proprietors. The public sector banks include savings banks and Landesbanks owned by governments at the city-, county-, or state-level. The cooperative banking pillar comprises cooperative banks and central credit cooperatives. These banks are organized as mutuals.

Starting from the entire population of private, public, and cooperative banks in Germany, we first remove all banks from the sample that were subject to regulatory interventions, capital support measures, and distress mergers (see Berger, Bouwman, Kick, and Schaeck (2011)) to allow a clean identification of the effect of changes in board composition on bank risk taking in a sample of banks that does not contain seriously troubled institutions. Next, we split our sample on an annual basis into mutually exclusive groups of banks that experienced changes in

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[15] The Bank Act clearly sets out the details of when an individual can be considered as having relevant managerial experience. This experience is normally assumed if the candidate has the professional qualifications necessary for managing an institution and if the person can demonstrate three years' managerial experience at an institution of comparable size and type of business.

executive board composition (treatment group) and the remaining set of banks that did not experience changes in board composition (control group). A bank that experienced any one of the types of board change we study in this paper cannot be a control group in our sample.

We restrict our samples to changes in board composition that do not alter the size of the executive board. Our reasoning for this restrictive criterion is as follows: a change in board size may affect the strategic alignment and corporate outcomes of banks. For example, it is very likely that adding an additional senior executive to the bank's board, such as a chief risk or chief loan officer impacts the group's decision-making process and may be driven by endogenous factors, e.g., supervisory or shareholder pressure to contain risk taking or organizational considerations such as merger and acquisition activities. Since we are interested in the effects of how socioeconomic characteristics of executives affect bank risk taking and want to exclude the possibility that board changes are driven by organizational considerations, this assumption of only examining board replacements is necessary to allow identification of the parameters of interest.[16]

Specifically, we construct three samples on which our estimations are performed. For the analysis of the effect of age composition on risk taking, we construct the treatment group of banks that observe a decrease in average board age following mandatory retirement of executives. For the analysis of gender composition and risk taking, banks with an increase in the female proportion of board members after the board change are classified as the treatment group. Finally, to test our education hypothesis, banks that experience an increase in the representation of board members holding Ph.D.s form our treatment group.[17] The benefit of

[16] That is, we exclude „endogenous“ executive turnovers, i.e. we do not want to measure a drop in bank risk-taking after an executive was dismissed because of his or her risk-loving behavior.

[17] In unreported tests, we also exploit information on the presence of MSc and MBA degrees using the biographical information about bank executives. Those tests are qualitatively identical to the results shown in the paper using Ph.D. degrees. On balance, the magnitude of the effect of Ph.D. degrees is stronger than for MSc and MBA degrees and we therefore only present the results for Ph.D. degrees. Since the Ph.D. degrees are nested within the

having three different subsamples is that this approach allows a clean identification of the effect of board changes.

To obtain the corresponding control groups for the three samples of banks experiencing board changes in age, gender, and education composition, we match the treatment banks with banks of similar characteristics that experienced no change of any kind (i.e., no change in age, gender, or education composition) in the executive board in the respective year.

As matching criteria, we use size, time period, and bank type to account for the considerable heterogeneity among German banks in terms of ownership structures, business models, and scope and scale of activities. The size criterion ensures comparing banks with similar operations in terms of scope and scale and business model (Schaeck, Cihak, Maechler, and Stolz (forthcoming)). Specifically, we match bank *i* to other banks whose total assets range between 80 and 120% of bank *i*'s total assets in the same year. The bank type criterion ensures comparing banks from the same banking pillar. As a final criterion, we match on previous performance, captured by return on assets (ROE) to reflect on the fact that accounting measures of firm performance are mean reverting over time (Barber and Lyon (1996); Huson, Malatesta, and Parrino (2004); Schaeck *et al.* (forthcoming)).[18] For the match on previous performance, we select banks whose ROE lies between 80 and 120% of the ROE of the bank where the executive retired in the period prior to the retirement. Our matching procedure is a *1:n* matching method that ensures we have at least one control bank for each bank that experienced

MSc and MBA results we do not report the results for MSc and MBA degrees here. They are available from the authors upon request.

[18] The problem of mean reversion may be particularly relevant in instances when there are changes among executive board members because this resembles mean reversion around treatment. This phenomenon was detected by Ashenfelter (1978). He examined the impact of job training programs on earnings of different groups of trainees in the months prior to and after entering a training programs and found that increases in earnings after the job training resemble a return to a mean path of earnings that was interrupted only temporarily by some sort of labor market phenomenon.

a board change. Since we want to exploit the entire population of German banks, we do not restrict the number of control banks in the sample.

Table II presents means and standard deviations for characteristics of executive boards and banks in our dataset. The first column refers to characteristics of the treatment group. This sample contains bank-year observations of banks that experience a change in board composition. We have 855 observations with a decrease in average board age, 28 observations with an increase in female board share, and 46 observations with an increase in the proportion of board members with Ph.D.s. For each treated bank, at least three and at most seven bank-year observations around the treatment period are included. In the empirical tests below, we only consider one board change per bank, and we delete banks whose board change of any one type coincides with another board change of the same type in a time window of +/- three years. While removing banks with regulatory interventions, capital support measures, banks that exited the market via forced mergers and those that had their charter revoked from the sample, and imposing the criterion to focus only on changes if no other board change occurred within a three-year time window reduces the number of board changes we can use for our analysis, our conservative approach avoids influences from endogenous effects arising from risk taking. It also mitigates the scope for confounding effects arising from two board changes taking place within a short span of time to be better able to have a clean sample to identify the effect of replacing executives.

[Table II: SUMMARY STATISTICS]

In Table II, the second column describes our control banks in more detail. We include the matched banks that do not experience any of the considered board changes here. The last column describes the entire set of banks that are used in our estimations. Treated banks are very similar to control banks in terms of average board age and female board representation. They tend to have a slightly higher share of board members holding a Ph.D.

In Table III and Figure I, we show how executive board composition has evolved since 1994 in Germany. We present mean values of board characteristics and the number of board changes in each year. During this time period, board size has increased significantly by almost 70%. On average, board members nowadays are older, more experienced and have longer tenure. The number of board changes inducing a decrease in average board age suggests that this shift mainly took place in the 1990s. Although still on a very low level, female representation has risen during the observation period. Whereas in 1994, just 1% of all board seats were filled by women, this share tripled by 2010. However, in the last years, the female share has not increased much, thus stimulating a discussion about gender quotas.

[Table III: EVOLUTION OF BOARDS]

[Figure I: EVOLUTION OF BOARDS]

IV. EMPIRICAL METHODOLOGY

A. Glejser tests for heteroskedasticity

Prior to estimating the effect of board changes on risk taking, we conduct Glejser (1969) tests for heteroskedasticity to establish that executive board composition matters for variability in bank risk.[19] Note that the purpose of this exercise is not yet to offer insights into whether age, gender, and education composition increase or decrease risk-taking. Rather, the intention is to provide an empirical underpinning that that these three dimensions have observable implications for the variability in risk-taking that will be followed by more detailed explorations in subsequent analyses.

Recent work by Adams *et al.* (2005) and Cheng (2008) exploit Glejser (1969) tests to examine how characteristics of firm's boards and their members affect firm performance and risk taking. The Glejser (1969) test proceeds in two steps. First, we estimate a regression of banks' risk on the variables of interest and control variables. The variables of interest contain

[19] The difference between the Glejser test and the Breusch-Pagan test is that the Glejser test does not assume a linear relationship between the error variance and the explanatory variables in testing for heteroskedasticity.

information on board composition as detailed more specifically below. Second, we use the absolute value of the residuals obtained from this estimation and regress them on the same set of independent variables. We first estimate the following regression

$$\left[\frac{RWA}{TA}\right]_{it} = \alpha_o + \alpha_1 avg\_Age_{it} + \alpha_2 share\_female\ board\ members_{it} + \alpha_3 share\_Ph.D.s + \alpha_4 total\ assets_{it} + \alpha_5 Total\ Asset\ Growth_{it} + \alpha_6 \left[\frac{Core\ deposits}{TA}\right]_{it} + \alpha_7 Capital\ Adequacy\ Ratio_{it} + \alpha_8 \left[\frac{Customer\ Loans}{TA}\right]_{it} + \alpha_9 \left[\frac{OBS\ items}{TA}\right]_{it} + \alpha_{10} Merger_{it} + \alpha_{11} Powerful\ CEO_{it} + \alpha_{12} Board\ Size_{it} + \alpha_{13} GDP\ growth_{it} + \alpha_{14} interest\ rate\ spread_t + \alpha_{15} Population_{it} + \eta_{it} \quad (1)$$

The dependent variable is the ratio of risk-weighted assets to total assets (RWA/TA) as measure of bank risk. The concept of risk-weighted assets is widely used as a standard measure of risk in banking supervision and regulation (Basel Committee on Banking Supervision (2010)), and has also been used extensively in the empirical banking literature because it is perceived to be a true ex ante measure of risk (e.g., Avery and Berger (1991); Shrieves and Dahl (1992); Berger (1995)). This ratio weights assets and off-balance sheet activities according to their perceived risk to allow inferences about the soundness of the bank. We use this risk measure as our main dependent variable because unlike other widely used proxies of bank risk such as non-performing loans and loan loss provisions, our measure is more likely to reflect changes in risk-taking behavior of the bank without any time lags.[20] In addition, since our sample consists primarily of small and medium-sized public and

[20] The Z-score, computed as the ratio of a bank's capital to total assets plus return on assets over the standard deviation of return on assets is another widely used measure of risk taking in the literature. However, computation on the standard deviation of returns requires a rolling time window for long time series that are not adequately available with our data and we therefore do not exploit this measure in our analysis.

cooperative banks whose main risks arise from the balance sheet's asset side rather from the liability side, it is the best possible approximation of the risks inherent in these types of institutions.

