Bridging the Gap: The Impact of Board-Management Commonality on Firm Value and Board Decision-Making Effectiveness

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Abstract

We investigate the impact of board-management commonality on firm value and board effectiveness, using a support vector machine to measure shared traits across various dimensions between the board and management. We employ a quasi-experimental design, utilizing California's 2018 diversity mandates as an instrumental variable for board-management commonality. We find that higher commonality increases firm value. This effect is stronger in firms with less diverse boards, more diverse management teams, and greater operational complexity. Firms with greater commonality exhibit fewer material events requiring 8-K filings, indicating less erratic decision-making, and adjust capital expenditures more promptly in response to negative market feedback, reflecting more effective consensus-building. These firms also demonstrate increased innovation output, as measured by the number of patents and improved innovation quality (measured by patent value and citation counts). Overall, our findings highlight the importance of commonality, often overshadowed by diversity initiatives, in enhancing firm value and facilitating efficient decision-making.

Keywords: Board-management commonality, board diversity, management diversity, support vector machine, information exchange, board effectiveness

JEL Classification: G30, G34, G38, M14

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1. Introduction

Recent actions by major institutional investors, such as State Street, BlackRock, and Vanguard, to scale back board diversity policies, alongside legal challenges to prior initiatives—the Fifth Circuit's 2024 invalidation of Nasdaq's diversity rules and the 2022 overturning of California's Senate Bill 826 (SB 826)—have reignited debate over the potential benefits and costs of diversity, equity, and inclusion (DEI) initiatives.[1] These developments, coupled with a limited understanding of the impact of management diversity, underscore how board and management team composition and alignment influence firm value, board decision-making, and governance effectiveness. While prior studies have largely focused on the impact of board diversity on firm value and board effectiveness (Bernile, Bhagwat, and Yonker, 2018; Kang, Kim, and Oh, 2022; Gormley et al., 2023; Baik, Chen, and Godsell, 2024), the significance of shared characteristics between management and board members—a key aspect of board-management dynamics—remains underexplored. This research gap is particularly noteworthy given the critical roles of independent directors, executive directors, and senior executives in governance and decision-making, as well as the impact of their interactions on firm outcomes (Hoitash and Mkrtchyan, 2022).

Our research aims to address this gap by examining how the characteristics of the overall leadership team—including the board (independent directors) and management (executive directors and senior managers)—influence firm value and board effectiveness. We focus on board-management commonality, which captures shared values, experiences, and perspectives across demographic and cognitive dimensions, and examine its effects on firm value and board decision-

[1] State Street, BlackRock, and Vanguard removed explicit board diversity targets from their 2025 proxy voting guidelines. State Street no longer requires at least 30% female directors, BlackRock dropped its targets for two women and 30% diversity on S&P 500 boards, and Vanguard now emphasizes "cognitive diversity." On December 11, 2024, the U.S. Court of Appeals for the Fifth Circuit invalidated Nasdaq's board diversity rules. Earlier, on May 13, 2022, a California court overturned SB 826—the mandate for female board representation—citing constitutional concerns.

making. While board diversity is often assessed by individual attributes, interactions between boards and management are frequently overlooked. Diversity initiatives aim to improve decision quality but can also create coordination challenges that impede consensus and strategic implementation, reducing firm effectiveness (Baranchuk and Dybvig, 2009; Malenko, 2014; Van Peteghem, Bruynseels, and Gaeremynck, 2018). Understanding how commonality fosters alignment and collaboration is crucial for realizing the benefits of diversity. Because commonality influences conflict resolution, communication, and mutual understanding, evaluations of diversity initiatives should consider both board and management composition.[2]

Measuring commonality is empirically challenging. We address this issue using a support vector machine (SVM). Unlike standard SVM applications that generate universal classification rules for group separation (Perols et al., 2017; Bao et al., 2020; Blankespoor, Hendricks, and Miller, 2023; Fedyk and Hodson, 2023), our approach identifies "misclassified" members within each firm's board and management annually, capturing nuanced overlaps between directors and management across various dimensions. This approach offers a holistic assessment of leadership team dynamics beyond conventional board or management diversity metrics.

To illustrate how an SVM evaluates the overlap between two groups along a specific dimension, consider the following example. Directors are classified into Group 1 if they share characteristics with other board members and into Group 2 if they exhibit greater similarity to managers. Similarly, managers are classified into Group 3 if they share characteristics with other managers and into Group 4 if they have more in common with directors. The SVM categorizes directors in Group 1 and managers in Group 3 as correctly classified, while categorizing directors

[2] Bourveau, Gao, and Hope (2025) show that Canada's diversity disclosure mandate significantly increases board-level diversity but has limited impact on senior management, suggesting a potential misalignment between the composition of boards and management teams.

in Group 2 and managers in Group 4 as incorrectly classified. We refer to directors in Group 2 as "manager-like directors" and managers in Group 4 as "director-like managers."

Building on this concept, we utilize SVM classification to categorize board and top management team members by identifying the hyperplane that best separates director-like managers and manager-like directors from others across multiple characteristics (Hastie, Tibshirani, and Friedman, 2009). We consider traits such as demographics (age and gender), cultural background (Hofstede, 2001), and educational and functional backgrounds. These factors, identified as important demographic and cognitive variables in prior research (e.g., Adams, Akyol, and Verwijmeren, 2018; Bernile, Bhagwat, and Yonker, 2018; Kang, Kim, and Oh, 2022; Balakrishnan et al., 2023), are detailed, along with the process of variable construction, in Section 2.2. Overall, this SVM approach provides valuable insights into dynamic overlaps between boards and management teams, which are crucial for understanding their functionality and effectiveness.

SVM-based commonality and diversity are distinct constructs. Commonality measures shared characteristics between groups, while diversity captures variation within a group. For instance, a homogeneous board and management team can exhibit high commonality due to shared attributes despite low within-group diversity. Conversely, a diverse board may exhibit low commonality with management if the characteristics of the board and management members differ significantly. High commonality suggests alignment between directors and executives, potentially influencing decision-making, whereas high within-group diversity promotes varied perspectives without ensuring cross-group alignment. By focusing on inter-group alignment, the commonality measure provides unique insights into governance dynamics. Our correlation and quintile analyses confirm this distinction, showing that commonality is not mechanically linked to diversity.

The impact of board-management commonality on firm value and policy is complex. While shared characteristics can accelerate consensus-building and improve decision-making efficiency (Baranchuk and Dybvig, 2009; Malenko, 2014; Donaldson, Malenko, and Piacentino, 2020), the effects are not uniformly positive. Similar backgrounds foster mutual understanding, facilitating quicker strategic alignment and execution, as managers and directors readily understand each other's perspectives. For example, manager-like directors, who possess operational insights, are more likely to support value-enhancing projects proposed by management, ensuring their feasibility and effectiveness.[3] On the other hand, director-like managers bridge the informational gap between the board and management by communicating operational implications effectively. Furthermore, commonality can reduce dissent costs, as modeled by Chemmanur and Fedaseyeu (2018), allowing directors to report their private signals truthfully and vote accordingly. Reducing dissent costs alleviates coordination challenges, facilitating faster board decision-making and preventing passive acceptance of suboptimal policies. Commonality also facilitates open communication and cooperation, which are essential for informed board decisions (Baranchuk and Dybvig, 2009; Chemmanur and Fedaseyeu, 2018).[4] Collectively, these arguments suggest that board-management commonality positively affects firm value and board decision-making.

While board-management commonality can foster efficiency, it also poses risks to independent oversight. Excessive harmony can stifle critical evaluation and limit the exploration of diverse strategic options. High commonality may induce conformity pressure, discouraging board members from challenging management's perspectives. This limits the board's ability to

[3] Boards are responsible for project evaluation, strategic oversight, and managerial monitoring, while management executes these decisions (e.g., Hermalin and Weisbach, 1998; Donaldson, Malenko, and Piacentino, 2020).
[4] Baranchuk and Dybvig (2009) model board decisions as a consensus-driven process that depends on director communication and cooperation. Chemmanur and Fedaseyeu (2018) illustrate how open board discussions enhance decision quality when dissent costs are low.

critically evaluate management's strategies and explore diverse strategic options in response to external threats and opportunities. As Bikhchandani, Hirshleifer, and Welch (1998) suggest, conformity can trigger informational cascades within decision-making bodies, such as corporate boards. When board members align with management's initial views, they may forgo independent analysis, leading to unanimous board decisions based on incomplete or erroneous information. Consequently, the board's ability to scrutinize management proposals is compromised, potentially causing new business opportunities to be overlooked. Boards exhibiting high commonality with management are more prone to endorse management's strategies without adequate scrutiny, neglecting alternative viewpoints and risks. This conformity can also stifle innovation and creativity, hindering the identification of emerging opportunities and the development of new ideas, products, and services. Therefore, board-management commonality can negatively impact firm value and board decision-making by undermining the board's essential oversight function.

We examine these competing views on board-management commonality and find evidence supporting its positive impact on firm value: higher commonality is significantly associated with increased firm value as measured by Tobin's *q*. Further analysis reveals a curvilinear relationship between commonality and firm value, suggesting that while initial increases in commonality enhance firm value, the effect diminishes as commonality continues to increase.

To address the endogeneity of board-management commonality, we utilize the enactment of California's SB826 as an instrumental variable (IV). This legislation mandated gender diversity on boards for firms located in California (treatment firms), inducing an exogenous shock to board composition and, inevitably, commonality. This setup provides a quasi-experimental research design, as prior studies have documented the economic effects of mandated quotas on board composition (Ahern and Dittmar, 2012; Hwang, Shivdasani, and Simintzi, 2021; Allen and Wahid,

2024; Baik, Chen, and Godsell, 2024; Bourveau, Gao, and Hope, 2025). The enactment of this legislation of similarity between independent directors and managers, thereby affecting commonality. The IV meets the relevance requirement, as SB826 is expected to significantly decrease commonality in treatment firms post-enactment compared to matched control firms. The exclusion restriction is also likely satisfied because there is no compelling reason to presume that a firm's past decision to locate in California would directly influence its current value and policies, except through its effect on commonality. To further strengthen the exclusion condition of an IV, we control for firm-level characteristics, including a composite diversity index that captures various aspects of diversity, including gender and race, industry-year fixed effects, and state-level economic conditions. As predicted, our first-stage least squares regressions of *Board-management commonality* on an interaction term between the treatment firm indicator and the post-enactment indicator show a negative coefficient for the interaction term, suggesting that the regulatory mandate leads to a significant reduction in commonality in treatment firms post-enactment by disrupting the established alignment between the board and management. In the second-stage least squares regressions of firm value on instrumented *Board-management commonality*, we find that the coefficient on instrumented *Board-management commonality* is positive and significant at the 5% level, indicating that commonality between board members and management positively affects firm value.

Next, to examine the mechanisms through which commonality benefits shareholders, we perform two subsample analyses. First, we examine how the impact of commonality on firm value varies with board and management diversity. We hypothesize that commonality is particularly advantageous in two scenarios: (1) in firms with lower board diversity, where commonality can broaden boardroom perspectives by introducing unique insights through director-like managers

and manager-like directors, who complement the lack of natural conduits for information exchange,[5] and (2) in firms with higher management diversity, where it facilitates board endorsement of value-enhancing projects proposed by management teams with diverse backgrounds, thereby maximizing the benefits of management diversity. Consistent with our predictions, we find that the positive impact of commonality on firm value is more pronounced among firms with lower board diversity and those with higher management diversity.

Second, we examine whether commonality helps mitigate conflicts arising from divergent perspectives, facilitating swift decision-making, particularly in firms with complex operations. In such environments, effective communication and mutual understanding are essential, and shared perspectives and collaboration between the board and management facilitate decisive actions, enabling firms to adapt quickly to changes. By fostering alignment, commonality enhances information processing and decision-making efficiency, which are crucial for firms with complex operations. We utilize Principal Component Analysis (PCA) to construct a business complexity index that assesses the multifaceted aspects of business complexity, encompassing operational complexity, regulatory uncertainty, and market volatility. Our findings indicate that the positive impact of commonality is most pronounced in firms with higher operational complexity, suggesting that this shared perspective is particularly valuable in complex business environments.

We then examine the role of commonality in improving board decision-making effectiveness in two empirical settings. First, we analyze the frequency of material events requiring 8-K filings, which indicates inconsistent decision-making, as Giannetti and Zhao (2019) note. Consistent with our hypothesis that shared backgrounds and perspectives mitigate decision-making friction and foster more predictable and cohesive decision-making processes, we find that firms with greater

[5] The incremental benefits of director-like managers and manager-like directors may be less pronounced on more diverse boards, where the directors' diverse backgrounds already foster more effective communication.

commonality exhibit fewer material events requiring 8-K filings. Second, we examine capital expenditure (capex) investment decisions, which benefit from prompt consensus-building and corrective actions informed by external feedback (Jayaraman and Wu, 2019; Bae, Biddle, and Park, 2022). We find that firms with higher commonality respond more effectively to market feedback on capex forecasts, leading to subsequent investment adjustments, suggesting that commonality facilitates consensus in corrective actions by promoting communication and cooperation.

Finally, we investigate the impact of commonality on firms' innovation policy, noting its long-term, multi-stage nature and the inherent risks of innovation (Balsmeier, Fleming, and Manso, 2017). Board-management commonality plays a pivotal role by fostering shared understanding and tolerance for long-term risks. When the board and management share a common vision and risk appetite, they are more likely to support projects that generate long-term value despite incurring short-term expenses. Our analysis indicates that firms with higher commonality experience increased innovation output, as measured by the number of patents, and improved quality, as measured by patent value and the number of citations. These results suggest that commonality facilitates consensus-building, particularly in innovation policy, which requires sustained efforts and poses challenges in achieving agreement.