Our three main explanatory variables in the Glejser (1969) tests are **average board age** (avg_age), the **share of female board members** (share_female board members) and the **share of board members with Ph.D.s** (share_Ph.D.s). These variables indicate how the executive board of bank *i* is composed during year *t* in terms of age, gender, and education and constitute the three proxies for the board's socioeconomic composition that we focus on.

Control variables

The regressions contain several control variables. We include bank size, measured in terms of **Total assets (log, deflated[21])** to account for the fact that larger banks have more subdivisions and larger branch office networks that are more complex to manage. Since larger banks have a greater capacity to absorb risk and some institutions are considered to be too important to fail, we anticipate a positive relation between size and risk taking.

In times of fast asset growth, banks are supposedly characterized by a different degree of risk taking than during normal times. To control for this effect, we add **total asset growth**.

Keeley (1990) has shown that risk-taking incentives are reduced if banks have high charter values. To proxy for a bank's charter value, we include the ratio of **core deposits to total assets**, and expect an inverse relation between risk taking and charter value.[22]

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[21] Nominal variables are deflated to the base year 2000.

[22] The charter value reflects future economic rents a bank can obtain via its access to markets that are largely protected from competition. Traditionally, charter values in banking are measured using Tobin's q. However, in the absence of a large number of listed banks, an alternative measure of charter value needs be considered. Hutchison and Pennacchi (1996) provide evidence that the ratio of demand deposits to total deposits is informative about a bank's charter value. Furlong and Kwan (2006) find a similar positive relationship.

We control for the **Capital adequacy ratio (measured by Tier 1 and Tier 2 capital to risk-weighted assets)** because theory suggests that a higher level of capital reduces moral hazard incentives, and encourages banks' monitoring incentives (e.g., Morrison and White (2005); Allen, Carletti, and Marquez (2011). We expect an inverse relation between the capital adequacy ratio and risk taking.

To account for differences in balance sheet composition, we include the ratio of **Customer loans to total assets**, and the ratio of **Off-balance-sheet items to total assets**.[23] While we anticipate a risk-increasing effect arising from loan exposure, the effect of off-balance sheet activities is not clear ex ante. On the one hand, corporate hedging by the use of off-balance-sheet items can reduce risk substantially. Dionne and Triki (2005) report that hedging increases a firm's return on equity which indicates that it has effects on corporate outcomes. On the other hand, off-balance-sheet items also represent an alternative way of risky investments for banks which would imply a positive relation.

To consider the effect of corporate control activities, we incorporate a **Merger dummy** into our regressions. This variable takes on the value one if the bank engaged in a merger or acquisition in any previous year during the sample period or zero otherwise. Accounting for mergers is important because they frequently coincide with changes in board composition. [24]

[23] Off-balance-sheet items are defined as the sum of contingent liabilities (contingent liabilities from bills of exchange; liabilities from guarantees and contracts of indemnity; liabilities from furnishing of securities for outside liabilities) and other undetermined liabilites (repurchase obligations from reverse purchase agreements; placement obligations and underwriting obligations; unconditional loan commitments including obligations from interest rate-related options, forwards and futures).

[24] In unreported tests, we replicate our estimations from Table VII below and omit all banks that were involved in mergers and acquisitions during the sample period. The number of observations decreases from 6,440 in Column (I) of Table VII to 3,782, from 3,073 (Column II) to 1,378, and from 1,229 (Column III) to 632. The results, however, are identical with respect to sign and significance of the estimated coefficients. The results are available upon request.

To reflect on findings by Adams, Almeida, and Ferreira (2005) that influential CEOs can directly affect risk, we include **Powerful CEO** as a control, captured by the current CEO's tenure. The effect of a powerful CEO can be counterbalanced by the other executives. We therefore also consider **Executive board size**. Group decision making gives rise to more diverse opinions, and the ultimate decisions are compromises that reflect the different group members' views on risky projects resulting in rejection of both too risky and too good projects, reducing risk taking on balance (Sah and Stiglitz (1986, 1991)).

GDP growth is the annual percentage change of real GDP per capita on the federal state level. This variable adjusts the regressions for the macroeconomic environment. We anticipate a positive relation between GDP growth per capita and risk taking since episodes of economic prosperity frequently coincide with increased risk taking (Dell'Ariccia and Marquez (2006)).

We include the **interest rate spread** between 10-year and 1-year government bonds in Germany. This spread captures the effect of inflation expectations and macroeconomic conditions and has strong implications for the degree of bank risk taking. Additionally, a large interest rate spread allows banks to issue long-term loans at high rates while refinancing cheaply at low rates through short-term debt. This gives rise to maturity mismatch and influences a bank's risk profile.

Finally, we consider market size since banks may be able to realize economies of scale in their business activities. To this end, we add **population (log)** of the state where the bank has its headquarters as a proxy for market size to our set of control variables. This approximation is widely used in the literature on banking markets (e.g., Dick (2007)).

To proceed with the Glejser (1969) test, we model the absolute value of the residuals as a function of the explanatory variables described above:

$$
\begin{aligned}
|\hat{\eta}it| = \beta_o + {} & \beta_1 avg\_Age_{it} + \beta_2 share\_female\,board\,members_{it} \\
& + \beta_3 share\_Ph.D.s + \beta_4 total\,assets_{it} + \beta_5 Total\,Asset\,Growth_{it} \\
& + \beta_6 \left[\frac{Core\,deposits}{TA}\right]_{it} + \beta_7 Capital\,Adequacy\,Ratio_{it} \\
& + \beta_8 \left[\frac{Customer\,Loans}{TA}\right]_{it} + \beta_9 \left[\frac{OBS\,items}{TA}\right]_{it} + \beta_{10} Merger_{it} \\
& + \beta_{11} Powerful\,CEO_{it} + \beta_{12} Board\,Size_{it} + \beta_{13} GDP\,growth_{it} \\
& + \beta_{14} interest\,rate\,spread_t + \beta_{15} Population_{it} + \mu_{it}
\end{aligned} \qquad (2)
$$

where $\hat{\eta}_{it}$ denotes the residuals from the risk regression. In this test, we are interested in the significance of the variables that capture board composition. The results of the Glejser (1969) test are shown in Table IV. For the dependent variable, we show the regression results from the first step in Columns (1) – (3), and focus in our discussion on the results from the second step in Columns (4)-(6). The tests provide evidence that the variability in risk taking significantly depends on banks' board composition. More precisely, we find that average board age is positively related to the variability in risk taking while the share of female board members shows a negative relationship. For the share of board members with Ph.D. degrees we find no significant influence on the variability of risk within the age, gender and education subsamples. Therefore, we conclude that the risk-taking behavior of female executives can be determined more precisely in our subsequent analyses than for their male colleagues. Similarly, for younger executives' risk taking, our inference may be more precise than for older board members. Moreover, we also reject the null hypothesis that β_1, β_2 and β_3 are jointly zero (p-value = 0) in all of our regressions. This indicates that apart from the influence of the included control variables, the social composition of the executive board substantially determines how bank risk varies.

[Table IV: GLEJSER TEST]

B. *Identification strategy*

The preceding tests show that board composition matters for risk taking. In the subsequent analysis, we focus on the question of which specific socioeconomic characteristics of board members are relevant and, more specifically, how they influence risk taking.

Changes in board structure are likely to be endogenous (Hermalin and Weisbach (1998), Adams *et al.* (2010)). For example, changes in the ownership structure of a bank could be associated with new shareholders forcing a riskier conduct of business while, at the same time, replacing old executives with younger ones. A naive analysis of the effect of board age on risk taking would attribute the changes in risk taking to board age, whereas the underlying reason is ownership structure. Therefore, we only analyze board changes which are a consequence of executives reaching retirement age. Thereby, we avoid a range of possible confounding factors. The impacts of board changes are analyzed using a difference-in-difference matching (DDM) estimator.

The difference-in-difference (DID) estimator is frequently used in the program evaluation literature (Meyer (1995)). The estimator compares a treatment group to a control group both before and after treatment. Here, the treated group consists of banks experiencing a board change of one of the three types of changes mentioned above due to retirement. The control group consists of banks with similar characteristics which do not experience a board change during the same time period. The construction of the control groups is described above in Section III.B. By analyzing the time difference of the group differences, the DID estimator accounts for omitted variables which affect treated and untreated banks alike. For example, regulatory changes might coincide with changes in board structure. But as such changes may affect banks in a similar fashion, the estimator only attributes the *additional* changes in risk taking to a board change. Difference-in-difference estimators have recently been used in the finance literature (e.g., Beck, Levine, and Levkov (2010); Schaeck *et al.* (2011)).

We combine the DID estimator with a matching strategy to establish three relevant control groups for the three samples of treatment banks. The combined difference-in-difference matching (DDM) estimator has been introduced by Heckman, Ichimura, and Todd (1997). Smith and Todd (2005) document the superior performance of a DDM estimator relative to other matching estimators in an empirical setting. In a simple form, our DID approach is based on estimating a regression, whereby the parameter of interest is the coefficient γ_3 of the interaction term:

$$\boldsymbol{Y_{it} = \gamma_0 + \gamma_1 Treated_{it} + \gamma_2 Post_{it} + \gamma_3 Post_{it} \times Treated_{it} + \varepsilon_{it}} \quad (3)$$

where $\boldsymbol{\varepsilon_{it}}$ is an idiosyncratic error term.

We denote by Y_{it} our risk-taking measure. The variable $Treated_{it}$ is a dummy variable for a bank belonging to the treatment group, i.e., it takes on the value one if the bank experienced either a decrease in board age, an increase in the proportion of female executives, or an increase in the proportion of executives with Ph.D. degrees, respectively. The slope parameter γ_1 therefore captures the difference in means between treatment and control group before the treatment takes place. The variable $Post_{it}$ is a dummy variable for the post-treatment period. While γ_2 picks up common shocks of both treatment and control group, γ_3 quantifies solely the additional shift of the treatment group's mean after being treated. In an evaluation framework, this parameter corresponds to the mean treatment effect on the treated.

[Table V: EXCLUDED CONTROL VARIABLES]

Table V indicates which of the key explanatory variables are excluded from our regressions to avoid overcontrolling. Additionally, we include bank fixed effects c_i. Our final specification can be written as:

$$\boldsymbol{Y_{it} = \delta_0 + \delta_1 Treated_{it} + \delta_2 Post_{it} + \delta_3 Post_{it} \times Treated_{it} + \delta_4 X_{it} + c_i + v_{it}} \quad (4)$$

The identifying assumption for a general matching strategy with controls is that, conditional on the control vector X_{it}, treatment is quasi-random: After matching banks and accounting for differences in observables X_{it}, we require the control group to constitute a valid counterfactual scenario for the treatment group. The combination of matching with a DID estimator weakens this requirement: we allow for *time-invariant* differences between treatment and control groups. For our empirical strategy to be valid, we only require the absence of *time-varying* differences in unobservables between the two groups after the matching procedure, conditional on control variables X_{it}.

We include a range of control variables. Importantly, we control for all board characteristics which might change simultaneously with the variable we investigate. For example, an increase in female board membership is likely to result in lower average board age, as the executive replacement was triggered by the retirement of another board member. Hence, controlling for average board age is necessary to identify the effect of gender composition on bank risk taking. Similarly, since educational attainment covaries with age cohorts (see, e.g., Besedes, Deck, Sarangi, and Shor (forthcoming)) the regression that focuses on the effect of age composition on risk taking also controls for the average representation of executives holding a Ph.D. degree.

The control vector X_{it} consists of *Average board age, share of females, share of Ph.D.s, Total assets (log, deflated), Growth of total assets, Capital adequacy ratio, Charter value, Merger dummy, Powerful CEO, Executive Board Size, Customer loans to total assets, Off-balance sheet items to total assets,* and *GDP per capital growth.* Finally, we also include a *Time trend* to account for serial correlation within panels (Bertrand, Duflo, and Mullainathan (2004)).

V. RESULTS

In this section, we provide empirical evidence for the hypotheses discussed in Section II.

Prior to discussing the results of our difference-in-difference estimations, we verify that there is no systematic change in risk taking prior to the board changes. A systematic increase or decrease in these variables could render our inferences about the relationship between changes in board composition and risk taking invalid. Table VI shows the mean values of risk-weighted assets to total assets (RWA/TA) of the treatment banks in the three periods prior to the considered board changes. In addition, we present the evolution of the loan portfolio concentration measured by the Herfindahl Hirschman Index (HHI, log) calculated for 8 sectors before the change in board composition because we use the HHI (log) as an alternative risk measure in subsequent robustness tests.[25] While this series fluctuates to some extent, there is no evident trend in risk taking of banks prior to the board change. We interpret these empirical patterns as suggestive evidence that changes in board composition are not triggered by poor performance.

[Table VI: PERFORMANCE PRIOR TO BOARD CHANGES]

Table VII contains our main results of the difference-in-difference estimations. For each type of change in executive board composition, we present the coefficients and t-statistics, the regressions use heteroskedasticity-robust standard errors. We show results with a widely-used risk measure, the ratio of risk-weighted assets to total assets (RWA/TA). Our regression setup of using separate regressions for each type of board change allows tracing out the specific effect of the respective board change on risk.[26]

[25] The eight sectors include agriculture, forestry and fishing; mining, energy and water supply; manufacturing; building and construction; commerce; maintenance and repair of vehicles and durables; transportation and communication; financing (without MFIs) and insurance; and services (real estate, renting and leasing, IT services, research and development, hotel business and catering industry, health and veterinarian, other public and personal services).

[26] Note that our approach could be subject to simultaneous effects for risk taking if simultaneous types of board changes occur within one year. In unreported tests, we find that only in 6 instances we observe more than one type of board change taking place in the same year in the same bank. Removing these observations does not qualitatively affect our findings. These results are available from the authors upon request.

[Table VII: MAIN RESULTS]

A. Main results

The results of Table VII, Column (1), confirm our first hypothesis (H1), i.e., for H1 the null is rejected. The coefficient on the interaction term between the board change and the period following the board change enters positively and significantly. A board change causes a decrease in the average age of board members and raises the bank's risk profile significantly relative to the control group. At different stages of their careers, executives have different attitudes towards risk. Our result is consistent with, *inter alia*, the findings presented in Bucciol and Miniaci (forthcoming), Agarwal *et al.* (2009), and Sahm (2007).

Column (2) suggests that board changes that increase the representation of female executives are not conducive to reducing bank risk. Rather, a higher proportion of female board members significantly increases risk taking. This outcome is consistent with hypothesis (HIIb), but seems inconsistent with several studies concluding that females are more risk averse in economic experiments (Croson and Gneezy (2009)) and corporate settings (Barber and Odean (2001); Niessen and Ruenzi (2007)). However, these authors either look at nonprofessional populations or at fund managers that are not part of the top management team. Risk preferences are likely to differ between these groups and board members. Recent work by Adams and Funk (2011) shows that Swedish female top executives are less risk-averse than their male counterparts. Our results provide evidence that women determine corporate governance of banks significantly and are not marginalized by a male-dominated board culture. This observation is in line with previous research for U.S. firms (see Adams and Ferreira (2008)) and indicates that female board membership is not window dressing, but has real implications.[27]

[27] Female appointments may happen as response to external pressure for gender heterogeneity in executive positions. Farrell and Hersch (2005) argue that firms may add female board members as a response to external pressure exerted by institutional shareholders. This seems not to apply here as women have a significant impact after joining the board indicating that they are appointed for other reasons than just for diversity.

In view of the ongoing public debate in European countries about the introduction of gender quotas for executive positions, it is important to emphasize this influence. Norway and France, among others, have adopted legislative measures that regulate female board representation. The Netherlands and Belgium have passed laws requiring large firms to fill at least 30 percent of executive positions with females.[28] Recently, the European Parliament passed a non-legislative resolution demanding 40 per cent of supervisory and executive positions of large European firms to be filled by women (The Economist (2011)).[29] In Germany, policy makers are pursuing the objective of introducing a gender quota as well. The Secretary of State for Employment, Ursula von der Leyen, envisages a federal law that mandates firms to increase the female board representation to 30 per cent from 2018 onwards (Handelsblatt, 2011).[30] Concerned about mandatory gender quotas, several German companies therefore now consider voluntary gender quotas (The Economist (2011)).

The political movement towards gender quotas is based on the desire to establish equality on the top management team level. The real effects of this legislation, however, are less discussed. Nevertheless, our results show that female board members significantly (at the 10% level) influence risk taking. The findings suggest that a public policy debate must take this real impact into consideration properly and government actions should be modeled accordingly.

We examine the effect of education, in terms of Ph.D. degrees in Column (3). In line with hypothesis (HIIIa), adding better educated individuals to the board reduces risk, suggesting

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[28] The law in the Netherlands refers to supervisory and executive boards of firms with more than 250 employees. The Belgian regulation applies to all listed firms.

[29] The Economist (2011) devotes considerable attention to the matter of introducing gender quotas to promote the representation of women in the boardroom. While the underrepresentation of females highlights that companies that tend to only recruit male individuals for the boardroom lose out on attracting well qualified females, the Economist (2011) concludes that imposing gender quotas is not conducive to achieving the desired objective because quotas promote females who would otherwise not get the job in the boardroom. This conclusion is in line with the results obtained by Ahern and Dittmar (2010) in their study of the effects of gender quotas in Norway.

[30] Interview given to Handelsblatt, June 17th, 2011: “Eine Ohrfeige für eine ganze Generation“.

such executives apply better risk management techniques. Survey evidence presented by Graham and Harvey (2001) supports this consideration. They show that executives holding an MBA make more use of sophisticated capital budgeting practices, which indicates that their risk management is more appropriate.

Among the control variables, we find that a higher charter value, captured by the ratio of core deposits to total assets, reduces risk taking. Large banks are less exposed to risk (i.e., they show lower RWA/TA). A higher capital adequacy ratio is throughout all regressions inversely related to risk taking. Banks that are active in lending business have more risky investments. In line with intuition, risky banks also hold on average more off-balance-sheet items. This indicates that these items are not used to offset risks on the balance sheet, but rather as an additional instrument to engage in risky investments. The positive and significant coefficient on GDP growth in most risk regressions suggests that risk taking tends to move procyclically.

B. Economic significance

The results thus far offer empirical evidence that board composition has statistically significant effects on risk taking. In Table VIII, we now examine whether these effects are also economically significant. To this end, we trace out the impact of a decrease in age, and increases in gender and education composition by a magnitude of one standard deviation in our key independent variables.

[Table VIII: ECONOMIC SIGNIFICANCE]

Panel A indicates that the age structure of the board is highly relevant for the degree of risk taking and banks' return. We find that if average board age decreases by roughly 5 years, which corresponds to one standard deviation, the ratio of risk-weighted assets to total assets increases by 2.66. With a sample mean of (RWA/TA) equal to 59.88 in our observation period, the effect is clearly economically significant.

Panel B suggests the impact of additional female board members on bank outcomes is less important. An increase in the female share of executives by 13 percentage points increases our measure of risk taking only by 0.15 (corresponding to 0.25% of its mean value). The same conclusion holds for an increase in the number of board members holding a Ph.D. degree. Panel C indicates that changes in the proportion of individuals with a Ph.D. degree does not influence risk taking to an economically significant degree.

C. Exploring the mechanisms

In this section, we turn to a detailed exploration of the mechanisms that drive the results obtained with the difference-in-difference estimator in Section V.A. Specifically, we exploit t-tests to home in on differences in board characteristics of the treatment group before and after the composition change. In addition to analyzing changes in the treatment group, we compare differences in characteristics between treatment and control groups to draw firm conclusions. Table IX presents the results.