We conduct several additional tests to validate our findings further. First, we examine the impact of unexpected director and manager deaths, which alter board and management composition and commonality, regardless of prior firm conditions. Stock prices decline more significantly following the deaths of both manager-like directors and director-like managers, indicating that both groups contribute equally to firm value. Second, placebo tests using manager-like directors and director-like managers—identified as such in other firms during a given year but not in the focal firm—confirm that the positive impact of directors and managers with commonality

is attributable to their shared similarities with other groups, rather than to specific individual traits. Third, we find that the positive and significant impact of commonality on firm value persists even when each component of shared characteristics is excluded, suggesting that shared traits across various characteristics collectively influence decision-making dynamics between the board and management. Fourth, consistent with the results using Tobin's q, which measures firm value, we find that commonality positively affects firms' operating performance, measured as the change in the average return on assets (ROA). Fifth, an analysis of director biographies indicates that manager-like directors focus more on community engagement and social responsibility, emphasizing their role in communication, consensus-building, and informed decision-making. Finally, our textual analysis of firms' proxy statements, following the methodology of Loughran and McDonald (2016), reveals that firms with higher commonality emphasize integrity and teamwork in their director-selection criteria, providing further insights into the distinct characteristics of these firms.

Our study contributes to the literature by providing empirical evidence that supports theoretical models exploring board dynamics and decision-making processes (Baranchuk and Dybvig, 2009; Malenko, 2014). By examining board-management commonality, we extend beyond the concept of director-management connections (Fracassi and Tate, 2012; Hoitash and Mkrtchyan, 2022) to capture a wider range of governance dynamics. This approach highlights the significance of shared traits between independent directors and the broader executive team, providing a more nuanced analysis of how board diversity impacts firm decisions by considering the overall composition of boards and management.

Second, our study extends the literature on the unintended consequences of mandated gender diversity quotas (Hwang, Shivdasani, and Simintzi, 2021; Bian, Li, and Li, 2025; Von Meyerinck

et al., 2025).[6] Although legal challenges to diversity mandates often focus on specific diversity dimensions, we emphasize the need to consider the broader interplay between the board and management. We show that mandated quotas lead to a sharp decline in board-management commonality, which in turn diminishes alignment between the board and management and adversely affects firm value and decision-making efficiency.

Third, we contribute to the literature on machine learning in accounting and finance by applying an SVM classification algorithm to measure board-management commonality. Previous studies (Perols et al., 2017; Bao et al., 2020; Blankespoor, Hendricks, and Miller, 2023; Fedyk and Hodson, 2023) typically employ SVMs, a supervised machine learning algorithm, to identify universal rules for classifying financial and textual data sources, such as fraudulent financial reports and earnings disclosures. Our study diverges from this approach by focusing on misclassified data points. These misclassifications serve as indicators for assessing the level of commonality between the two groups across multiple dimensions, a method that, to our knowledge, has not been empirically implemented in prior research.

The paper proceeds as follows: Section 2 describes the sample and key variables. Section 3 examines the impact of board-management commonality on firm value, using California's SB826 as an IV, and conducts subgroup analyses based on diversity and business complexity. Section 4 analyzes the impact of commonality on board decision-making efficiency and innovation policy. Section 5 presents additional robustness tests, and Section 6 concludes.

2. Data and variable definitions

2.1 Sample and variable definitions

[6] Studies by Hwang, Shivdasani, and Simintzi (2021), Von Meyerinck et al. (2025), and Bian, Li, and Li (2025) document that quotas lead to skill mismatches, stock market losses due to regulatory uncertainty, and backlash against female employment, respectively.

We match BoardEx firms with those covered in Compustat and the Center for Research in Security Prices (CRSP) to create the BoardEx-Compustat-CRSP database, covering the period 2003–2021. We begin in 2003 to mitigate the confounding effects of the 2002 Sarbanes-Oxley Act on board composition and the role of independent directors.[7] We obtain financial data from Compustat and stock return data from the CRSP. We exclude firms in the financial industry (Standard Industrial Classification (SIC) codes 6000-6999) and those with missing values for key variables. The final sample comprises 44,115 firm-year observations from 5,213 firms with complete data on the key variables.

2.2 Measurement of board-management commonality

Our key explanatory variable, *Board-management commonality*, measures the overlap of demographic, cultural, educational, and functional attributes between the board and management —characteristics identified as important demographic and cognitive factors in prior studies (Adams, Akyol, and Verwijmeren, 2018; Bernile, Bhagwat, and Yonker, 2018; Balakrishnan et al., 2023). The appendix provides a detailed description of all variables used to define these four dimensions. While overlapping members can be visually identified on a two-dimensional plane when considering only two characteristics, this graphical method becomes impractical for multiple characteristics due to the time-intensive manual inspection required for each firm annually.

To address this limitation, we employ the SVM algorithm to separate the board and management by constructing an optimal hyperplane for each characteristic. We then compute the first principal component to derive a comprehensive measure of *Board-management commonality* that accounts for all characteristics. While the SVM effectively divides groups, it imperfectly separates those with partially overlapping values, resulting in the misclassification of some

[7] The BoardEx dataset expanded significantly in 2003, providing more comprehensive coverage of U.S. firms (Fracassi and Tate, 2012).

members. These misclassifications serve as a metric for the extent of overlap between the board and management, which we use to measure board-management commonality.

Our approach employs a linear kernel to ensure robust classification across varying levels of within-group diversity while avoiding complex decision boundaries that create artificial distinctions from minor differences. Instead, it identifies meaningful overlaps when board and management teams share similar characteristics. Unlike conventional SVM applications that establish universal group identification rules, we conduct firm-specific SVM analyses each year to classify directors and managers, thereby identifying misclassified individuals.[8]

We obtain data on the demographic, educational, and functional characteristics of board members and management from BoardEx. For cultural background, we use OnoGraph to identify their country of origin based on first and last names (Giannetti and Zhao, 2019). Cultural values are derived from Hofstede's (2001) model of national culture. To ensure comparability, we standardize continuous variables—such as tenure, age, and Hofstede's cultural values—to range from zero to one. Additionally, we demean all 20 characteristic variables by industry (using two-digit SIC codes) and year to account for time-varying, industry-specific trends. This adjustment enhances data compatibility and ensures classification is based on intrinsic characteristics rather than external industry or temporal factors.

For each attribute, we apply the SVM classifier to classify independent directors and management. The fraction of manager-like directors and director-like managers—calculated as one minus the SVM classification accuracy—represents the overlap between board and management attributes. This overlap is illustrated in Panel A of Figure 1.

[8] Since our objective is not to establish a universal rule applicable across different firms and periods, distinguishing between training and test samples is unnecessary.

After measuring the commonality of each attribute, we compute the first principal component to derive a comprehensive measure of *Board-management commonality* that reflects the overlap between board members and management across multiple dimensions.[9]

$$\textit{Board-management commonality} = \frac{\text{No. of director-like managers} + \text{No. of manager-like directors}}{\text{Total no. of management team members} + \text{Total no. of directors}}$$

This approach mitigates the influence of noise from any single characteristic or small sample size, resulting in a more robust and firm-specific assessment of board-management commonality.[10] A higher value of *Board-management commonality* indicates a greater degree of shared characteristics, values, experiences, or perspectives between board members and management.[11]

We select the SVM classification-based measure over other machine learning methods because it effectively identifies overlapping characteristics based on complex attribute distributions.[12] Alternative machine learning methods, such as XGBoost, Random Forest, and neural networks, offer flexibility in addressing multidimensional problems but may lead to overfitted classification boundaries. This overfitting is undesirable in our context, where identifying misclassified members is the primary goal, as illustrated in Panel B of Figure 1.

We conduct two untabulated tests to ensure that our SVM-based commonality measure accurately captures the genuine overlap in characteristics between the board and management rather than merely reflecting board or management diversity. First, the correlation matrix reveals a minimal correlation between commonality and board diversity (0.003) and a modest correlation

[9] The weights of the 20 characteristics contributing to *Board-management commonality* are generally evenly distributed, ranging from a high of 0.25 for Hofstede's (2001) power distance to a low of 0.136 for legal expertise.
[10] As Hastie, Tibshirani, and Friedman (2009) note, the performance of SVM improves with the number of data points. To address potential concerns about small sample sizes, we conduct a sensitivity analysis, excluding cases with fewer than four board or management members (bottom tenth percentile). The results remain unchanged, suggesting that our findings are robust to sample size variations.
[11] A detailed technical description of the SVM-based commonality measure is available upon request.
[12] One might consider traditional methods, such as centroid-based distance classification. However, this approach relies solely on the distance to the group centroid, limiting its ability to classify beyond average traits. In contrast, SVM's hyperplane-based separation enables differentiation based on specific characteristics, which is particularly valuable in contexts requiring nuanced, individual-level differentiation.

with management diversity (0.085).[13] Second, we perform a quintile analysis of diversity measures across commonality groups. We find that board diversity exhibits a modest increase in mean values from -1.01 to -0.98 across quintiles, with median values showing minimal variation from -1.05 to -1.02. Similarly, management diversity shows a gradual increase in mean values from -0.86 to -0.80 across commonality quintiles, with median values following a similar pattern from -0.90 to -0.82. The results provide further evidence that the SVM-based commonality measures and diversity represent fundamentally distinct constructs.

2.3 Summary statistics

Table 1 presents the summary statistics for the main variables of the sample firms in the BoardEx-Compustat-CRSP database. The mean (median) *Board-management commonality* is 1.63 (1.68). The mean (median) board and management sizes are 6.55 (six) and 9.76 (nine), respectively. All continuous variables are winsorized at the 1st and 99th percentiles. Figure 2 illustrates the cross-sectional and time-series variation in board-management commonality. In Panel A, to analyze the persistence, or "stickiness," of commonality across firms, we categorize firms into three groups based on the annual change in commonality: firms with no annual change, those with an increase, and those with a decrease. The figure shows that firms are more likely to experience positive or negative changes in commonality than maintain a constant level. Panel B depicts annual changes in average commonality, which fluctuate until 2012 and then trend upward, suggesting that commonality varies by year rather than exhibiting strong persistence.

3. Board-management commonality and firm value

3.1 Ordinary least squares (OLS) analyses

[13] *Board-management commonality* exhibits weak correlations with most governance measures, except for a significant negative correlation with *Management size* (-0.54).

We estimate OLS regressions to examine the impact of board-management commonality on firm value. Shared experiences and backgrounds between board members and management can foster clearer communication and better understanding, facilitating effective oversight and faster decision-making. However, shared views may diminish critical evaluation, reducing director dissent and compromising the board's checks-and-balances role. Consequently, while shared views enhance firm value through alignment, they may also diminish value by limiting critical oversight.

Panel A of Table 2 presents the results of the OLS regression analysis. The dependent variable is Tobin's *q*. The regressions control for various firm characteristics that influence board and management composition and firm value, including firm size, past performance (stock returns and return on assets (ROA)), return volatility, leverage, research and development (R&D) intensity, and governance characteristics (the proportion of independent directors, institutional ownership, board size, and management size). We also control for board diversity, management diversity, and board-management social networks (Fracassi and Tate, 2012; Hoitash and Mkrtchyan, 2022). In column (1), which controls for industry and year fixed effects and various firm-level characteristics, we find that the coefficient on *Board-management commonality* is positive and significant at the 1% level. This result remains consistent when we replace industry fixed effects with firm fixed effects in column (2) and year fixed effects with industry-year fixed effects in column (3). In columns (4) and (5), we investigate the curvilinear relationship between commonality and firm value by adding the square term of commonality in the regressions. We find positive coefficients on *Board-management commonality* but negative coefficients on the squared term, indicating a nonlinear association between commonality and firm value. Specifically, Tobin's *q* increases

initially with higher commonality but declines as commonality increases further. Firm value reaches its maximum when commonality is 1.96 (1.91), as shown in column (4) (column (5)).[14]

3.2 California's SB826 as an instrument for board-management commonality

A key concern in the regression analysis above is that a firm's selection of directors and management may be endogenously determined. Unobservable firm characteristics, such as corporate culture and strategic priorities, can influence both commonality and value. For example, firms with a collaborative culture and strong communication may naturally align their board and management, increasing commonality and firm value through strategic outcomes. Similarly, well-performing firms may have more resources and incentives to foster harmonious board-management relationships, contributing to a positive relation between commonality and firm value.

To address these concerns, we employ California's SB826 in the post-enactment period as an IV for commonality.[15] Enacted on September 30, 2018, SB826 mandated gender diversity on the boards for all California-based public companies, imposing significant financial sanctions—$100,000 for initial infractions and $300,000 for repeated offenses. This legislation should increase board diversity, particularly gender diversity, among California-based public companies. To the extent that SB826 does not significantly affect management diversity, its enactment should abruptly reduce these firms' board-management commonality, thereby satisfying the relevance condition of our IV. Furthermore, our IV is unlikely to have a direct, significant effect on firm value and policies except through its impact on commonality, satisfying the exclusion restriction. To further bolster the exclusion restriction—ensuring that SB826's effect on firm outcomes

[14] The turning point for commonality is calculated as $-\beta_1/(2\beta_2)$, where β_1 and β_2 are the coefficients on *Board-management commonality* and its squared term, respectively. Using the coefficients from column (4) (0.744 and -0.19), the estimated maximum firm value occurs at a commonality level of approximately 1.96.

[15] Both Ahern and Dittmar (2012) and Hwang, Shivdasani, and Simintzi (2021) show that firms achieved mandated gender quotas by replacing existing members and expanding the hiring pool, suggesting an abrupt change in board-management commonality.

operates solely through changes in commonality rather than direct effects of gender diversity or other firm-specific variables—we employ a propensity score matching approach. Specifically, we use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables include all control variables listed in Table 2, such as *Board diversity* and *Management diversity* indices. Additionally, we require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. This approach yields a sample of 281 firms headquartered in California (treatment firms) and 938 propensity score-matched firms headquartered in other states (control firms). The sample period spans from 2015 to 2021, as a California court subsequently overturned this statute on May 13, 2022.

Panel B of Table 2 presents the results of the two-stage least squares (2SLS) regressions. In column (1), we regress the interaction term *Treatment firm* and *Post* on *Board-management commonality* after controlling for variables related to state economic conditions, in addition to firm-level variables included in Panel A. We also control for year fixed effects and firm fixed effects. *Treatment firm* is an indicator equal to one for treatment firms, and zero for control firms. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's SB 826 was enacted (September 30, 2018). *Treatment firm* × *Post* is negatively and significantly associated with *Board-management commonality* at the 1% level. The negative coefficient in the first stage indicates that treatment firms significantly decrease commonality post-SB826. By imposing structural changes on board composition without a corresponding impact on management, this regulatory mandate inherently disrupts the pre-existing alignment between the board and management. Moreover, to comply with the mandate, firms are compelled to appoint female directors, requiring them to expand beyond their existing networks or labor supply sources (Hwang, Shivdasani, and Simintzi, 2021; Gormley et al., 2023).

As a result, they are more likely to appoint directors who differ from existing board members and management teams in terms of experience, priorities, or social networks, further reducing alignment between the board and management. In column (2), we estimate the second-stage regression by regressing Tobin's *q* on instrumented *Board-management commonality* and control variables. The coefficient on instrumented *Board-management commonality* is positive and significant at the 5% level, indicating that higher firm value is associated with shared commonality between board members and management. The first-stage Cragg-Donald *F*-statistic is 29.9, rejecting the null hypothesis of weak identification. The results in columns (3) and (4) remain consistent when year fixed effects are replaced with industry-year fixed effects. The coefficient estimates for *Board-management commonality* in columns (2) and (4) are 4.876 and 5.022, respectively, indicating that a one-standard-deviation increase in *Board-management commonality* is associated with a 47.78% and a 49.22% increase in firm value. These effects are both economically and statistically significant.[16]

3.3 Value-enhancing mechanisms of board-management commonality: Subgroup analyses

3.3.1 Board diversity and management diversity

To investigate the mechanisms through which commonality enhances firm value, we analyze how its impact varies between firms with high and low board or management diversity. We argue that board-management commonality facilitates alignment and coordination between the board and management, whereas diversity fosters varied perspectives within a group but does not necessarily promote cross-group alignment.[17] This argument suggests that the role of commonality

[16] Given a mean Tobin's *q* of 2.91, the change in *Board-management commonality* from the 25th to the 75th percentile corresponds to approximately a 58.81% increase in Tobin's *q* (4.876 × (1.858 - 1.507) / 2.910).

[17] Our untabulated tests show that although both management and board diversity decline noticeably throughout the study period, management diversity consistently surpasses board diversity. The trends of *Board diversity index* by components further show that functional diversity increases steadily while cultural, demographic, and educational diversity levels remain low. Demographic diversity declines over time, but cultural and educational diversity remain

in improving firm value is particularly important when firms' boards lack diversity but their management teams are highly diverse. In firms with less diverse boards, manager-like directors and director-like managers mitigate the limitations of homogenous voices by acting as conduits for information exchange and fostering consensus-building. These directors and managers bridge communication gaps and decision-making by introducing unique insights through shared perspectives with management and the board, respectively. In contrast, in more diverse boards, the inherent advantage of diverse perspectives and effective communication reduces the incremental benefits of commonality. Shared traits contribute less significantly to decision-making processes already enriched by diverse viewpoints and strong communication. As a result, the incremental value of commonality diminishes when a board already possesses diverse views and broad insights. Conversely, boards with higher commonality are more likely to approve when diverse management teams propose value-enhancing projects due to improved mutual understanding and alignment. Boards with lower commonality, however, may reject such proposals, failing to fully leverage management diversity. Therefore, the full potential of management diversity is realized only when there is sufficient commonality between the board and management.

To examine this issue, we conduct subsample analyses by dividing the full sample into two groups based on the annual sample median of *Board diversity index* and *Management diversity index*, respectively. The results are presented in Table 3. In columns (1) through (4), the coefficients on instrumented *Board-management commonality* are positive and significant only for firms with lower board diversity. In columns (5) through (8), the coefficients are positive and significant only for firms with more diverse management teams. The results suggest that the positive impact of commonality on firm value is more pronounced in firms with lower board diversity, as manager-

stable. The trends of *Management diversity index* by components show that educational diversity in management teams remains high, while demographic, functional, and cultural diversity have decreased over time.

like directors and director-like managers help mitigate the limitations of less diverse boards. Similarly, in firms with higher management diversity, these individuals facilitate the integration of diverse management perspectives into board decision-making.

3.3.2 Business complexity

As a second mechanism through which commonality enhances firm value, we examine whether its role in improving firm value is more pronounced in firms with complex operations. If board-management commonality helps mitigate conflicts arising from divergent perspectives and facilitate swift decision-making, this effect is likely to be more pronounced in complex business environments, such as those characterized by operational complexity, regulatory uncertainty, or market volatility. In such environments, commonality and collaboration between the board and management enable the board to navigate intricate operations and support decisive actions effectively, allowing firms to adapt quickly to changing environments. Consequently, we expect the positive impact of commonality on firm value to be more significant when firms face complex business operations. To assess the multifaceted nature of business complexity, we utilize a principal component analysis (PCA) approach to construct a comprehensive *business complexity index*. This index integrates six key variables: 1) *geographic segment complexity*, measured as the number of geographical segments, 2) *financial disclosure complexity*, calculated as the ratio of complexity words retained based on the model selection process to the total word count in the 10-K filing for a given year (Loughran and McDonald, 2024), 3) *product market dynamism*, measured as the similarity between changes in a firm's product descriptions from its 10-K filings and the evolving product descriptions of its rivals within the same industry (Hoberg, Phillips, and Prabhala, 2014), 4) *regulatory overlap complexity*, an index that measures the degree to which multiple federal agencies regulate firms based on the relevance of each regulatory topic to the firm

(Kalmenovitz, Lowry, and Volkova, 2025), 5) *state-level policy uncertainty index*, which captures the level of uncertainty within a state, derived from local newspaper articles capturing state and local policy uncertainty (Baker, Davis, and Levy, 2022), and 6) *systemic risk*, measured as the variance of the product of market daily returns and beta, estimated using Carhart's (1997) four-factor model. We then divide the sample into two subsamples based on the annual sample median of the index and estimate the regression separately for each subsample.

Table 4 presents the results. The coefficients on *Board-management commonality* are positive and significant for firms with a higher business complexity index but insignificant for firms with a lower business complexity index. These findings suggest that the positive impact of commonality on firm value is more pronounced in complex business environments, underscoring the importance of timely decision-making and swift implementation of business strategies from a shared perspective in navigating complex business operations. In such environments, where directors and managers may hold varied perspectives, commonality plays a critical role in overcoming communication barriers—a result consistent with theoretical insights from Malenko (2014) and Donaldson, Malenko, and Piacentino (2020).

4. The impact of board-management commonality on decision-making efficiency and innovation activities

4.1 Board decision-making efficiency

We argue that commonality expedites consensus-building and improves boardroom decision-making efficiency, ultimately enhancing firm value. To investigate this argument, we conduct two analyses in this section: the frequency of material events requiring 8-K filings, as a measure of erratic decision-making, and capex investment adjustment in response to market feedback, which captures firms' corrective actions.

4.1.1 Incidence of material events requiring 8-K filings

We analyze the frequency of material events requiring 8-K filings, which indicates erratic decision-making (Giannetti and Zhao, 2019). Theoretical models suggest that commonality fosters communication and consensus-building through shared backgrounds and perspectives (Baranchuk and Dybvig, 2008; Malenko, 2014; Chakraborty and Yilmaz, 2017; Chemmanur and Fedaseyeu, 2018). Accordingly, we predict that firms with higher commonality exhibit more predictable and aligned decision-making, resulting in fewer such filings.

Table 5 presents the results where the second-stage dependent variable is the natural logarithm of one plus the number of material event-related 8-K filings. In addition to the controls in Panel B of Table 2, we include several factors that are likely to influence a firm's filing tendency. These variables include *Product similarity*, measured by pairwise similarity scores between firms based on textual analysis of their 10-K product descriptions (Hoberg and Phillips, 2016); *Significant share issuance*, an indicator for firms where the number of shares outstanding, adjusted for stock dividends and splits, increases by more than 10% compared to the previous year; *Analysts' forecast dispersion*, the standard deviation of earnings forecasts provided by analysts covering the firm; and *Book-to*-market, the ratio of the book value of equity to the market value of equity. We find a negative and significant coefficient on the second-stage instrumented board-management commonality, which indicates that higher commonality is associated with more efficient and stable board decision-making, as evidenced by fewer 8-K filings.

4.1.2 Capex investment adjustment

Next, we examine capex investment decisions to assess whether shared perspectives between boards and management can mitigate conflicts and effectively adjust their proposed action based on market reactions (Jayaraman and Wu, 2019; Bae, Biddle, and Park, 2022). Since commonality

facilitates consensus-building and efficient information flow, we expect firms with higher commonality to adjust their capex investment in response to market reactions to managerial capex forecasts. We obtain annual capex forecast data from the I/B/E/S Guidance database and use the first managerial capex forecasts of the fiscal year to minimize bias arising from management-disclosed information later in the year.

Table 6 presents the results, where the second-stage dependent variable is the percentage difference between the capital expenditures made by the firm in a year and the firm's initial forecasted amount for the same year (*Capex adjustment*). In addition to controls in Panel B of Table 2, we include additional controls that are likely to affect a firm's decision to adjust capex investment: *Capex/assets*, the ratio of capital expenditure to total assets; *Analyst coverage*, the natural logarithm of one plus the number of analyst coverage; *Analysts forecast dispersion*, defined as in Table 5; *Earnings surprise*, the difference between the quarter's earnings per share and that of the same quarter of the previous year; and *Earnings announcement*, an indicator for a firm's capex announcements accompanied by earnings announcements. We divide the sample into two subgroups based on whether the cumulative abnormal returns from one day before to one day after a firm's capex forecast announcement date (CAR (-1, 1)) are negative (columns (1) and (2)) or positive (columns (3) and (4)). Abnormal stock returns are calculated using the Fama-French-Carhart four-factor model (Carhart, 1997). For a subsample of negative announcement events, the coefficient on the second-stage instrumented board-management commonality is negative and significant in column (1), although it is insignificant in column (2), where industry-year fixed effects are used. The findings indicate that firms with higher commonality respond by cutting down actual capital expenditures in response to negative market feedback to managerial capex forecasts.

In columns (3) and (4), none of the coefficients are significant, indicating that firms do not seem to increase capex investment when market feedback is positive to their proposed investment plan.

Overall, these findings suggest that commonality contributes to more consistent decision-making processes and alignment in preferences and facilitates detailed, timely information sharing among leadership team members, thus facilitating prompt corrective actions if required.

4.2 Innovation policy

Innovation policies involve complex, long-term decision-making processes requiring multistate efforts to achieve positive outcomes (Balsmeier, Fleming, and Manso, 2017). Commonality can foster a shared understanding and tolerance for these risks and potential failures associated with innovation. When the board and management share a common vision and risk appetite, they are more likely to support projects with substantial long-term value creation potential. As a result, shared risk tolerance leads to increased innovation output and enhanced productivity.

To investigate this argument, we measure firm innovation using patent data from Kogan et al. (2017) and regress the second-stage innovation variables on instrumented *Board-management commonality*.[18] Table 7 presents the results. The second-stage dependent variable in columns (1) and (2) is the number of patents. In columns (3) through (6), innovation productivity serves as the second-stage dependent variable. Specifically, in columns (3) and (4), the dependent variable is the value of patents, measured by stock market reactions to patent grant announcements, while in columns (5) and (6), it is the number of patent citations. All these measures are scaled by the firm's total assets. We include *cash/assets*, *book-to-market*, and investment intensity (*PPE/assets* and *Capex/assets*), following prior research (Balsmeier, Fleming, and Manso, 2017; Hirshleifer, Hsu, and Li, 2017), in addition to other control variables used in Table 2. The coefficients on

[18] We thank Kogan et al. (2017) for making their patent data available through Noah Stoffman's website (https://www.stoffprof.com/)

instrumented *Board-management commonality* are positive and significant across all specifications. This finding suggests that shared risk tolerance and acceptance of failure between directors and managers foster more efficient innovation through effective communication and consensus-building, leading to increased innovation output and quality.

5. Additional tests

5.1 Valuation analysis around the deaths of directors and managers

In addition to the quasi-experimental setting that leverages California's diversity mandates, we exploit the deaths of directors and managers, which alter the composition and commonality of the board and management, independent of firm conditions (e.g., Fracassi and Tate, 2012). If director-like managers and manager-like directors play a value-enhancing role, stock prices should decline after their deaths. We identify 815 deaths through BoardEx, news reports, U.S. Securities and Exchange Commission filings, and other sources. Our SVM approach classifies directors and managers based on their contributions to commonality before their unexpected demise, allowing for a nuanced analysis. This method isolates the effects of commonality from the shocks caused by the loss of key personnel, thereby enhancing the credibility of our causal inferences.

Table 8 presents the results. The dependent variable is the CAR (-1, 1) around the death of directors and management team members, with abnormal returns calculated as in Table 6. In column (1), the key variable is *Manager-like director/Director-like manager*, an indicator equal to one for directors or managers who share similarities across four dimensions.[19] Along with the firm-level controls in Panel A of Table 2, we include individual-level controls: indicators for CEO and board chair, *age*, and *tenure*. We find that the coefficient on *Manager-like director/Director-*

[19] This individual-level analysis, which leverages the unexpected removal of individuals from the board and management, enables us to more precisely isolate their causal impact on firm value. By contrast, firm-level panel data analysis captures only aggregated average effects, making it difficult to disentangle interaction effects among these individuals and others within the leadership team.

like manager is negative and significant at the 5% level, suggesting that outside investors value these individuals. In column (2), we use separate indicators for *Manager-like director* and *Director-like manager* to isolate their contributions. The positive effect of commonality may primarily originate from director-like managers, who better understand projects ratified by the board due to their shared perspectives with directors, enabling them to execute decisions more effectively. Alternatively, it could stem from manager-like directors, who are more likely to ratify value-enhancing proposals because they align with managers' perspectives. We find negative and significant coefficients for both indicators, suggesting that the positive impact of commonality is not driven by either group but rather reflects the incremental value of both groups.[20]

In columns (3) to (6), we further focus on deaths largely unanticipated by the stock market, excluding suicides, cancer, and deaths of individuals aged over 75 years. The results are similar, although the coefficient on *Director-like manager* loses its significance in column (6). These findings are generally consistent with those of our earlier firm-level analyses, suggesting that manager-like directors and director-like managers perform value-enhancing roles.