[Table IX: MECHANISMS]

Changes in age composition

Our first key finding that a change in board age composition increases risk may relate to age heterogeneity, consequently we examine age range, defined as the difference between the oldest and the youngest executive per bank. Board members from similar age cohorts share the same experiences which favors board cohesiveness and therefore groupthink (Janis (1972, 1982)). If mutual decision-making is characterized by a distinctive sense of togetherness, this might hinder a reasonable individual assessment of possible risks of corporate strategies. As Panel A of Table VIII shows, the degree of age heterogeneity of executive boards remains unchanged prior to and following the board change, and difference also remains insignificant. This suggests that groupthink arising in a more homogeneous top management team and the lack of diversifying influences in board meetings are not the main factors that can account for the observed increase in risk taking. Instead, the higher risk taking after the board change seems attributable to the appointment of younger, more risk-oriented executives.

Changes in gender composition

Panel B of Table IX explores the reasons for the increase in risk taking following board changes that give rise to a higher representation of females. If appointed women differ significantly with respect to characteristics compared to their male counterparts, corporate outcomes and risk taking may be changed for reasons other than gender-specific risk preferences. Such considerations can explain the increase in risk taking through a higher female board representation reported above despite the commonly held view that women are more risk averse than men (e.g., Niessen and Ruenzi (2007)).

First, we focus on possible differences in terms of job experience, captured by the number of years an individual served over an entire career as an executive at any institution. Table IX indicates that the new female board members are significantly less experienced, providing some suggestion that lack of expertise drives the increase in risk taking. A similar argument is provided by Ahern and Dittmar (2010) who focus on the relationship between firm value and board structure in Norway. They find that the introduction of a gender quota in 2003 had adverse effects on firm values because the appointed female directors lacked experience and were younger on average.

The dramatically lower job experience of appointed female executives and the fact that women only occupy an extremely small share of executive positions (see Table II) suggest that the heterogeneity of board composition is significantly higher after the board change. This may provide an additional explanation for the increase in risk taking. Bantel and Jackson (1989) argue that higher group heterogeneity disturbs communication in organizations which can restrict the exchange of ideas among board members that is needed to arrive at well founded decisions. Additionally, if group members come from very heterogeneous backgrounds in terms of experience and values, this might increase the potential for conflict inside the group and hinder the decision-making process. Our results indicate that the board changes increasing the female share of board members lead to higher group diversity at the executive level with effects on the bank's risk-strategy.

Second, given the discussions about mandating female board quotas to raise female board representation in numerous countries, the question arises as to whether women can select certain types of firms as employers. We therefore compare bank characteristics prior to the increase in female board representation between the treatment and the control groups. Table IX shows that treatment banks have a significantly lower ratio of risk-weighted to total assets and a significantly higher capital adequacy ratio prior to increasing the proportion of women on the board. Female board members seemingly self-select into boards of sound and stable banks according to their preferences since they are highly demanded. Furthermore, a homogeneous board is supposedly more valuable in times of high risk, making a female appointment less likely in times of high uncertainty. Our argumentation is supported by Farrell and Hersch (2005) who measure risk by the standard deviation of the firm's monthly stock returns. Their estimations show similarly that firms with lower risk exposure are more likely to add female executives to the board.

Third, the observation that women are more likely to become board members of less risky and seemingly more stable banks is also interesting in connection to the glass ceiling hypothesis. The hypothesis states that career advancement is more difficult for women than for men and prevents them from rising above a certain hierarchical stage of organizations. Evidence on the existence of a glass ceiling in the context of corporate boards and CEO positions suggests that women still face difficulties in reaching top executive positions, although this problem has seemingly mitigated (Daily, Certo, and Dalton (1999)). Our test indicates that women have to overcome more severe obstacles than men in entering boards of banks, i.e. by having to accept a higher risk exposure.

Fourth, the comparison between treatment and control group indicates that women are more likely to be appointed to executive boards that are chaired by a female CEO, consistent with a prior finding that females are more likely to be appointed when there are other women on the board (Berger, Kick, Koetter, and Schaeck, forthcoming). This finding suggests that female executives play an important role in recruiting new board members of the same gender. Additionally, it may be more attractive for women to serve on a board that is already diversified and not dominated by men (Farrell and Hersch (2005)).

Changes in education composition

We focus on the mechanisms for the effect of higher education in Panel C of Table IX. Research by Graham and Harvey (2001) and Bertrand and Schoar (2003) shows that executive's educational background affects investment, financing, and business strategies. To assess the extent to which such changes in these strategies are responsible for the observed reduction in risk, we examine the structure of banks' balance sheets in the treatment group following the board change with respect to funding, income, and capital structure.

The significant increase in core deposits suggests that better educated board members adjust the liability composition towards more stable funding sources. If banks rely more on core deposits, they are less exposed to sudden withdrawals of funds. This change in the liability composition implies a lower degree of risk exposure. Moreover, the increase in core deposits raises the bank's charter value which serves as a disincentive to take on risk. Additionally, Table IX shows that board members with higher academic degrees are more likely to diversify the banks' income streams. Fee income is significantly larger in banks that experienced a board change of this type relative to the control group. Non-traditional income through fees may depend less on the cyclicality of overall business conditions than interest income. A higher share of fee income may therefore decrease volatility in income streams by decoupling revenues from business cycles. This enhances bank soundness. We do not find support for the idea that better educated executives decrease risk by changing the capital adequacy ratio. Similarly, the share of off-balance-sheet is not the driving force in reducing risk.

These findings do not indicate that higher educated managers follow more aggressive business strategies characterized by higher risk as stated by Bertrand and Schoar (2003). They rather indicate that top executives with higher education tend to act moderately. It is likely that executives with Ph.D.s are not as risk prone as their counterparts. One reason may be that managers without such degree may have to climb up the job ladder without the signaling advantage of a Ph.D. degree. To reach top executive positions, they have to prove their ability by extraordinary performance which is likely to be related to higher risk taking.

An additional explanation refers to board heterogeneity. Specifically, board heterogeneity in terms of education increases after the appointment of a new executive with a Ph.D. As can be seen from Table IX, the standard deviation of academic degrees increases when an executive holding a Ph.D. is appointed. We interpret the heterogeneity channel as another potential avenue explaining the decrease in risk. More homogenous boards seem to take on more risks. Conversely, more heterogeneous boards are likely to face a wider range of opinions avoiding extreme outcomes.

Our results suggest that an increase in highly educated board members has important consequences for the decision-making process taking place on the executive level. Adams and Ferreira (2010) argue that group decision making is characterized by reaching a consensus between different opinions and involves sharing all relevant information available to group members. An executive with a Ph.D. degree presumably exhibits the needed financial expertise and increases the pool of useful information available to the board considerably. Consequently, board decisions tend to be more moderate because they rely increasingly on appropriate evidence which prevents excessive risk taking. This hypothesis finds support in our findings.

D. Robustness tests

In this section, we investigate the robustness of our findings. First, we exclude all loss-making banks from the estimations. We do this because badly performing banks which incur losses may have incentives to change boards in specific ways to restore profitability (Schaeck *et al.* (2011)). This might lead to an endogeneity problem because they may appoint directors that personify certain managerial traits. Second, we use the Herfindahl Hirschman Index of loan concentration (HHI, log) as an alternative measure of bank risk. The HHI reports the degree of concentration in banks' loan portfolio and hence serves as reasonable indicator of risk exposure. Third, we apply an alternative matching procedure to determine the control banks in our matching procedure. Fourth, we conduct a placebo test to rule out that our results are driven by spurious correlations.

Columns (1), (3), and (5) of Table X present the results for the estimations that exclude loss-making banks from our sample. We regress the ratio of risk-weighted assets to total assets on the same set of explanatory variables as before. In all samples, the signs of the coefficients on the interaction terms are qualitatively identical to the signs obtained in the full-sample estimation of Table VII. Importantly, these coefficients are highly significant as well. In short, these tests confirm that our results in Table VII are not driven by appointments of poorly performing banks.[31]

[Table X: ROBUSTNESS TESTS - Part A]

In columns (2), (4), and (6) of Table X, we check the robustness of our results with respect to a different measure of risk taking. The dependent variable in the regressions is the Herfindahl Hirschman Index (HHI) in logs calculated for loans granted to 8 sectors. As it shows the banks' vulnerability towards idiosyncratic sector-specific shocks, it indicates the degree of risk exposure inherent in the banks' lending activities. We find that our previous results are robust to this alternative concept of measuring risk with respect to the results for

[31] Note that our matching strategy also considers performance using ROE as a matching criterion.

changes in terms of age and gender composition. In contrast, the result for the effect of education composition is now rendered statistically insignificant.

Next, we verify that our matching strategy does not drive our inferences, and use an alternative matching strategy that considers regulatory capital as an additional matching criterion, and we also narrow our matching band. Our intuition is that differences in regulatory capital across banks induce differences in the degree of monitoring by the regulator. A bank with lower regulatory capital is subject to more intense supervision and may therefore not be able to engage in risk taking (Ashcraft (2008); Schaeck *et al.* (forthcoming)). Specifically, we match bank *i* to other banks whose capital adequacy ratios and ROEs lie between 90 and 110% of bank *i*'s capital adequacy ratio and ROE in the same year. We also adjust the previously used matching criteria accordingly and narrow the matching window also to 90 and 110% of the treatment bank's size, and we keep the matching on year and bank type. As shown in Table XI, our previous findings are robust to this alternative matching strategy, the signs and significance levels of the coefficients on the interaction terms are unchanged. We conclude that our results are not driven by the specific choice of the control banks.