5.2 Placebo tests

Manager-like directors and director-like managers may play value-enhancing roles due to their unique traits rather than shared characteristics with individuals in other groups. To address this alternative explanation, we conduct placebo tests using *Placebo board-management commonality*, computed as the ratio of the sum of placebo manager-like directors and placebo director-like managers to the total number of directors and managers. Placebo manager-like directors and

[20] Supporting this evidence, untabulated descriptive statistics on the roles of manager-like directors and director-like managers indicate their significant presence in key positions that facilitate communication and coordination between the board and management. Manager-like directors frequently serve as chairpersons (50.3%) and play critical committee roles, including audit (39.14%), compensation (31.86%), and nominating committees (29%), which are essential to board governance. Director-like managers occupy influential positions within the management team, such as CEO (26.72%), president/vice president (36.90%), and CFO (13.42%).

placebo director-like managers are those identified as such in other firms during a given year but not in the focal firm. We repeat all our analyses using *Placebo board-management commonality* and find that none of the coefficients on *Placebo board-management commonality* are significant (not reported). This finding indicates that the positive impact of manager-like directors and director-like managers documented in earlier analyses is attributable to their shared similarities with individuals in other groups rather than their specific traits.

5.3 Effect of each component of board-management commonality on firm value

As a firm's board-management commonality is measured across different dimensions, we assess the impact of each component on the baseline results by excluding each dimension from the measure. Panel A of Table 9 presents estimates from OLS regressions, and Panel B presents estimates from second-stage 2SLS regressions, where the instrument used for *Board-management commonality—excluding each component* is the interaction term *Treatment firm* × *Post*. The findings suggest that no single dimension significantly influences our main results, implying that the combined variation in commonality affects decision-making rather than any single dimension.

5.4 Operating performance

As an alternative measure of firm performance, we focus on ROA, a key indicator of a firm's long-term sustainability and ability to maintain profitability, in addition to the market-based Tobin's *q*. Table 10 presents the results. We focus on the change in ROA instead of the ROA level to assess how commonality affects firms' operational efficiency over time. Specifically, the second-stage dependent variable is ΔROA, which is calculated as the difference between the average ROA over the subsequent three years (Year $_{t+1}$, Year $_{t+2}$, Year $_{t+3}$) and the ROA in the base year (Year $_{t}$). We find that the coefficient on instrumented *Board-management commonality* is positive and significant in both columns. This finding suggests that firms with greater commonality

exhibit superior operational performance, consistent with our earlier evidence of higher firm value as measured by Tobin's q. By combining these metrics, we provide evidence of the positive impact of commonality on firm performance from both operational and market perspectives.

5.5 Role of manager-like directors

To understand the roles of manager-like directors in board-management dynamics, we conduct a text-based analysis of director biographies to explore the differences between manager-like directors and other directors (Gow, Wahid, and Yu, 2018).[21] Untabulated results indicate that, compared with other directors, manager-like directors are more likely to emphasize community engagement and social responsibility and less likely to emphasize strategic leadership competence. Prior studies highlight the importance of stakeholder influence in achieving consensus and fostering shared values through improved communication (Freeman, Wicks, and Parmar, 2004). Therefore, manager-like directors prioritizing community engagement and social responsibility enhance communication, consensus-building, and decision-making. These insights underscore the importance of recognizing shared traits between board members and managers for effective corporate governance.

5.6 Textual analysis of firms with higher board-management commonality

To understand the characteristics of firms with higher commonality, we analyze proxy statements focusing on director skill descriptions mandated by Regulation S-K Item 401(e) for U.S. public firms. These disclosures help identify key characteristics associated with higher commonality. To capture relevant discussions of director selection and nomination policies, we

[21] We obtain the latest editions of manager-like directors' biographies from S&P Capital IQ (CIQ). We do not extend this analysis to director-like managers due to concerns about sample selection bias from differing disclosure requirements. Specifically, while U.S. firms are required by Regulation S-K (2009) to disclose directors' biographies, no such requirement exists for nonboard management members. Consequently, the resulting data for managers would be incomplete and potentially biased, hindering accurate representation of the broader managerial population.

extract sentences containing "director" and either "governance," "nomination," or "nominating." We focus on three sample years—2010, 2015, and 2020—due to data processing constraints and limited variation in the wording of proxy statements across years.

Similar to Baker et al. (2024), who measure firms' DEI commitments by counting DEI-related terms in mandatory SEC filings relative to actual workforce diversity, we use ChatGPT to analyze proxy statement language and assess the discussion of director selection policies. If relevant, we search for keywords related to five cultural values—integrity, teamwork, innovation, quality, and respect—as defined in the culture dictionary by Li et al. (2020).[22] We then use ChatGPT to extract and categorize these keywords. In untabulated tests, we estimate a linear probability model in which the dependent variable is an indicator for whether a firm's proxy statement mentions any of these cultural value keywords in the director selection and nomination section. We find that firms with high commonality are more likely to mention terms related to integrity or teamwork, although the effect is slightly weaker for teamwork. A one-standard-deviation increase in *Board-management commonality* (0.276) is associated with a 1.41 percentage point increase in the likelihood of mentioning integrity-related words, corresponding to an unconditional probability of 19.12%. These findings suggest that firms with higher commonality prioritize integrity and teamwork in the director selection process, which may reduce friction and improve decision-making by promoting ethical practices and collaborative approaches.

6. Conclusion

We investigate how the commonality between boards and management (board-management commonality) influences firm value and board effectiveness. To measure board-management

[22] We exclude common words such as "expertise," "governance," "corporate governance," "independence," "skill," and "executive."

commonality, we use the SVM algorithm to identify overlapping individuals by separating the two groups based on demographic, cultural, educational, and functional characteristics.

We find that commonality significantly increases firm value, as measured by Tobin's q. Further analysis reveals a curvilinear relationship, suggesting that while moderate levels of commonality are beneficial, excessive harmony can have adverse effects. Using a quasi-experimental design leveraging the enactment of California's SB826 as an IV, we show that commonality positively affects firm value, independent of any direct effects of gender diversity mandates. The positive effect of commonality is more pronounced in firms with less diverse boards, more diverse management teams, and more complex operations. Firms with higher commonality also experience fewer material events requiring 8-K filings, adjust capital expenditures more promptly in response to negative market feedback—reflecting effective consensus-building—and exhibit increased innovation output and quality.

Overall, our results suggest that shared characteristics, values, experiences, and perspectives between boards and management significantly affect firm value and board effectiveness. Amid increasing resistance to DEI initiatives and legal challenges to mandated gender diversity, the emphasis on board diversity has evolved beyond specific dimensions, such as gender or race, as illustrated by recent policy changes from major institutional investors. Our study underscores the importance of considering board and top management composition across various dimensions to enhance alignment and board decision-making, thereby contributing to the ongoing debate on DEI initiatives and a broader understanding of their benefits.

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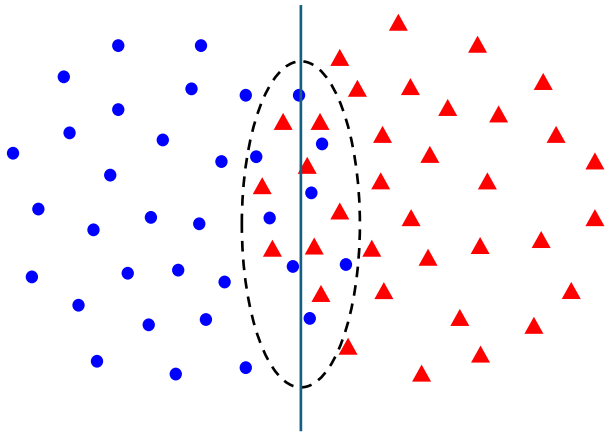
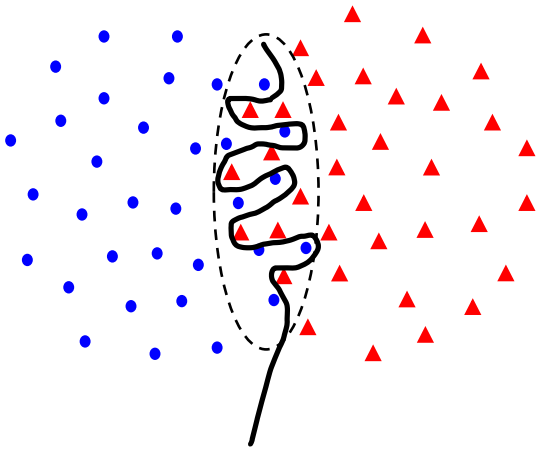
Figure 1. Comparison of Support Vector Machine (SVM) and alternative methods for measuring board-management commonality

Panel A: Classifying manager-like directors and director-like managers using the SVM approach



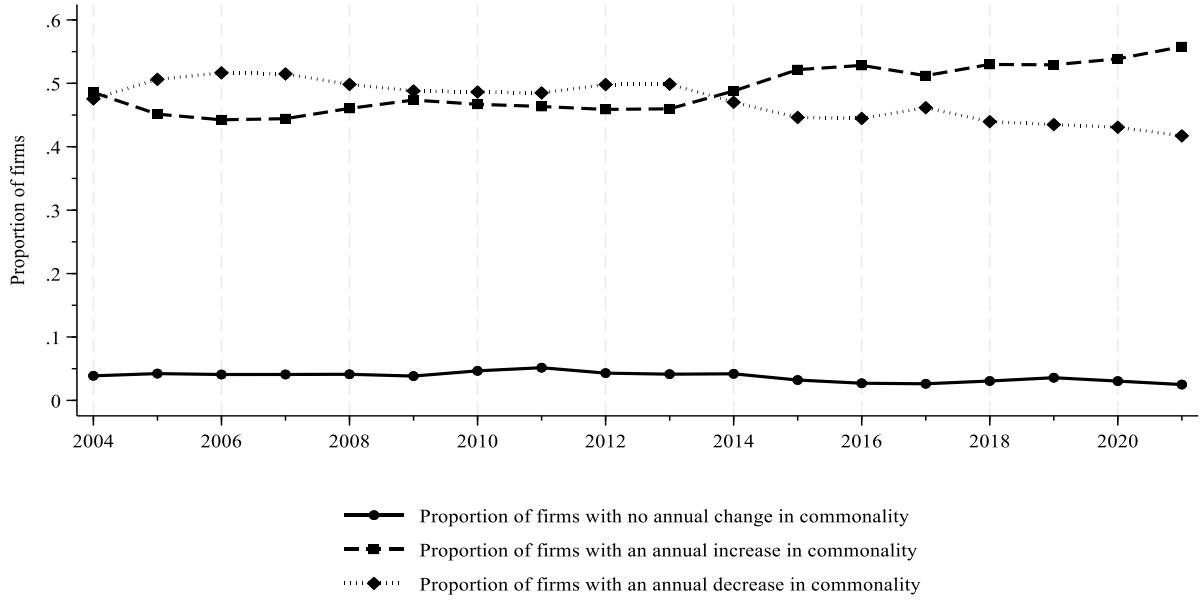
Panel B: Limitations of flexible machine learning methods



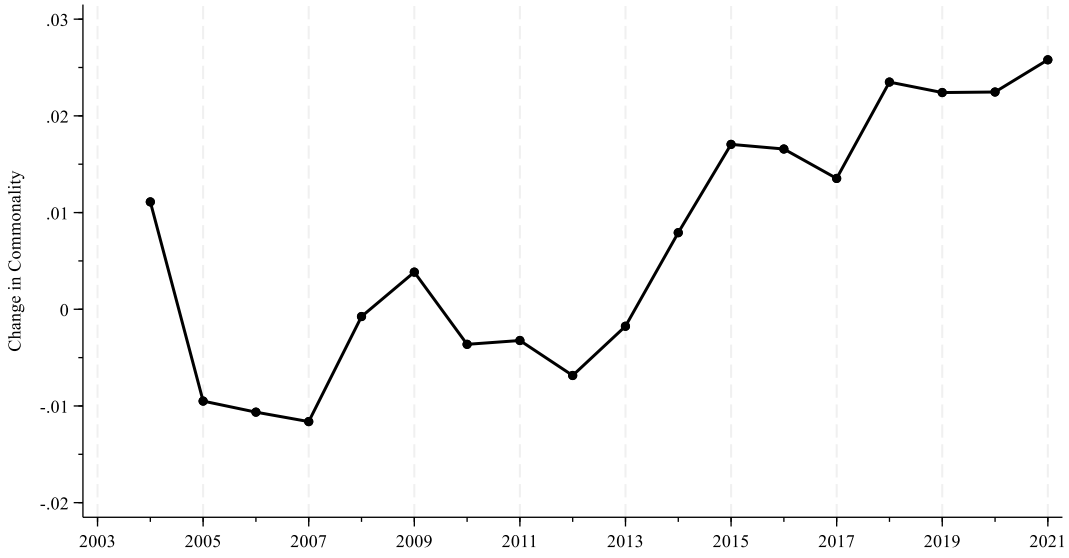
This figure compares the support vector machine (SVM) approach with alternative methods for measuring board-management commonality. Panel A illustrates how an SVM classifier identifies the overlap between board members (depicted as circular dots) and the management team (depicted as triangular dots). Dots located on the opposite side of the hyperplane are identified as "misclassified" individuals, representing either manager-like directors (circular dots) or director-like managers (triangular dots). *Board-management commonality* is defined as the ratio of independent directors and managers who share similarities across four dimensions (i.e., demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using the SVM classification approach. Panel B illustrates the limitations of flexible machine learning methods (e.g., XGBoost, neural networks, and random forests), which generate overly complex boundaries (e.g., overfitting curves) that prioritize correct group classifications, thereby failing to identify misclassified members effectively.