[Table XI: ROBUSTNESS TESTS – Part B]

Finally, we consider a further experiment to make sure that our main results do not arise from spurious correlations. To this end, we run a placebo regression to verify that the significant changes in corporate outcomes are indeed caused by changes in board composition. Specifically, we repeat the difference-in-difference estimations explained above with one modification, and redefine the dummy variable ***Treatment*** to take on the value 1 in the period two years prior to the actual board change. If the estimated coefficient on the interaction term is insignificant, this placebo treatment test suggests that the change in risk taking is indeed caused by the new board composition. A significant coefficient on the interaction term, however, would indicate that the treatment group differs significantly from the control group even before the change actually occurs and invalidate our previous inferences. The underlying idea of the Placebo test is to pretend a board change at a point in time when it did not occur in reality. If we cannot observe a significant change in response to this placebo treatment, we find additional evidence that only actual board changes significantly influence the degree of risk taking and can confirm that our conclusions from above are not based on spurious correlations. The results of this exercise are shown in Table XII. Compared to Table VII, the magnitude of the estimated coefficients on the interaction terms is small and all coefficients on the interaction terms are insignificant at conventional levels. These findings suggest that the adjustments in risk taking and behavior do not occur prior to the change in executive board composition. They rather indicate that it is in fact the composition of boards and the individual characteristics of executives that trigger the change in corporate outcomes.

[Table XII: PLACEBO TESTS]

VI. CONCLUDING REMARKS

In this paper, we raise the question of how the composition of a bank's executive team affects risk taking. Unlike previous papers, we take a team perspective and only focus on managers, rather than non-executive directors. Specifically, we analyze three dimensions of team composition: age, gender, and education.

Exploiting a unique dataset from the Deutsche Bundesbank that provides detailed information about executives' biographies that we combine with bank data for the period 1994-2010, we conduct heteroskedasticity tests in an initial step of our analysis to show that the socioeconomic composition of an executive team significantly determines the variability of bank risk taking. To better understand the direction in which age, gender, and education composition affect the propensity to take risk, we subsequently use difference-in-difference estimation with matching techniques to exploit exogenous variation in mandatory executive retirements to formulate and test hypotheses about how these three dimensions of team composition correlated with risk taking.

Our main findings can be summarized as follows.

First, decreases in average board age robustly increase bank risk taking. This effect is not only statistically but also economically large. A one standard deviation decrease in board age of approximately 5 years raises the ratio of risk-weighted assets to total assets from 59.88 to 62.54. In terms of policy implications, it appears desirable for regulators to consider changes in age structure of bank's executive teams following mandatory retirements.

Second, female executives might self-select into stable and well-capitalized banks. However, in the three years following the increase in female board representation, risk taking increases although the change is economically marginal. Our exploration of the underlying mechanism suggests that this result is mainly attributable to the fact that female executives have less experience than their male counterparts.

Third, educational attainment, measured by the presence of executives with Ph.D. degrees is associated with a decrease in risk taking. Our estimations suggest the decrease is rather small but highly statistically significant. We assign this result to the fact that better-educated executives employ more sophisticated risk management techniques and adjust the business model accordingly.

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Table I: Hypotheses and empirical predictions

Dependent variable		RWA/TA	HHI (log)
Age hypothesis			
HI	*Risk tolerance decreases in board age*	-	-
Female risk taking hypothesis			
HIIa	*Female risk-reduction hypothesis*	-	-
HIIb	*Female risk-increasing hypothesis*	+	+
Education hypothesis			
HIIIa	*Positive education hypothesis*	-	-
HIIIb	*Negative education hypothesis*	+	+

Risk taking is measured by the ratio of risk-weighted assets to total assets (RWA/TA), and in a robustness test, we use the concentration of the loan portfolio HHI (log) as an alternative risk measure.

Table II: Characteristics of executive boards and banks

	Treatment Group (N = 5,823) (1)		**Control Group** (N =10,701) (2)		**All banks** (N = 16,615) (3)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Executive board characteristics						
Board size	3.74	1.99	2.59	1.70	3.00	1.89
Board age composition	50.03	4.87	50.00	5.01	50.01	4.96
Board gender composition	0.03	0.10	0.02	0.11	0.02	0.10
Board education composition (Ph.D. degree)	0.05	0.13	0.01	0.07	0.03	0.10
Board tenure composition	10.34	5.58	13.07	6.13	12.07	6.07
# of board changes (increases only)	929		0		929	
# increases (females)	28		0		28	
# decreases (age)	855		0		855	
# increases (education, Ph.D. degree)	46		0		46	
Bank characteristics and macroeconomic environment						
Total assets (log, deflated)	19.93	1.47	19.09	1.21	19.38	1.36
ROE	13.25	10.97	16.33	9.05	15.25	9.879
Charter value	17.81	8.11	16.69	6.69	17.08	7.236
CEO power	7.22	7.49	7.04	7.24	7.10	7.33
Capital adequacy ratio	19.90	130.2	12.52	4.31	15.12	77.35
GDP growth (per capita)	1.59	3. 58	1.68	3.32	1.64	3.41
Private bank dummy	0.13	0.34	0.02	0.12	0.06	0.23
Public bank dummy	0.36	0.48	0.15	0.36	0.22	0.42
Cooperative bank dummy	0.51	.50	0.84	0.37	0.72	0.45
Merger dummy	0.03	0.16	0.06	0.23	0.05	0.21
Risk measures						
RWA/TA	58.00	14.93	60.62	10.92	59.70	12.54

We present summary statistics of the banks in our sample. Column (1) refers to the sample of banks that experienced board changes altering the average board age, the female share of executives, or the share of executives with Ph.D.s. Column (2) refers to the sample of banks that experienced no board change altering their socioeconomic board composition. In Column (3), all banks of our sample are included. We present mean values and standard deviations of the variables. Board size refers to the number of executives. Board age composition denotes the board age. Board gender composition denotes the share of female executives. Board education composition denotes to the share of executives holding Ph.D.s. Board tenure composition refers to the average amount of years spent working in the bank. # of board changes presents the total number of board changes. # increases (females) denotes the number of board changes increasing the female share of executives. # increases (education, Ph.D. degree) denotes the number of board changes increasing the share of executives with Ph.D.s. Bank size is measured by the log of total assets (deflated). Performance is measured by return on equity (ROE). Charter value is defined as core deposits to total assets. CEO power captures the current CEO's tenure. The capital adequacy ratio is calculated as the ratio of Tier 1 + Tier 2 to total assets. GDP growth refers to the state where the bank is registered. Private (public, cooperative) dummy takes on the value one if the bank is private (public, cooperative). Merger dummy equals 1 if the bank was engaged in a merger during the observation period. RWA/TA is defined as the ratio of risk-weighted assets to total assets.

Table III: Evolution of executive board composition

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Evolution of board characteristics																	
Board size	2.26	2.35	2.52	2.61	2.86	3.20	3.44	3.51	3.56	3.52	3.62	3.49	3.55	3.53	3.51	3.52	3.78
Board age composition	48.36	48.84	49.24	49.73	50.11	50.29	50.18	50.31	50.44	50.62	50.79	51.12	51.16	51.10	51.02	50.86	51.35
Board gender composition	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Board education composition (Ph.D.)	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
Board tenure composition	11.65	11.84	11.96	12.34	12.23	11.85	11.62	11.77	11.79	11.89	12.17	12.72	12.70	12.55	12.36	12.22	12.27
# of board changes	29	23	16	22	11	13	22	20	19	14	19	12	5	5	15	13	2
# increases (females)	*1*	*2*	*3*	*1*	*1*	*0*	*4*	*3*	*2*	*3*	*3*	*1*	*0*	*2*	*4*	*1*	*1*
# decreases (age)	*17*	*11*	*9*	*11*	*10*	*4*	*10*	*9*	*7*	*7*	*10*	*5*	*4*	*3*	*5*	*8*	*1*
# increases (education, Ph.D. degree)	*5*	*5*	*2*	*4*	*0*	*4*	*4*	*4*	*4*	*2*	*3*	*3*	*0*	*0*	*3*	*2*	*0*

We present the evolution of board characteristics over time. This table exhibits the evolution over time of board size (number of board members), board age composition (average board age), board gender composition (fraction of women on the board), board education composition (fraction of board members with a PhD) and board tenure composition (years of experience within the bank). The number of relevant board changes in the respective year is listed, where a board change of interest is defined as a board change leading to an increase in the average age/ fraction of females/average education (PhD). We require the board change to happen due to the retirement of a board member to avoid endogeneity concerns. We only consider board changes in which the size of the board remains constant.