Figure 2. Cross-sectional and time-series variations in board-management commonality, 2003–2021

Panel A. Annual changes in board-management commonality across firms



Panel B. Annual changes in average board-management commonality over time



This figure plots cross-sectional and time-series variation in board-management commonality from 2003 to 2021. Panel A plots the proportions of three types of firms based on annual changes in *Board-management commonality* index: those with no annual change, those with an annual increase, and those with an annual decrease from 2003 to 2021. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using the support vector machine (SVM) classification. Panel B plots the annual change in the average *Board-management commonality* index from 2003 to 2021.

Table 1
Summary statistics

This table presents summary statistics for firm characteristics. The sample consists of 44,115 nonfinancial firm-year observations from the BoardEx-Compustat-CRSP database over the period 2003 to 2021. *Board-management commonality* is the ratio of independent directors and managers who share similarities in demographic, cultural, educational, and functional characteristics to the total number of independent directors and managers, using the support vector machine (SVM) classification. The appendix provides detailed descriptions of all variables.

	Mean	Standard deviation	P10	Median	P90
Tobin's q	2.106	1.547	0.964	1.578	3.876
Board-management commonality	1.629	0.276	1.227	1.683	1.945
Market capitalization (US$ billion)	4.466	23.667	0.043	0.669	9.013
Stock return	0.299	1.113	-0.528	0.083	1.074
Return volatility	0.032	0.016	0.015	0.028	0.054
ROA	0.005	0.225	-0.231	0.061	0.17
Leverage	0.227	0.22	0	0.190	0.521
R&D	0.061	0.122	0	0.004	0.187
Board size	6.552	2.117	4	6	9
Management size	9.758	5.366	4	9	17
Board diversity	-1.003	0.254	-1.302	-1.038	-0.653
Management diversity	-0.824	0.250	-1.128	-0.853	-0.483
Proportion of independent directors	0.765	0.131	0.571	0.800	0.9
Board-management social networks	0.307	0.265	0	0.250	0.714
Institutional ownership	0.572	0.352	0	0.667	0.967

Table 2
Board-management commonality and firm value

Panel A of this table presents estimates from ordinary least squares (OLS) regressions in which the dependent variable is Tobin's *q*, calculated as (total assets – book equity + market value of equity) / total assets. The sample consists of 44,115 firm-year observations covered in the BoardEx-Compustat-CRSP universe of nonfinancial firms over the period 2003 to 2021. *Board-management commonality* is the ratio of independent directors and managers who share similarities across four dimensions (i.e., demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using the support vector machine (SVM) classification approach. Panel B presents estimates from two-stage least squares (2SLS) regressions in which the dependent variable is *Board-management commonality* in columns (1) and (3) and Tobin's *q* in columns (2) and (4). The sample consists of 9,109 firm-year observations of 281 firms headquartered in California (treatment firms) and 938 firms headquartered in other states (propensity score-matched control firms) over the period 2015 to 2021. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. *Treatment firm* is an indicator equal to one for treatment firms, and zero for control firms. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). Both indicators are absorbed by firm and year fixed effects, respectively. We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality*. All other variables are defined in the appendix. In Panel A (B), *p*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the firm (state-by-year) level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. OLS regression

	Tobin's *q*				
Independent variable	(1)	(2)	(3)	(4)	(5)
Board-management commonality	0.196***	0.147***	0.158***	0.744***	0.886***
	(0.001)	(0.000)	(0.000)	(0.004)	(0.001)
Board-management commonality (squared)				-0.190**	-0.232***
				(0.019)	(0.005)
Firm size	0.411***	0.345***	0.335***	0.345***	0.335***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Stock return	0.066***	0.031***	0.032***	0.031***	0.032***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Return volatility	6.396***	4.730***	5.121***	4.725***	5.119***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	-0.127	0.052	0.055	0.051	0.054
	(0.468)	(0.650)	(0.643)	(0.654)	(0.649)
Leverage	0.084	0.327***	0.338***	0.327***	0.339***
	(0.336)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/assets	4.613***	2.774***	2.703***	2.772***	2.701***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (board size)	-0.598***	-0.267***	-0.248***	-0.276***	-0.259***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (management size)	-0.390***	-0.239***	-0.228***	-0.234***	-0.221***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board diversity	0.141*	0.117*	0.143**	0.262***	0.274***
	(0.057)	(0.071)	(0.029)	(0.000)	(0.000)
Management diversity	0.294***	0.263***	0.275***	0.119*	0.146**
	(0.000)	(0.000)	(0.000)	(0.067)	(0.027)
Proportion of independent directors	-0.152	-0.192*	-0.144	-0.199*	-0.151
	(0.163)	(0.059)	(0.162)	(0.051)	(0.141)
Board-management social networks	-0.060	-0.032	-0.052	-0.036	-0.056
	(0.302)	(0.639)	(0.456)	(0.601)	(0.419)
Institutional ownership	-0.269***	-0.170***	-0.183***	-0.171***	-0.184***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Year fixed effects	Yes	Yes	No	Yes	No
Industry fixed effects	Yes	No	No	No	No
Firm fixed effects	No	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	No	Yes	No	Yes
Observations	44,115	44,115	44,115	44,115	44,115
Adjusted R^2	0.311	0.651	0.657	0.651	0.658

Panel B. 2SLS regression

	1st stage	2nd stage	1st stage	2nd stage
	Board-management commonality	Tobin's q	Board-management commonality	Tobin's q
Independent variable	(1)	(2)	(3)	(4)
Treatment firm × Post	-0.033***		-0.033***	
	(0.000)		(0.000)	
Instrumented: Board-management commonality		4.876**		5.022**
		(0.042)		(0.046)
GDP growth	0.001	-0.019	0.001	-0.019
	(0.717)	(0.503)	(0.818)	(0.495)
Log (population)	0.027**	-0.388**	0.030**	-0.431***
	(0.025)	(0.011)	(0.016)	(0.009)
Unemployment rate	0.000	-0.019	0.002	0.001
	(0.915)	(0.603)	(0.673)	(0.988)
Other control variables (as in Panel A)	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	No
Firm fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	No	Yes	Yes
Observations	9,109	9,109	9,100	9,100
Adjusted R^2	0.743	-	0.751	-
Cragg-Donald Wald F-statistic		29.898		31.124
Kleibergen-Paap rk Wald F-statistic		16.794		16.428

Table 3
Board-management commonality and board/management diversity

This table presents second-stage estimates from two-stage least squares (2SLS) regressions where the dependent variable is Tobin's *q*, calculated as (total assets – book equity + market value of equity) / total assets. We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 9,169 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. In columns (1) to (4), the sample is divided into two subgroups based on the annual sample median of *Board diversity index*. In columns (5) to (8), the sample is divided into two subgroups based on the annual sample median of *Management diversity index*. *Board* (*Management diversity*) *index* is measured by the first principal component of the standard deviations of the characteristics of independent directors (management team members) across four dimensions: demographics (age and gender), cultural background (Hofstede's measures: power distance, uncertainty avoidance, individualism/collectivism, masculinity/femininity, long/short-term orientation, and indulgence/restraint) (Hofstede, 2001), education (college, Ph.D., MBA, and Ivy League), and functional characteristics (financial expertise, industry-specific experience (i.e., experience in the same industry as the current company), non-industry experience (NGO, academia), tenure, CEO experience, technology experience, foreign experience, and legal expertise). All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable: Tobin's *q*							
	Board diversity				Management diversity			
	High		Low		High		Low	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Instrumented: Board-management commonality	7.340	6.057	6.133**	7.068**	7.544**	6.939**	9.226	12.652
	(0.141)	(0.216)	(0.021)	(0.045)	(0.022)	(0.022)	(0.223)	(0.260)
GDP growth	0.040	0.029	-0.020	-0.011	-0.023	-0.031	0.007	-0.028
	(0.438)	(0.602)	(0.628)	(0.810)	(0.598)	(0.483)	(0.907)	(0.748)
Log (population)	-0.312	-0.288	-0.431	-0.567	-0.203	-0.203	-0.476	-0.617
	(0.223)	(0.233)	(0.150)	(0.118)	(0.239)	(0.262)	(0.237)	(0.241)
Unemployment rate	-0.011	0.019	0.061	0.092	-0.000	-0.009	-0.021	-0.048
	(0.820)	(0.707)	(0.398)	(0.270)	(1.000)	(0.866)	(0.803)	(0.670)
Other control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	4,475	4,447	4,522	4,492	4,485	4,476	4,515	4,466
Cragg-Donald Wald *F*-statistic	7.788	7.855	23.862	16.956	17.315	22.244	11.623	6.889
Kleibergen-Paap rk Wald *F*-statistic	5.114	4.427	9.599	5.930	11.977	13.841	4.449	2.496

Table 4
Board-management commonality and firms' business complexity

This table presents second-stage estimates from two-stage least squares (2SLS) regressions, where the dependent variable is Tobin's *q*, calculated as (total assets – book equity + market value of equity) / total assets. We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 9,169 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. The sample is divided into two subgroups: a subsample of firms with the *business complexity index* above the annual sample median (columns (1) and (2)) and a subsample of firms with the *business complexity index* below the annual sample median (columns (3) and (4)). *Business complexity index* is measured using principal components analysis (PCA) across six variables: 1) *geographic segment complexity*, measures as the number of geographical segments), 2) *financial disclosure complexity*, measured as the ratio of complexity words retained based on the model selection process to the total word count in the 10-K filing for a given year (Loughran and McDonald, 2024), 3) *product market dynamism*, measured as the similarity between changes in a firm's product descriptions from its 10-K filings and the evolving product descriptions of its rivals within the same industry (Hoberg, Phillips, and Prabhala, 2014), 4) *regulatory overlap complexity*, an index that measures the degree to which multiple federal agencies regulate firms based on the relevance of each regulatory topic to the firm (Kalmenovitz, Lowry, and Volkova, 2025), 5) *state-level policy uncertainty index*, which captures the level of uncertainty within a state, derived from local newspaper articles capturing state and local policy uncertainty (Baker, Bloom, and Levy, 2022), and 6) *systemic risk*, measured as the variance of the product of market daily returns and beta, estimated using Carhart's (1997) four-factor model. All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable: Tobin's *q*			
	Subsample of firms with higher business complexity		Subsample of firms with lower business complexity	
Independent variable	(1)	(2)	(3)	(4)
Instrumented: Board-management commonality	7.866*	7.649**	-2.656	0.488
	(0.072)	(0.045)	(0.495)	(0.928)
GDP growth	-0.092	-0.094	0.037	0.021
	(0.214)	(0.234)	(0.206)	(0.436)
Log (population)	-0.341	-0.370	-0.502***	-0.658**
	(0.282)	(0.242)	(0.001)	(0.029)
Unemployment rate	0.096	0.112	0.021	-0.019
	(0.389)	(0.343)	(0.672)	(0.697)
Control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes
Observations	3,639	3,600	3,669	3,650
Cragg-Donald Wald *F*-statistic	23.485	31.634	5.790	2.421
Kleibergen-Paap rk Wald *F*-statistic	8.569	13.717	3.057	0.875

Table 5
Board-management commonality and incidence of material event-related 8-K filings

This table presents second-stage estimates from two-stage least squares (2SLS) regressions, where the dependent variable is the natural logarithm of one plus the number of material event-related 8K filings in a given year. 8-K filing data are obtained from the SEC Analytics Suite database. We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 7,294 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. *Product similarity* is a pairwise similarity score between firms, based on the textual analysis of their 10-K product descriptions (Hoberg and Phillips, 2016). *Significant share issuance* is an indicator that equals one if a firm's number of shares outstanding, adjusted for stock dividends and stock splits, increases by more than 10% compared to the previous year, and zero otherwise. *Analysts' forecast dispersion* is measured as the standard deviation of analysts' earnings forecasts, as obtained from the IBES database. *Book-to-market* is the ratio of the book value of equity to the market value of equity. All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable:	
	Log (1 + No of material event-related 8-K-filings)	
Independent variable	(1)	(2)
Instrumented: Board-management commonality	-2.963*	-3.134*
	(0.067)	(0.093)
Product similarity	-0.005*	-0.004
	(0.078)	(0.127)
Significant share issuance	-0.062**	-0.078**
	(0.023)	(0.021)
Analysts' forecast dispersion	1.050	1.092
	(0.244)	(0.296)
Book-to-market	-0.192***	-0.190**
	(0.007)	(0.016)
GDP growth	0.001	-0.005
	(0.969)	(0.758)
Log (population)	0.163**	0.167*
	(0.031)	(0.056)
Unemployment rate	0.015	0.016
	(0.505)	(0.521)
Other control variables (as in Panel A of Table 2)	Yes	Yes
Year fixed effects	Yes	No
Firm fixed effects	Yes	Yes
Industry-year fixed effects	No	Yes
Observations	7,294	7,279
Cragg-Donald Wald *F*-statistic	21.732	18.397
Kleibergen-Paap rk Wald *F*-statistic	11.755	9.910

Table 6
Board-management commonality and capital expenditure (capex) adjustments

This table presents second-stage estimates from two-stage least squares (2SLS) regressions, where the dependent variable is the percentage difference between the capital expenditures made by the firm in a year and the firm's initial forecasted amount for the same year (*Capex adjustment*). We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. We obtain capex forecast data from the IBES Guidance database and match it with nonfinancial firms from the BoardEx-Compustat-CRSP database. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using the support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 1,399 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. Columns (1) and (2) use a subsample of negative CAR (-1, 1) events in the analysis, and columns (3) and (4) use a subsample of positive CAR (-1, 1) events in the analysis. *CAR (-1, 1)* is the cumulative abnormal returns from one day before to one day after a firm's capex forecast announcement date. Abnormal stock returns are calculated using the Fama-French-Carhart four-factor model (Carhart, 1997). *Capex/assets* is the ratio of capital expenditure to total assets. *Analyst coverage* is the natural logarithm of one plus the number of analysts covering the firm, as reported in the IBES database. *Analysts' forecast dispersion* is the standard deviation of earnings forecasts provided by analysts covering the firm, as reported in the IBES database. *Earnings surprise* is the difference between the current quarter's earnings per share and that of the same quarter in the previous year. *Earnings announcement* is an indicator equal to one if a firm's capex announcements are accompanied by earnings announcements, and zero otherwise. All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable:			
	Capex adjustment			
	Subsample of negative CAR (-1, 1) events		Subsample of positive CAR (-1, 1) events	
Independent variable	(1)	(2)	(3)	(4)
Instrumented: Board-management commonality	-0.484**	0.111	-0.867	-0.073
	(0.026)	(0.840)	(0.477)	(0.899)
Capex/assets	0.000	-0.000	-0.000	0.000
	(0.712)	(0.549)	(0.691)	(0.670)
Analyst coverage	0.047*	-0.043	0.070	-0.036
	(0.090)	(0.571)	(0.571)	(0.730)
Analysts' forecast dispersion	0.307	-0.469	0.049	-0.063
	(0.101)	(0.783)	(0.938)	(0.974)
Earnings surprise	-0.000	0.001	-0.001	0.003
	(0.839)	(0.470)	(0.352)	(0.715)
Earnings announcement	-0.028	-0.016	-0.073	-0.008
	(0.216)	(0.193)	(0.244)	(0.640)
GDP growth	-0.010	0.001	-0.009	0.002
	(0.110)	(0.729)	(0.434)	(0.617)
Log (population)	0.806	0.057	1.698	0.028
	(0.261)	(0.106)	(0.561)	(0.453)
Unemployment rate	-0.010	-0.006	-0.041	-0.002
	(0.225)	(0.749)	(0.358)	(0.897)
Other control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No
Year fixed effects	Yes	No	Yes	No
Industry-year fixed effects	No	Yes	No	Yes
Observations	642	762	603	717
Cragg-Donald Wald *F*-statistic	15.394	1.067	2.355	3.835
Kleibergen-Paap rk Wald *F*-statistic	8.844	0.413	0.609	1.655

Table 7
Board-management commonality and innovation activities

This table presents second-stage estimates from two-stage least squares (2SLS) regressions. The dependent variable is the number of patents scaled by the firm's total assets in columns (1) and (2); the value of patents, measured using stock market reactions to patent grant announcements and scaled by the firm's total assets, in columns (3) and (4); and the number of patent citations scaled by the firm's total assets in columns (5) and (6). All patent data are obtained from Kogan et al. (2017). We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 3,277 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. *Cash/assets* is the ratio of cash and short-term investments to total assets. *Book-to-market* is the ratio of the book value of equity to the market value of equity. *PPE/assets* is the ratio of property, plant, and equipment to total assets. *Capex/assets* is the ratio of capital expenditure to total assets. All other variables are defined in the appendix. P-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable:					
	No. of patents/assets		Value of patents/assets		No. of citations/assets	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Instrumented: Board-management commonality	0.483**	0.490**	3.435**	3.239***	0.995*	0.825*
	(0.016)	(0.013)	(0.017)	(0.009)	(0.079)	(0.095)
Cash/assets	0.052	0.051	0.231	0.179	0.021	0.008
	(0.233)	(0.264)	(0.204)	(0.312)	(0.730)	(0.896)
Book to market	-0.016	-0.017	-0.185**	-0.181**	0.004	0.004
	(0.170)	(0.152)	(0.034)	(0.030)	(0.894)	(0.901)
PPE/assets	-0.067	-0.081	0.354	0.193	0.025	-0.021
	(0.269)	(0.195)	(0.348)	(0.550)	(0.843)	(0.866)
Capex/assets	0.149	0.168	1.226	1.346	0.524	0.632
	(0.233)	(0.233)	(0.190)	(0.156)	(0.153)	(0.100)
GDP growth	-0.006	-0.005	-0.036	-0.030	-0.000	0.003
	(0.259)	(0.297)	(0.106)	(0.122)	(0.976)	(0.699)
Log (population)	0.003	0.001	0.017	0.044	0.010	0.021
	(0.834)	(0.943)	(0.842)	(0.612)	(0.712)	(0.432)
Unemployment rate	0.000	-0.000	-0.023	-0.016	0.017	0.021
	(0.976)	(0.979)	(0.476)	(0.646)	(0.265)	(0.141)
Other control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes	No	Yes
Observations	3,277	3,251	3,277	3,251	3,277	3,251
Cragg-Donald Wald *F*-statistic	14.508	17.472	8.824	11.005	14.508	17.472
Kleibergen-Paap rk Wald *F*-statistic	8.824	11.005	16.38	16.38	8.824	11.005

Table 8
Board-management commonality and firm value: Evidence from the deaths of manager-like directors and director-like managers

The table presents estimates from ordinary least squares (OLS) regressions in which the dependent variable is *CAR (-1, 1)*, the cumulative abnormal returns from one day before to one day after the sudden death date of directors and management team members. Abnormal stock returns are calculated using the Fama-French-Carhart four-factor model (Carhart, 1997). The four factors are the CRSP value-weighted index, SMB, HML, and UMD (the daily return difference between high and low prior return portfolios). The sample consists of 815 deaths involving 283 directors and 532 management team members over the period 2003 to 2021. *Manager-like director* is an indicator equal to one for directors who share similarities in demographic, cultural, educational, and functional characteristics with managers, and zero otherwise. *Director-like manager* is an indicator equal to one for managers who share similarities in the four characteristics with directors, and zero otherwise. *Manager-like director* and *Director-like manager* are classified using the support vector machine (SVM) classification. *CEO* is an indicator equal to one for CEOs, and zero otherwise. *Board chair* is an indicator equal to one for the chair of the board of directors, and zero otherwise. *Age* is the age of a director/management team member in years. *Tenure* is the years a director (manager) has served on the board (the company). All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	CAR (-1, 1)					
	Full sample		Subsample			
			Excluding deaths from suicide and cancer		Excluding deaths from suicide and cancer, and those of individuals aged over 75	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Manager-like director/Director-like manager	-0.013**		-0.017**		-0.026***	
	(0.033)		(0.014)		(0.010)	
Manager-like director		-0.011*		-0.015**		-0.027**
		(0.063)		(0.034)		(0.012)
Director-like manager		-0.027*		-0.038**		-0.024
		(0.098)		(0.031)		(0.245)
CEO	-0.002	-0.001	-0.001	-0.000	-0.000	-0.000
	(0.845)	(0.927)	(0.893)	(0.974)	(0.986)	(0.978)
Board chair	0.001	0.001	0.001	0.001	0.005	0.005
	(0.784)	(0.800)	(0.868)	(0.883)	(0.407)	(0.410)
Age	0.000	0.000	0.000	0.000	0.000	0.000
	(0.292)	(0.302)	(0.192)	(0.206)	(0.622)	(0.622)
Tenure	0.001***	0.001***	0.001***	0.001***	0.001*	0.001*
	(0.002)	(0.002)	(0.006)	(0.006)	(0.085)	(0.087)
Other control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	815	815	675	675	474	474
Adjusted R^2	-0.002	-0.003	-0.015	-0.016	0.002	-0.001

Table 9
Board-management commonality, excluding each component

Panel A of the table presents estimates from ordinary least squares (OLS) regressions in which the dependent variable is Tobin's *q*, calculated as (total assets – book equity + market value of equity) / total assets. The sample consists of 44,115 nonfinancial firm-year observations from the BoardEx-Compustat-CRSP database over the period 2003 to 2021. *Board-management commonality—excluding demographics*—is the ratio of independent directors and managers who share similarities in cultural, educational, and functional characteristics to the total number of independent directors and managers, using the support vector machine (SVM) classification. *Board-management commonality—excluding cultural background*—is the ratio of independent directors and managers who share similarities in demographic, educational, and functional characteristics to the total number of independent directors and managers, using the SVM classification. *Board-management commonality—excluding education*—is the ratio of independent directors and managers who share similarities in demographic, cultural, and functional characteristics to the total number of independent directors and managers, using the SVM classification. *Board-management commonality—excluding functional background*—is the ratio of independent directors and managers who share similarities in demographic, cultural, and educational characteristics to the total number of independent directors and managers, using the SVM classification. Panel B of the table presents second-stage estimates from two-stage least squares (2SLS) regressions, where the dependent variable is Tobin's *q*. We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 9,109 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. All other variables are defined in the appendix. In Panel A (B), *p*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the firm (state-by-year) level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. OLS regression

	Tobin's *q*							
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Board-management commonality—excluding demographics	0.163***	0.174***						
	(0.000)	(0.000)						
Board-management commonality—excluding cultural background			0.180***	0.195***				
			(0.000)	(0.000)				
Board-management commonality—excluding education					0.148***	0.161***		
					(0.001)	(0.000)		
Board-management commonality—excluding functional background							0.148***	0.160***
							(0.003)	(0.002)
Control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	44,115	44,115	44,115	44,115	44,115	44,115	44,115	44,115
Adjusted R^2	0.651	0.657	0.651	0.657	0.650	0.657	0.650	0.657

Panel B. 2SLS regression

	2nd stage dependent variable: Tobin's *q*							
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Instrumented: Board-management commonality—excluding demographics	5.232**	5.385**						
	(0.039)	(0.041)						
Instrumented: Board-management commonality—excluding cultural background			6.454*	6.550*				
			(0.052)	(0.055)				
Instrumented: Board-management commonality—excluding education					5.190**	5.347**		
					(0.046)	(0.050)		
Instrumented: Board-management commonality—excluding functional background							5.599**	5.826**
							(0.041)	(0.046)
GDP growth	-0.022	-0.022	-0.019	-0.020	-0.018	-0.019	-0.014	-0.015
	(0.441)	(0.445)	(0.498)	(0.475)	(0.524)	(0.496)	(0.582)	(0.580)
Log (population)	-0.379**	-0.422***	-0.383**	-0.419**	-0.402**	-0.445***	-0.371**	-0.416**
	(0.011)	(0.009)	(0.014)	(0.011)	(0.012)	(0.010)	(0.014)	(0.011)
Unemployment rate	-0.025	-0.005	-0.016	0.000	-0.022	-0.004	-0.017	0.007
	(0.494)	(0.895)	(0.672)	(0.998)	(0.551)	(0.927)	(0.646)	(0.859)
Control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	9,109	9,100	9,109	9,100	9,109	9,100	9,109	9,100
Cragg-Donald Wald *F*-statistic	28.933	30.317	26.691	28.640	30.548	31.786	30.831	31.305
Kleibergen-Paap rk Wald *F*-statistic	17.683	17.921	13.362	14.109	16.009	15.776	19.081	16.961

Table 10
Board-management commonality and operating performance

This table presents second-stage estimates from two-stage least squares (2SLS) regressions, where the dependent variable is ΔROA, which is measured as the difference between the average return on assets (ROA) over the subsequent three years ($Year_{t+1}$, $Year_{t+2}$, $Year_{t+3}$) and the ROA in the base year ($Year_t$). We use the interaction term *Treatment firm* × *Post* as an instrumental variable for *Board-management commonality* in the first-stage regression. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Treatment firm* is an indicator equal to one for firms headquartered in California, and zero for propensity score-matched control firms headquartered in other states. *Post* is an indicator equal to one for the years 2019-2021, and zero for the years 2015-2017. We exclude 2018, the year when California's Senate Bill 826 (SB 826) was enacted (September 30, 2018). The sample consists of 9,109 firm-year observations of 281 treatment firms and 938 control firms over the period 2015 to 2021. Both treatment and control firms are nonfinancial firms from the BoardEx-Compustat-CRSP database. We use one-to-five nearest neighbor matching with replacement, based on a logistic model. The matching variables are *firm size*, *stock return*, *return volatility*, *ROA*, *leverage*, *R&D/assets*, *log (board size)*, *log (management size)*, *board diversity*, *management diversity*, *proportion of independent directors*, *board-management social networks*, and *institutional ownership*. We require treatment and control firms to be in the same industry (two-digit SIC codes) in 2017. All other variables are defined in the appendix. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the state-by-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	2nd stage dependent variable: ΔROA	
Independent variable	(1)	(2)
Instrumented: Board-management commonality	0.574*	0.605*
	(0.059)	(0.052)
GDP growth	0.000	0.000
	(0.978)	(0.983)
Log (population)	0.014	0.010
	(0.499)	(0.658)
Unemployment rate	-0.005	-0.003
	(0.294)	(0.487)
Control variables (as in Panel A of Table 2)	Yes	Yes
Year fixed effects	Yes	No
Firm fixed effects	Yes	Yes
Industry-year fixed effects	No	Yes
Observations	9,109	9,100
Cragg-Donald Wald *F*-statistic	31.669	32.502
Kleibergen-Paap rk Wald *F*-statistic	18.391	17.790

Appendix
Variable Definitions

This appendix provides detailed descriptions of all variables used in the tables.