Table IV: Glejser's (1969) heteroskedasticity tests

Dependent variable	***1st step RWA/TA***			***2nd step Absolute value of Risk (RWA/TA)residuals***		
	Age sample	Gender sample	Education sample	Age sample	Gender sample	Education sample
Board age composition (average board age)	***0.02***	***-0.01***	***-0.00***	***0.02***	***0.04*****	***0.10******
	[1.11]	***[-0.30]***	***[-0.00]***	***[1.64]***	***[2.38]***	***[3.32]***
Board gender composition (average female board representation)	***-6.69******	***-5.97******	***-4.69*****	***-1.80******	***-1.91******	***-2.65****
	[-9.20]	***[-8.46]***	***[-2.06]***	***[-4.32]***	***[-4.24]***	***[-1.80]***
Board education composition (average Ph.D. board representation)	***-0.14***	***7.87******	***3.70*****	***-0.50***	***-0.39***	***-0.03***
	[-0.14]	***[3.00]***	***[2.38]***	***[-0.76]***	***[-0.24]***	***[-0.03]***
Total assets (log, deflated)	-1.63***	-1.84***	-2.77***	-0.01	-0.22***	0.06
	[-17.22]	[-13.23]	[-8.83]	[-0.12]	[-2.75]	[0.32]
Core deposits/Total assets	0.08***	0.14***	0.21***	0.04***	0.01	-0.01
	[4.99]	[6.38]	[4.92]	[4.67]	[0.47]	[-0.24]
Powerful CEO	-0.01	-0.01	-0.04	-0.00	-0.01	-0.03**
	[-0.91]	[-0.32]	[-1.46]	[-0.69]	[-1.16]	[-2.39]
Capital adequacy ratio	-0.09***	-0.58***	-0.22**	0.09***	0.13***	0.13***
	[-2.68]	[-13.15]	[-2.01]	[6.43]	[4.69]	[4.76]
Customer loans/Total assets	0.66***	0.57***	0.76***	0.04***	0.03***	0.04**
	[70.12]	[40.44]	[29.03]	[6.89]	[2.89]	[2.17]
Off balance sheet items/Total assets	0.42***	0.51***	0.06	0.07***	0.12***	0.05***
	[17.75]	[9.60]	[1.21]	[5.33]	[3.62]	[5.32]
Total asset growth (deflated)	-0.00***	-0.05	-0.38***	-0.00	0.04*	-0.02
	[-2.97]	[-0.85]	[-5.62]	[-0.78]	[1.65]	[-0.41]
Board size	-0.56**	-1.01***	0.21	-0.43***	-0.20	0.09
	[-2.49]	[-3.22]	[0.44]	[-3.19]	[-1.09]	[0.30]
Interest rate spread	-1.42***	-1.72***	-0.70***	-0.19***	-0.17*	-0.26
	[-13.30]	[-10.77]	[-2.65]	[-2.92]	[-1.86]	[-1.64]
GDP growth (county)	0.07***	0.02	0.04	-0.06***	-0.04	-0.12***
	[2.81]	[0.49]	[0.70]	[-4.07]	[-1.63]	[-3.39]
Population (log, state)	0.46***	0.34	0.75**	-0.59***	-0.55***	-1.06***
	[3.09]	[1.63]	[2.06]	[-6.63]	[-4.33]	[-5.22]
Merger (dummy)	-0.18	-1.08*	-2.37**	10.09***	-0.19	-0.33
	[-0.42]	[-1.83]	[-2.04]	[5.95]	[-0.55]	[-0.51]
Observations	6,452	3,100	1,230	6,452	3,100	1,230
R-squared	0.653	0.655	0.70	0.056	0.050	0.084
F-Statistic for joint significance	***n/a***	***n/a***	***n/a***	***7.84******	***8.55******	***5.17******
p-value	***n/a***	***n/a***	***n/a***	***0.00***	***0.00***	***0.00***

This table reports estimation results for the Glejser (1969) tests. Bad banks are excluded. Age sample refers to the sample containing banks which experience a decrease in average board age after the board change and their matched control banks. Gender sample refers to the sample containing banks which experience an increase in the proportion of female executives after the board change and their matched control banks. Education sample refers to the sample containing banks which experience an increase in the share of executives with Ph.D. after the board change and their matched control banks. Columns (1)-(3) contain the first step OLS results from regressing risk-weighted assets to total assets (RWA/TA) on a set of explanatory variables. Columns (4)-(6) present results from the regression of the absolute value of the first step residuals on our set of explanatory variables. Board age composition denotes the average board age per year, board gender composition refers to the average female board representation per year, and board education composition is the average share of board members with Ph.D. degrees per year. Bank-specific control variables include the log value of total assets (log), the growth rate of total assets, the ratio of core deposits to total assets, Powerful CEO, (captured by CEO tenure), and a dummy variable Merger that equals 1 if the bank was engaged in a merger. Macroeconomic control variables include the interest rate spread between 10-year and 1-year federal government bonds, GDP growth and population in logs of the state where the headquarter of the bank is registered. Columns (4)-(6) present F-statistics and p-values testing the null hypotheses of joint significance of the variables board age composition, board gender composition and board education composition. We present t-statistics in parentheses. Constant terms included but not reported. ***,*,* indicate significance at the 1%, 5%, and 10% significance level, respectively.

Table V: Excluded control variables

Regression	Age composition	Gender composition	Education composition (Ph.D. degree)
Age	excluded	included	included
Gender	included	excluded	included
Ph.D.	included	included	excluded

This table shows whether the levels of average board age (Age), female board representation (Gender) and share of board members with Ph.D. (Ph.D.) are included in the specific regressions. Age composition refers to the regression estimating the impact of average board age on risk taking. Gender composition refers to the regression estimating the impact of female board representation on risk taking. Education composition (Ph.D. degree) refers to the regression estimating the effect of executives with Ph.D. on risk taking.

Table VI: Performance prior to board changes

	Period	*RWA/TA (Mean)*	*Loan portfolio concentration (HHI, log)*
Panel A: Age change			
	t_0	58.24	3.33
	t_{-1}	59.01	3.32
	t_{-2}	59.35	3.31
	t_{-3}	58.75	3.31
Panel B: Gender (female) change			
	t_0	54.80	3.30
	t_{-1}	55.72	3.30
	t_{-2}	58.72	3.35
	t_{-3}	57.76	3.34
Panel C: Education (Ph.D. degree) change			
	t_0	56.45	3.53
	t_{-1}	47.33	3.31
	t_{-2}	41.21	3.27
	t_{-3}	44.82	3.53

This table presents the mean values of risk-weighted assets to total assets (RWA/TA), and the Herfindahl Hirschman index (log) based on 8 sectors (HHI) in the three years prior to the board changes. The period t_0 denotes the year of the board change, t_{-1} (t_{-2}, t_{-3}) denotes the period 1 (2, 3) year(s) prior to the board change. Panel A refers to the sample containing banks which experience a decrease in average board age after the board change and their matched control banks. Panel B refers to the sample containing banks which experience an increase in the share of female executives after the board change and their matched control banks. Panel C refers to the sample containing banks which experience an increase in the proportion of executives with Ph.D. degrees after the board change and their matched control banks.

Table VII: Main Results

	Age composition (1) RWA/TA	Gender composition (2) RWA/TA	Education composition (Ph.D. degree) (3) RWA/TA
Board change	-0.02	0.99	-1.48**
	[-0.15]	[1.56]	[-2.18]
Post period	0.13	0.59***	0.23
	[0.86]	[3.27]	[0.84]
Board change * Post period	**0.55*** **	**0.96***	**-2.26*** **
	[2.96]	**[1.89]**	**[-4.07]**
Timetrend	-0.24***	0.79***	0.93***
	[-4.55]	[11.56]	[8.69]
Total assets (log, deflated)	-2.15***	-20.97***	-12.14***
	[-2.84]	[-20.27]	[-7.07]
Core deposits/Total assets	-0.16***	-0.17***	-0.18***
	[-8.39]	[-6.80]	[-4.45]
Powerful CEO	0.02*	0.00	-0.05**
	[1.93]	[0.08]	[-2.00]
Capital adequacy ratio	-0.21***	-1.49***	-1.01***
	[-13.04]	[-35.13]	[-13.58]
Customer loans/Total assets	0.61***	0.37***	0.41***
	[44.04]	[20.01]	[12.97]
Off balance sheet items/Total assets	0.11***	0.19***	0.01
	[6.37]	[7.66]	[1.02]
Growth of total assets (deflated)	0.00	0.01	0.04
	[1.05]	[1.01]	[1.58]
Board size	0.70***	0.38	-0.48
	[3.10]	[1.35]	[-1.10]
Interest rate spread	-1.05***	-0.62***	-0.08
	[-19.31]	[-8.62]	[-0.67]
GDP growth (county)	0.08***	0.08***	0.02
	[6.12]	[5.04]	[0.74]
Population (log, state)	68.10***	48.63***	-24.66*
	[9.64]	[6.22]	[-1.96]
Merger (dummy)	0.34	-0.35	-0.05
	[1.33]	[-1.24]	[-0.09]
Average board age	n/a	0.04*	-0.03
		[1.80]	[-0.80]
Average Ph.D. representation	1.69	11.24***	n/a
	[1.39]	[2.58]	
Average female representation	-0.10	n/a	0.37
	[-0.09]		[0.14]
Observations	6,440	3,073	1,229
R-squared	0.452	0.615	0.358
Number of banks	1,578	652	260
Number of board changes	569	24	25

We report results from difference-in-difference estimations. Board change banks are matched with banks of similar size (+/- 20% of Total assets, log), similar performance (+/- 20% of ROE), bank type (private, public, and cooperative banks) and year. Bad banks are excluded. Column (1) refers to the sample containing banks that experience decreases in average board age after the board change and their matched control banks. Column (2) refers to the sample containing banks which experience an increase in female board representation after the board change and their matched control banks. Column (3) refers to the sample containing banks which experience an increase in the proportion of executives with a Ph.D. degree after the board change and their matched control banks. Board change is a dummy equal to 1 if the bank experienced a board change of the considered type. Post period is a dummy equal to 1 in the period following a board change. We include a time trend, and control for total assets (log), total asset growth, core deposits to total assets, powerful CEO (captured by CEO tenure), and a dummy variable Merger that equals 1 if the bank was engaged in a merger. In addition, Columns (2) and (3) control for average board age to account for the levels of the board characteristics, and Column (1) and (2) control for the average proportion of executives holding a Ph.D. Columns (1) and (3) control for the average share of female executives per year. Macroeconomic control variables include the interest rate spread between 10-year and 1-year government bonds, GDP growth and population (log) of the state where the headquarter of the bank is registered. t-statistics in parentheses. Constant term included but not reported. ***,*,* indicate significance at the 1%, 5%, and 10% level, respectively.