Variable name	Definition	Source
Board diversity (Management) diversity index	First principal component of the standard deviations for the characteristics of independent directors (management team members) across demographic, cultural, educational, and functional dimensions, as described above	BoardEx; Hofstede website; OnoGraph
Board-management commonality	Ratio of independent directors and managers who share similarities across four dimensions to the total number of independent directors and managers, using the support vector machine (SVM) classification. The four dimensions are as follows: demographics (age and gender), cultural background (Hofstede's measures: power distance, uncertainty avoidance, individualism/collectivism, masculinity/femininity, long/short-term orientation, and indulgence/restraint) (Hofstede, 2001), education (college, Ph.D., MBA, and Ivy League), and functional characteristics (financial expertise, industry-specific experience—e.g., experience in the same industry as the current company—non-industry experience such as NGO or academia, tenure, CEO experience, technology experience, foreign experience, and legal expertise) (e.g., Adams, Akyol, and Verwijmeren, 2018). Independent directors are defined as non-executive directors whose role names include the term "independent" in the BoardEx database. Management teams include senior executives (e.g., CEO, CFO, CIO, COO), division executives (e.g., division CEO, CFO, COO, and president), and regional executives (e.g., regional CEO, CFO, COO, and president), as reported in the BoardEx database.	BoardEx; Hofstede website (https://geerthofstede.com/research-and-vsm/dimension-data-matrix/); OnoGraph
Board-management social networks	Ratio of the number of management team members connected to independent directors through past employment, shared educational institutions, or social activities to the total number of board members and management team members (Fracassi and Tate, 2012)	BoardEx
Firm size	Natural logarithm of market capitalization	Compustat
GDP growth	Real Gross Domestic Product (GDP) at the state level, expressed as a percentage change from the preceding period	Bureau of Economic Analysis (BEA)
Institutional ownership	Ratio of the number of shares held by all institutional investors to the total number of common shares outstanding	Thomson/Refinitiv 13F
Leverage	Ratio of the sum of long-term debt and debt in current liabilities to total assets	Compustat
Log (board size)	Natural logarithm of the number of directors	BoardEx
Log (management size)	Natural logarithm of the number of top management team members	BoardEx
Log (population)	Natural logarithm of the state population in millions	BEA
Proportion of independent directors	Ratio of the number of independent directors to the total number of directors, where independent directors are defined as non-executive directors whose role names include the term "independent" in the BoardEx database	BoardEx
R&D/assets	Ratio of R&D expenses to total assets	Compustat
Return volatility	Standard deviation of daily excess stock returns over the fiscal year	CRSP
ROA	Ratio of operating income after depreciation to total assets	Compustat
Stock return	Market-adjusted annual stock return, where the market index is the CRSP value-weighted return	CRSP
Unemployment rate	Seasonally adjusted unemployment rate for each state	Bureau of Labor Statistics

Appendix B

Measuring Board-Management Commonality Using Support Vector Machine (SVM)

Problem setup for SVM

Consider a $n \times p$ data matrix X, consisting of n members from the board and management, each with p characteristics (p-dimensional space),

$$x_1 = \begin{pmatrix} x_{11} \\ \vdots \\ x_{1p} \end{pmatrix}, \cdots, x_n = \begin{pmatrix} x_{n1} \\ \vdots \\ x_{np} \end{pmatrix}.$$

Each member is categorized into two classes, $y_1, \cdots, y_n \in \{-1,1\}$, where -1 represents one class (e.g., board) and 1 represents the other class (e.g., management). The separating hyperplane is defined by the following equation:

$$f(x_{i1}, \cdots, x_{ip}) = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip} = 0.$$

When the hyperplane coefficients are normalized (i.e., $\sum_{j=1}^{p} \beta_j^2 = 1$), the value of $f(x_{i1}, \cdots, x_{ip}) = M$ represents the shortest distance from the hyperplane to the corresponding data point. The SVM algorithm aims to find the hyperplane that optimally separates these two groups.

Hyperplane and shortest distance from a data point: A two-dimensional example

In a two-dimensional space defined by (x_1, x_2), a hyperplane can be represented by

$$f(x_1, x_2) = \frac{-1}{\sqrt{2}} + \frac{1}{\sqrt{2}} x_1 + \frac{1}{\sqrt{2}} x_2 = 0.$$

For the point $(\frac{1}{2}, \frac{1}{2})$,

$$f(0,0) = \frac{-1}{\sqrt{2}} + \frac{1}{\sqrt{2}} \frac{1}{2} + \frac{1}{\sqrt{2}} \frac{1}{2} = 0,$$

indicating that it lies on the hyperplane.

For the point (0,0),

$$f(0,0) = \frac{-1}{\sqrt{2}} + \frac{1}{\sqrt{2}} 0 + \frac{1}{\sqrt{2}} 0 = \frac{-1}{\sqrt{2}} < 0,$$

showing that it lies below the hyperplane, and the shortest distance to the hyperplane is $\frac{-1}{\sqrt{2}}$.

For point (1,1),

$$f(1,1) = \frac{-1}{\sqrt{2}} + \frac{1}{\sqrt{2}}1 + \frac{1}{\sqrt{2}}1 = \frac{1}{\sqrt{2}} > 0,$$

indicating that it lies above the hyperplane, and the shortest distance to the hyperplane is $\frac{1}{\sqrt{2}}$. Thus, for a point (x_{i1}, x_{i2}), the function $f(x_{i1}, x_{i2}) = \frac{-1}{\sqrt{2}} + \frac{1}{\sqrt{2}}x_{i1} + \frac{1}{\sqrt{2}}x_{i2} = M$ calculates the shortest distance from the point to the hyperplane when the hyperplane equation is normalized. The sign of M indicates the position of the point relative to the hyperplane: if $M > 0$, the point lies above the hyperplane; if $M < 0$, it lies below the hyperplane.

Step 1. Optimally dividing the sample using SVM

i) The fully separable case

If the data representing board members and management can be perfectly separated by a hyperplane, an infinite selection of possible hyperplanes exists. The optimal hyperplane possesses the largest margin, implying that it is positioned at the maximum distance from all the data points. This is determined by computing the perpendicular distance from each data point to the hyperplane and selecting the hyperplane that maximizes this minimum distance. This process can be formally described as finding the solution to the optimization problem:

$$\max_{\beta_0,\cdots,\beta_p,M} M$$

$$Subject\ to \sum_{j=1}^{p} \beta_j^2 = 1,$$

$$y_i(\beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip}) \geq M, \forall i = 1, \cdots, n.$$

In optimizing for a hyperplane, the first constraint, $\sum_{j=1}^{p} \beta_j^2 = 1$, serves to normalize the coefficients, thus ensuring that M represents the shortest distance from the hyperplane to any given point. The second constraint $y_i(\beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip}) \geq M$ ensures that every data point not only resides on its correct side of the hyperplane but also maintains a distance from it that is no less than M.

ii) The non-separable case

Often, a hyperplane that perfectly separates all points does not exist. In such scenarios, one cannot find a solution where $M > 0$ for the optimization problem as defined previously. To address this, the

model's concept of a separating hyperplane is expanded to include a 'soft margin,' which allows for some misclassifications. This approach is formally defined as the optimization problem:

$$\max_{\beta_0,\cdots,\beta_p,\epsilon_1,\cdots,\epsilon_p,M} M$$

$$Subject\ to \sum_{j=1}^{p} \beta_j^2 = 1,$$

$$y_i\left(\beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip}\right) \geq M(1-\epsilon_i), \forall i = 1, \cdots, n,$$

$$\epsilon_i \geq 0,$$

$$\sum_{i=1}^{n} \epsilon_i \leq C,$$

where C is a nonnegative tuning parameter, and similar to the previously discussed case of perfect separability, M represents the width of the margin. ϵ_i denotes a slack variable, allowing individual data points to be positioned on the incorrect side of the margin or the hyperplane. If $\epsilon_i = 0$, then the i-th data point is on the correct side of the margin. This means that it is correctly classified. If $0 < \epsilon_i \leq 1$, then the i-th data point is on the incorrect side of the margin but has not crossed the hyperplane. This is a soft violation of the ideal conditions the SVM algorithm sets for classifying data points with a margin. This is not a misclassification. If $\epsilon_i > 1$, then the i-th data point has crossed the hyperplane and is on the side of the opposite class. This is a misclassification. C controls the sum of the slack variables ϵ_i, thus determining the number and extent of acceptable margin violations and hyperplane crossings.[1]

In summary, the SVM algorithm is designed to identify a hyperplane that either perfectly separates board members and management with complete accuracy or, in instances where perfect separation is unachievable, finds a hyperplane that accomplishes separation with the fewest possible violations, such as the misclassification of board members and management.

Step 2. Measuring *Board-management commonality*

[1] In our analysis, the choice of the penalty parameter *C* in the SVM model becomes less critical due to the nature of our data. As *C* increases, all data points are quickly involved in determining the separating line, rendering the specific value of *C* largely irrelevant. We only require *C* to be sufficiently large to ensure that SVM can identify a separating line for all firm-year observations. Once *C* reaches this threshold, the results become insensitive to further increases, which enhances the robustness of our empirical findings.

Following the optimal separation of board members and management by the SVM based on specified characteristics, commonality is measured by calculating the proportion of 'misclassified' independent directors (i.e., manager-like directors) and 'misclassified' managers (i.e., director-like managers) to the total number of independent directors and managers:

$$\text{Commonality} = \frac{\text{No. of director-like managers} + \text{No. of manager-like directors}}{\text{Total No. of management team members} + \text{Total No. of directors}}$$

While the preceding section described the SVM algorithm in the context of p-dimensional spaces, this study tailors the SVM approach to assess each characteristic of board members and management independently. This approach yields p-commonality measures, corresponding to the respective dimensions. To aggregate individual p-commonality measures, dimensionality reduction is conducted using principal component analysis (PCA). To derive a *Board-management commonality* index, we calculate the first principal component of commonalities for p characteristics for all firm-years. This index reflects the level of overlap between board members and management across multiple dimensions.

Internet Appendix

Bridging the Gap: The Impact of Board-Management Commonality on Firm Value and Board Decision-making Effectiveness

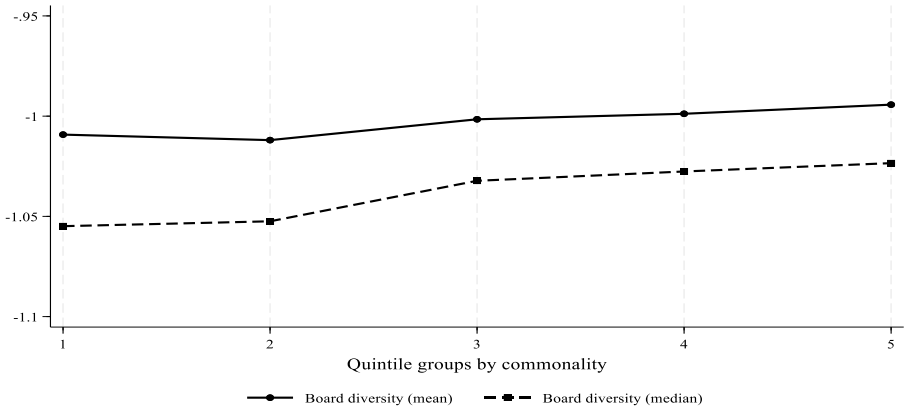
May 2025

This appendix presents tables for additional analyses discussed but not reported in the paper. Specifically, the appendix includes the following:

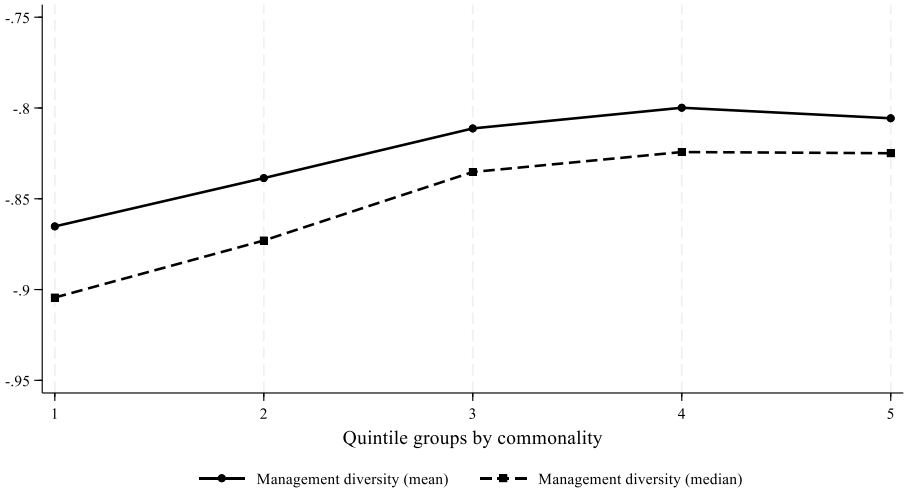
- Figure A.1 Board/management diversity index across quintile groups based on board-management commonality, 2003–2021
- Figure A.2 Time trends of board/management diversity index (average), 2003–2021
- Figure A.3 Time trends of board/management diversity index diversity by components (average), 2003–2021
- Table A.1 Correlation matrix
- Table A.2 Roles of manager-like directors and director-like managers
- Table A.3 Characteristics of manager-like directors: A biographical analysis using ChatGPT
- Table A.4 Board-management commonality and corporate culture: An analysis of director selection and nomination discussions in proxy statements

Figure A.1 Board/management diversity index across quintile groups based on board-management commonality, 2003–2021

Panel A. Board diversity index

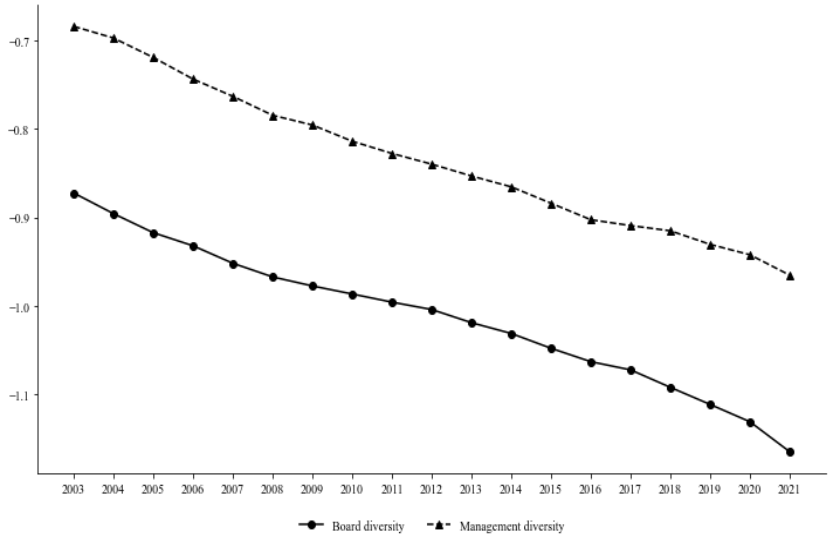


Panel B. Management diversity index



The figure displays *Board*/*Management diversity index* across quintile groups based on *Board-management commonality* from 2003 to 2021. Panel A shows the mean and median *Board diversity index*, and Panel B shows the mean and median *Management diversity index*. *Board-management commonality* is the ratio of independent directors and managers who share similarities across four dimensions (i.e., demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using the SVM classification approach. *Board (Management) diversity index* is calculated as the first principal component of the standard deviations for the characteristics of independent directors (management team members) across demographic, cultural, educational, and functional dimensions.

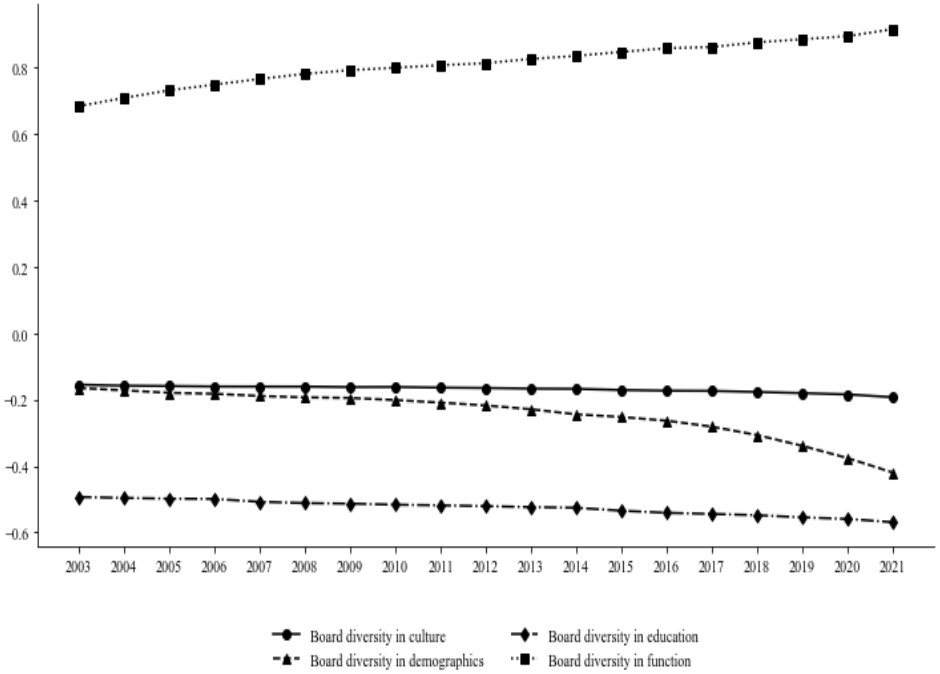
Figure A.2 Time trends of Board/Management diversity index (average), 2003–2021



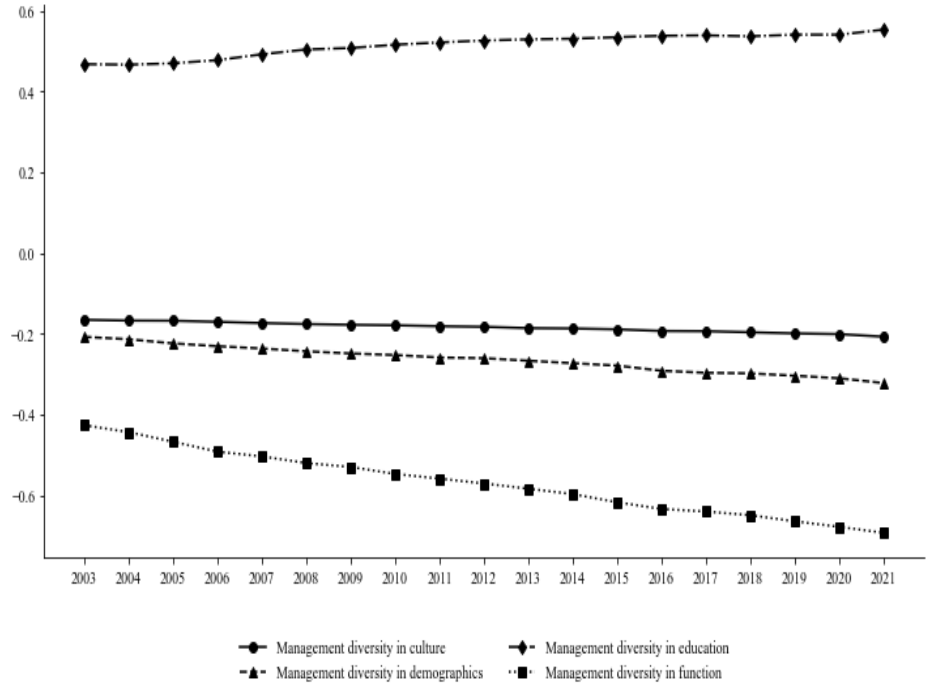
The figure presents time trends in average *Board diversity index* and *Management diversity index* from 2003 to 2021. *Board (Management) diversity index* is calculated as the first principal component of the standard deviations for the characteristics of independent directors (management team members) across demographic, cultural, educational, and functional dimensions.

Figure A.3 Time trends of Board/Management diversity index by components, 2003–2021

Panel A. Time trends of Board diversity index by components



Panel B. Time trends of Management diversity index by components



This figure presents time trends of *Board diversity index* and *Management diversity index* by components from 2003 to 2021. Panel A shows the time trends of *Board diversity index* by components, and Panel B shows the time trends of *Management diversity index* by components. *Board (Management) diversity index* is calculated as the first principal component of the standard deviations for the characteristics of independent directors (management team members) across demographic, cultural, educational, and functional dimensions.

Table A.1
Correlation matrix

This table presents the correlation matrix for the key index variables and firm-level governance variables. *Board-management commonality* is calculated as the ratio of independent directors and managers who share similarities across four dimensions (demographic, cultural, educational, and functional characteristics) to the total number of independent directors and managers, using support vector machine (SVM) classification. *Board (Management) diversity index* is calculated as the first principal component of the standard deviations of the characteristics of independent directors (management team members) across the same four dimensions as above. *Board size* is defined as the number of directors, and *Management size* is defined as the number of top management team members. *Proportion of independent directors* is the ratio of the number of independent directors to the total number of directors. *Board-management social networks* is measured as the ratio of the number of management team members connected to independent directors through past employment, shared educational institutions, or social activities to the total number of board members and management team members (Fracassi and Tate, 2012). *Institutional ownership* is the ratio of the number of shares held by all institutional investors to the total number of common shares outstanding. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Board-management commonality	1.000							
(2) Board diversity index	0.003	1.000						
(3) Management diversity index	0.085***	0.476***	1.000					
(4) Board size	0.128***	-0.552***	-0.325***	1.000				
(5) Management size	-0.541***	-0.383***	-0.436***	0.539***	1.000			
(6) Proportion of independent directors	0.063***	-0.378***	-0.263***	0.375***	0.228***	1.000		
(7) Board-management social networks	0.071***	-0.185***	-0.250***	0.160***	0.068***	0.014***	1.000	
(8) Institutional ownership	-0.096***	-0.245***	-0.209***	0.310***	0.361***	0.272***	-0.082***	1.000

Table A.2
Roles of manager-like directors and director-like managers

This table presents descriptive statistics regarding the roles of manager-like directors and director-like managers in our sample over the period 2003-2021. *Manager-like directors* are independent directors who share similarities in demographic, cultural, educational, and functional characteristics with managers. *Director-like managers* are managers who share similarities in demographic, cultural, educational, and functional characteristics with independent directors. Both *Manager-like directors* and *Director-like managers* are identified using the support vector machine (SVM) classification approach.

Position	Percentage
Manager-like directors' positions on the board	
Chairperson (including committee chair)	50.30
Audit committee member	39.14
Compensation committee member	31.86
Nominating committee member	29.00
Director-like managers' positions in the management team	
CEO	26.72
CFO	13.42
COO	4.91
President, Vice President	36.90
Other	18.06

Table A.3
Characteristics of manager-like directors: A biographical analysis using ChatGPT

The table presents estimates from ordinary least squares (OLS) regressions in which the dependent variable is an indicator equal to one if a director's biography includes any of the six categories specified in each column. In columns (1) and (2), *Career trajectory & expertise* reflects an independent director's accumulated knowledge, skills, and professional milestones (e.g., business acumen, extensive industry knowledge, board directorship experience). In columns (3) and (4), *Community engagement and social responsibility* reflects an independent director's involvement in social and community-focused initiatives (e.g., active community involvement, community leadership experience, philanthropic mindset). In columns (5) and (6), *Core personal attributes* encompasses an independent director's intrinsic characteristics, such as integrity, resilience, and ethics (e.g., ethical integrity, relationship-building skills, and standing commitment). In columns (7) and (8), *Innovative leadership & entrepreneurial spirit* captures an independent director's creative thinking and risk-taking essential in entrepreneurial roles (e.g., entrepreneurship, entrepreneurial vision, startup experience). In columns (9) and (10), *Strategic advisory expertise* denotes an independent director's ability to offer crucial guidance and advice (e.g., advisory background, board advisory experience, strategic advisory skills). In columns (11) and (12), *Strategic leadership competence* reflects an independent director's direct leadership roles and decision-making responsibilities at the executive level (e.g., business leadership skills, senior executive experience, and strategic management experience). The sample consists of 35,358 nonfinancial firm-year-director observations from the BoardEx-Compustat-CRSP database over the period 2003 to 2021. We obtain the latest editions of biographies from S&P Capital IQ's (CIQ) database. *Manager-like director* is an indicator equal to one for independent directors who share similarities in demographic, cultural, educational, and functional characteristics with managers, and zero otherwise. *Board chair* is an indicator equal to one for the chair of the board of directors, and zero otherwise. *Age* is the age of an independent director in years. *Tenure* is the number of years an independent director has served on the board as a director. All other variables are defined in Appendix A. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Career trajectory & expertise (indicator)		Community engagement & social responsibility (indicator)		Core personal attributes (indicator)		Innovative leadership & entrepreneurial spirit (indicator)		Strategic advisory expertise (indicator)		Strategic leadership competence (indicator)	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Manager-like director	0.004	0.003	0.009*	0.010*	0.005	0.005	-0.006	-0.006	-0.005	-0.006	-0.052***	-0.052***
	(0.576)	(0.622)	(0.072)	(0.057)	(0.260)	(0.252)	(0.150)	(0.182)	(0.276)	(0.151)	(0.000)	(0.000)
Board chair	0.027***	0.026***	-0.012***	-0.011***	-0.006***	-0.007***	-0.020***	-0.020***	0.004*	0.004	-0.000	-0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.003)	(0.000)	(0.000)	(0.096)	(0.116)	(0.992)	(0.754)
Age	-0.001***	-0.001***	0.001***	0.001***	0.000***	0.000***	-0.001***	-0.001***	0.001***	0.001***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure	-0.001	-0.000	0.000	0.000	0.001***	0.001***	0.002***	0.002***	-0.000**	-0.000**	-0.004***	-0.004***
	(0.121)	(0.190)	(0.719)	(0.869)	(0.001)	(0.001)	(0.000)	(0.000)	(0.020)	(0.037)	(0.000)	(0.000)
Other control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Industry fixed effects	No	No	No	No	No	No	No	No	No	No	No	No
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	35,358	35,358	35,358	35,358	35,358	35,358	35,358	35,358	35,358	35,358	35,358	35,358
Adjusted R^2	0.004	0.002	0.018	0.030	0.003	0.008	0.063	0.057	0.001	-0.003	0.031	0.030

Table A.4
Board-management commonality and corporate culture: An analysis of director selection and nomination discussions in proxy statements

The table presents estimates from ordinary least squares (OLS) regressions in which the dependent variable is an indicator equal to one if the proxy statement of the firm includes any of the thirty most representative words for each cultural value in its director selection and nomination section (i.e., integrity, teamwork, innovation, quality, and respect) from the culture dictionary (Li et al., 2020). The sample consists of 6,186 nonfinancial firm-year observations from the BoardEx-Compustat-CRSP database over the period 2003 to 2021, with proxy statements available for 2010, 2015, and 2020. These proxy statements are obtained from cleaned filings in the WRDS Cloud. *Board-management commonality* is the ratio of independent directors and managers who share similarities in demographic, cultural, educational, and functional characteristics to the total number of independent directors and managers, using the support vector machine (SVM) classification. All other variables are defined in Appendix A. *P*-values reported in parentheses are based on standard errors adjusted for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Use of words in integrity (indicator)			Use of words in teamwork (indicator)			Use of words in innovation (indicator)			Use of words in quality (indicator)			Use of words in respect (indicator)		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Board-management commonality	0.002	0.051**	0.051**	0.018*	0.008	0.008	0.005	0.009	0.007	0.008	0.011	0.006	-0.001	0.005	-0.000
	(0.896)	(0.020)	(0.023)	(0.096)	(0.650)	(0.668)	(0.557)	(0.581)	(0.676)	(0.298)	(0.441)	(0.657)	(0.950)	(0.842)	(0.998)
Control variables (as in Panel A of Table 2)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Industry fixed effects	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Firm fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Industry-year fixed effects	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186	6,186
Adjusted R^2	0.005	0.354	0.335	0.003	0.211	0.187	0.006	0.098	0.061	0.004	0.079	0.059	0.005	0.198	0.184