Table VIII: Economic significance

Type of board change	*Mean* (1)	*Standard deviation* (2)	*Mean of (RWA/TA)* (3)	*Effect of one standard deviation change on (RWA/TA)* (4)
Panel A: Age change				
Age	50.15	4.88	59.88	2.66
Panel B: Gender (female) change				
Proportion of female board members	0.03	0.13	59.79	0.15
Panel C: Education (Ph.D. degree) change				
Proportion of board members with a Ph.D. degree	0.04	0.13	60.36	-0.34

We present the quantitative effect of a one standard deviation change in the variables age (Panel A), proportion of female board members (Panel B), and the share of board members with Ph.D.s (Panel C), respectively, on the dependent variable risk-weighted assets to total assets (RWA/TA) . Panel A refers to the sample containing banks that experience a decrease in average board age after the board change and their matched control banks. Panel B refers to the sample that contains banks experiencing an increase in the share of female executives after the board change and their matched control banks. Panel C refers to the sample containing banks with an increase in the share of executives with Ph.D.s after the board change and their matched control banks. Columns (1) and (2) of each Panel show the mean value and the standard deviation of the respective variable. Column (3) presents the mean value of (RWA/TA) in the considered sample. Column (4) show the change in (RWA/TA) induced by a one standard deviation increase in the respective variable.

Table IX: Exploring the mechanisms

Panel A: Age composition	***Pre board change***	***Post board change***	***t-test***
Age Range	11.80	11.85	-0.25
Number of board changes	569		
Panel B: Gender composition	***Pre board change***	***Post board change***	***t-test***
Average job experience (all executives)	15.33	7.70	7.74***
Average job experience (CEO)	11.80	5.34	4.10***
	Treatment banks	***Control banks***	
Risk (RWA/TA) prior to board change	57.25	60.18	2.10**
Capital adequacy ratio	14.27	12.80	-3.81***
Proportion of female executives prior to board change	0.03	0.02	-0.14
Proportion of female CEOs prior to board change	0.04	0.02	-1.75*
Number of board changes	24		
Panel C: Education composition (Ph.D.)	***Pre board change***	***Post board change***	***t-test***
Average job experience (all executives)	11.85	7.22	5.26***
Average job experience (CEO)	13.56	8.29	3.11***
Capital adequacy ratio	11.60	12.22	-1.01
Off balance sheet/Total assets	7.94	6.81	1.26
Profitability (ROE)	15.30	14.60	0.33
Fee income	7.80	9.52	-2.04**
Core deposits/Total assets	12.65	16.88	-3.07***
Standard deviation of education	0.31	0.46	-4.62***
Number of board changes	25		

We present differences in board and bank characteristics between banks that experience a change in board composition (change banks) and control groups. Pre board change (post board change) refers to the observation period before (after) the change in board composition. The final column contains t-statistics that result from testing the null hypothesis that the variable is identical pre board change and post board change (or, respectively in Panel B, that the variable is identical for change banks and control banks). ***,*,* indicate significance at the 1%, 5%, and 10% significance level, respectively. Age Range denotes the difference in age between the oldest and the youngest board member. Average job experience reports the number of years spent working in the financial industry by the executives (respectively by the CEO). The capital adequacy ratio is defined as the ratio of Tier 1 and Tier 2 capital to total assets. Panel A refers to the sample containing banks which experience a decrease in average board age after the board change and their matched control banks. Panel B refers to the sample containing banks which experience an increase in the share of female executives after the board change and their matched control banks. RWA/TA prior to board change is the average ratio of risk-weighted assets to total-assets before the change in board composition. The proportion of female executives (female CEOs) prior to board change is the average share of female executives (female CEOs) before the change in board composition. Panel C refers to the sample containing banks which experience an increase in the share of executives with Ph.D. after the board change and their matched control banks. Off-balance sheet items are included as share of total assets. Profitability is measured as return on equity. Fee income denotes the share of fee income of total income. Core deposits are scaled by total assets. The standard deviation of education is calculated for the variable that takes on the value 1 if a board member holds a Ph.D. and zero otherwise.

Table X: Robustness tests, Loss making banks excluded and Loan portfolio concentration (HHI, log)

	Age Composition (decrease)		Gender Composition (increase)		Education composition (Ph.D. degree, increase)	
	(1)	(2)	(3)	(4)	(5)	(6)
	Loss making banks	Loan porfolio	Loss making banks	Loan porfolio	Loss making banks	Loan porfolio
Board change	-0.04	0.01	1.84**	0.00	-1.96**	0.01
	[-0.22]	[1.57]	[2.52]	[0.01]	[-2.38]	[0.65]
Post period	0.06	-0.01	0.45**	0.00	-0.04	0.01
	[0.38]	[-1.64]	[2.22]	[0.66]	[-0.13]	[1.58]
Board change * Post	**0.60*** **	**0.02*** **	**2.14*** **	**0.03* **	**-2.36*** **	**-0.02**
	[2.92]	**[4.14]**	**[3.66]**	**[1.83]**	**[-3.59]**	**[-1.32]**
Time trend	0.03	0.01***	1.06***	0.01***	1.38***	0.02***
	[0.54]	[3.54]	[12.88]	[4.04]	[10.54]	[5.24]
Total assets (log, deflated)	-4.22***	0.03	-22.08***	-0.08**	-18.53***	-0.02
	[-4.55]	[1.63]	[-15.98]	[-2.36]	[-8.58]	[-0.32]
Core deposits/Total assets	-0.18***	-0.00***	-0.15***	-0.00***	-0.30***	-0.00
	[-8.47]	[-2.82]	[-5.17]	[-3.50]	[-5.82]	[-1.41]
Powerful CEO	-0.01	-0.00	0.03	0.00	-0.03	-0.00*
	[-0.91]	[-0.61]	[1.26]	[0.41]	[-0.97]	[-1.92]
Capital adequacy ratio	-0.49***	-0.00*	-1.80***	-0.00**	-1.28***	-0.01***
	[-20.27]	[-1.78]	[-36.32]	[-2.22]	[-13.07]	[-2.85]
Customer loans/Total assets	0.63***	-0.00	0.36***	-0.00	0.31***	0.00*
	[38.75]	[-0.54]	[16.72]	[-0.21]	[7.28]	[1.78]
Off balance sheet	0.12***	0.00	0.15***	-0.00	0.22***	-0.00
	[6.15]	[1.20]	[5.13]	[-1.02]	[4.03]	[-0.13]
Growth of total assets	-0.04***	0.00	-0.04**	0.00**	0.04	0.00
	[-3.58]	[0.28]	[-2.38]	[2.52]	[1.37]	[1.01]
Board size	0.50**	0.01	0.81**	-0.00	-1.11**	-0.02
	[1.97]	[0.94]	[2.42]	[-0.08]	[-2.08]	[-1.43]
Interest rate spread	-0.84***	-0.01***	-0.44***	-0.00*	-0.12	0.00
	[-13.93]	[-5.58]	[-5.32]	[-1.78]	[-0.90]	[0.50]
GDP growth (county)	0.07***	-0.00	0.08***	0.00	0.01	0.00
	[5.34]	[-0.87]	[4.39]	[0.18]	[0.19]	[0.24]
Population (log, state)	58.22***	-0.64***	36.24***	-0.86***	-18.05	-0.18
	[7.30]	[-3.37]	[3.82]	[-3.55]	[-1.24]	[-0.47]
Merger (dummy)	0.20	-0.02**	-0.51*	0.00	0.26	-0.01
	[0.74]	[-2.47]	[-1.71]	[0.45]	[0.41]	[-0.78]
Average board age	n/a	n/a	0.02	0.00	-0.11**	0.00*
			[0.77]	[0.10]	[-2.17]	[1.73]
Average Ph.D.	2.21	0.03	6.46	0.43***	n/a	n/a
	[1.64]	[0.98]	[1.36]	[3.18]		
Average female	1.11	0.01	n/a	n/a	1.01	0.17**
	[0.93]	[0.47]			[0.35]	[2.24]
Observations	5,080	6,425	2,258	3,073	960	1,220
R-squared	0.493	0.036	0.653	0.034	0.363	0.158
Number of banks	1,284	1,574	490	652	206	258
Number of board changes	432	566	17	24	19	24

We report robustness tests. Treatment banks are matched with banks of similar size (+/- 20% of Total assets, log), similar performance (+/- 20% of ROE), bank type (private, public, and cooperative banks) and year. Estimation results are shown for regressions with risk-weighted assets over total assets (RWA/TA) as dependent variables in columns (1), (3), and (5). We exclude banks that incur losses. Columns (2), (4), and (6) use loan portfolio concentration, measured by a Herfindahl Hirschman index as dependent variable. Column (1) and (2) refer to the sample with banks that experience decreases in board age after the board change and control banks. Column (3) and (4) refer to the sample containing banks which experience an increase in female board representation after the board change and control banks. Column (5) and (6) refer to the sample containing banks which experience an increase in executives with Ph.D.s after the board change and matched control banks. Board change is a dummy equal to 1 if the bank experienced a board change. Post period is a dummy equal to 1 in the period following a change. We include a time trend, and control for total assets (log), total asset growth, core deposits to total assets, powerful CEO (captured by CEO tenure), and a dummy variable Merger that equals 1 if the bank was engaged in a merger. In addition, Columns (3)-(6) control for average board age to account for the levels of the board characteristics, and Column (1)-(4) control for the average proportion of executives holding Ph.D.s. Columns (1), (2) , (5), and (6) control for the average share of female executives per year. Macroeconomic control variables are identical to the ones used in the main regressions in Table VII. t-statistics in parentheses. Constant terms included but not reported. ***,*,* indicate significance at the 1%, 5%, and 10% level, respectively.

Table XI: Alternative matching strategy on capital adequacy ratio

	Age composition	Gender composition	Education composition (Ph.D. degree)
	(1)	(2)	(3)
	RWA/TA	RWA/TA	RWA/TA
Board change	-0.05	1.15*	-1.53**
	[-0.33]	[1.78]	[-2.12]
Post period	0.19	0.56***	0.41
	[1.24]	[2.61]	[1.16]
Board change * Post period	**0.46*** **	**1.49*** **	**-2.51*** **
	[2.60]	**[2.84]**	**[-4.19]**
Time trend	-0.10*	1.10***	1.31***
	[-1.96]	[12.88]	[10.38]
Total assets (log, deflated)	-4.49***	-26.77***	-17.97***
	[-6.09]	[-20.98]	[-8.93]
Core deposits/Total assets	-0.15***	-0.27***	-0.22***
	[-8.98]	[-8.98]	[-4.89]
Powerful CEO	0.02*	0.00	-0.01
	[1.87]	[0.07]	[-0.46]
Capital adequacy ratio	-0.35***	-1.87***	-1.26***
	[-20.21]	[-30.39]	[-13.00]
Customer loans/Total assets	0.65***	0.36***	0.43***
	[47.94]	[15.70]	[11.39]
Off balance sheet items/Total assets	0.15***	0.18***	0.01
	[8.06]	[6.26]	[0.91]
Growth of total assets (deflated)	0.00	0.03***	0.04
	[0.93]	[2.90]	[1.34]
Board size	0.68***	0.25	-0.46
	[3.09]	[0.71]	[-0.83]
Interest rate spread	-1.05***	-0.44***	0.01
	[-19.81]	[-5.06]	[0.04]
GDP growth (county)	0.07***	0.06***	0.03
	[5.80]	[3.05]	[0.85]
Population (log, state)	70.08***	79.19***	-37.73***
	[10.22]	[8.46]	[-2.66]
Merger (dummy)	0.56**	-0.04	-1.17*
	[2.17]	[-0.11]	[-1.69]
Average Ph.D. representation	1.86	2.03	n/a
	[1.52]	[0.50]	
Average female representation	-1.10	n/a	-3.22
	[-1.10]		[-0.86]
Average board age	n/a	0.03	-0.11**
		[0.91]	[-2.11]
Observations	6,872	2,178	874
R-squared	0.489	0.615	0.417
Number of banks	1,620	459	186
Number of board changes	569	24	25

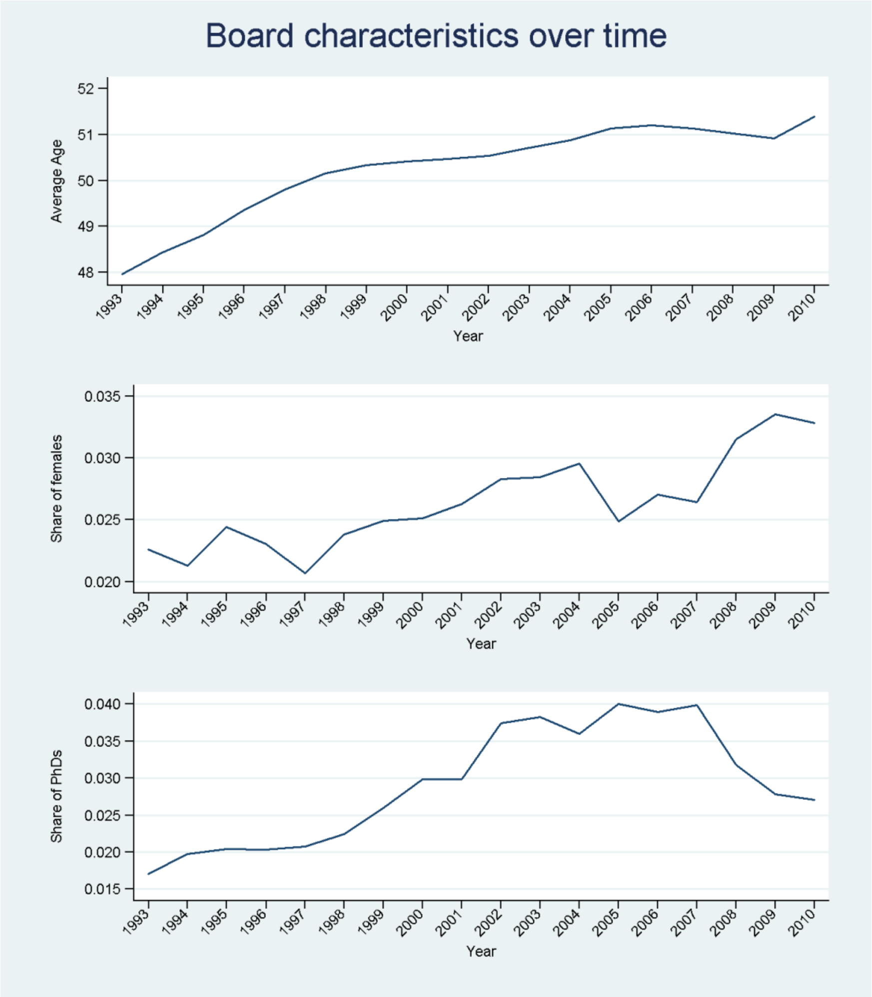
We report results from differences-in-differences estimations. Board change banks are matched with banks of similar capital adequacy ratio (+/- 10%), similar size (+/- 10 % of Total assets, log), similar performance (+/- 10% of ROE), bank type (private, public, and cooperative banks) and year. Bad banks are excluded. Column (1) refers to the sample containing banks that experience decreases in average board age after the board change and their matched control banks. Column (2) refers to the sample containing banks which experience an increase in female board representation after the board change and their matched control banks. Column (3) refers to the sample containing banks which experience an increase in the proportion of executives with a Ph.D. degree after the board change and their matched control banks. Board change is a dummy equal to 1 if the bank experienced a board change of the considered type. Post period is a dummy equal to 1 in the period following a board change. We include a time trend, and control for total assets (log), total asset growth, core deposits to total assets, powerful CEO (captured by CEO tenure), and a dummy variable Merger that equals 1 if the bank was engaged in a merger. In addition, Columns (2) and (3) control for average board age to account for the levels of the board characteristics, and Column (1) and (2) control for the average proportion of executives holding a Ph.D.. Columns (1) and (3) control for the average share of female executives per year. Macroeconomic control variables include the interest rate spread between 10-year and 1-year government bonds, GDP growth and population (log) of the state where the headquarter of the bank is registered. t-statistics in parentheses. Constant terms included but not reported. ***,*,* indicate significance at the 1%, 5%, and 10% level, respectively.

Table XII: Placebo tests

	Age composition (1) RWA/TA	Gender composition (2) RWA/TA	Education composition (Ph.D. degree) (3) RWA/TA
Board change	0.07	-0.78	-0.53
	[0.47]	[-1.30]	[-0.73]
Post period	-0.00	0.02	0.70**
	[-0.01]	[0.12]	[2.42]
Board change * Post period	**0.15**	**-0.76**	**-0.44**
	[0.65]	**[-1.41]**	**[-0.67]**
Time trend	0.39***	1.13***	0.91***
	[7.71]	[17.82]	[8.38]
Total assets (log, deflated)	0.11	-14.11***	-2.62**
	[0.28]	[-13.96]	[-2.55]
Core deposits/Total assets	-0.02	-0.02	-0.02
	[-0.80]	[-0.64]	[-0.34]
Powerful CEO	-0.01	0.02	-0.04*
	[-0.74]	[0.96]	[-1.67]
Capital adequacy ratio	-0.37***	-1.51***	-1.15***
	[-15.73]	[-31.35]	[-13.95]
Customer loans/Total assets	0.58***	0.44***	0.37***
	[41.07]	[24.02]	[11.58]
Off balance sheet	0.18***	0.35***	0.01*
	[10.68]	[13.25]	[1.77]
Growth of total assets	-0.03***	0.04***	-0.06**
	[-8.80]	[3.63]	[-2.23]
Board size	0.30	-0.47*	-0.31
	[1.28]	[-1.90]	[-0.65]
Interest rate spread	0.03	0.17**	0.35***
	[0.56]	[2.23]	[2.79]
GDP growth (county)	-0.01	-0.01	-0.03
	[-0.49]	[-0.92]	[-1.13]
Population (log, state)	-24.30***	-6.31	-95.28***
	[-3.15]	[-0.82]	[-5.90]
Merger (dummy)	0.09	-0.82**	-0.68
	[0.29]	[-2.34]	[-1.01]
Average Ph.D.	2.45**	6.60*	n/a
	[1.98]	[1.67]	
Average female	-1.79*	n/a	-9.56***
	[-1.66]		[-3.67]
Average board age	n/a	0.03	0.03
		[1.09]	[0.62]
Observations	4,518	2,428	915
R-squared	0.513	0.614	0.511
Number of banks	1,373	624	244
Number of board changes	503	21	22

We report results from the placebo test estimations. Board change banks are matched with banks of similar size (+/- 20% of Total assets, log), similar performance (+/- 20% of ROE), bank type (private, public, and cooperative banks) and year. Bad banks are excluded. Column (1) refers to the sample containing banks that experience decreases in average board age after the board change and their matched control banks. Column (2) refers to the sample containing banks which experience an increase in female board representation after the board change and their matched control banks. Column (3) refers to the sample containing banks which experience an increase in the proportion of executives with Ph.D.s after the board change and their matched control banks. Board change is a dummy equal to 1 if the bank experienced a board change of the considered type. Post period is a dummy equal to 1 in the period two years before the board change actually takes place. We include a time trend, and control for total assets (log), total asset growth, core deposits to total assets, powerful CEO (captured by CEO tenure), and a dummy variable Merger that equals 1 if the bank was engaged in a merger. In addition, Columns (2) and (3) control for average board age to account for the levels of the board characteristics, Columns (1) and (2) control for the average proportion of executives holding a Ph.D. and Columns (1) and (3) control for the average share of female executives per year. Macroeconomic control variables include the interest rate spread between 10-year and 1-year government bonds, GDP growth and population (log) of the state where the headquarter of the bank is registered. t-statistics in parentheses. Constant terms included but not reported. ***,*,* indicate significance at the 1%, 5%, and 10% level, respectively.

Figure I: Evolution of board characteristics over time



We present how board age, female share of executives, and the share of executives with Ph.D. have evolved over time. Average age refers to the average board age in a given year. Share of females denotes the average proportion of female board members. Share of PhDs denotes the average share of board members holding Ph.D.s. Averages are calculated per year.