Essays in Corporate Finance

by

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ABSTRACT

The first chapter uses data on birthplaces of 2,065 Chief Executive Officers (CEO) and a county-level measure of cultural individualism based on the westward expansion in American history to establish a positive relation between CEO cultural individualism and corporate innovation. Difference-in-differences estimations around CEO turnovers support the causality. Individualistic CEOs increase innovation by creating an innovative corporate culture, providing more flexibility to employees, and tolerance for failure.

The second chapter develops a model to study the corporate board structure and communication. Outside directors are related to potential competitors. As a result, they can bring valuable advice and cause information leakage. The firm needs to decide whether to have outside directors on the board. In the presence of the outside director, the other directors need to determine whether to communicate.

DEDICATION

To my parents.

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Chapter 1

CEO INDIVIDUALISM AND CORPORATE INNOVATION

1.1 Introduction

Innovation is a key driver of long-term economic growth (see, e.g., Hall *et al.* (2005) and Kogan *et al.* (2017)), and corporations constitute a large share to innovation. But innovation is only one of the many goals of the corporation. Innovation is also costly and risky, and it is difficult to make decisions of explorations for corporate management. Since CEOs personalities typically play an essential role in shaping corporate decisions, understanding which CEO characteristics matter for successful firm innovation is crucial for investors, corporate boards, and academics.

One such characteristic is cultural individualism, which is defined as a person's preference for pursuing individual interests above those of the collective. Individualists tend to emphasize "I" rather than "we", be self-reliant, and place a high value on personal freedom (Hofstede and Hofstede, 1984). A series of studies by Gorodnichenko and Roland (2011, 2017) and Boubakri *et al.* (2021) have documented a positive relationship between cultural individualism and innovation at the country level, arguing that individualism is the most important cultural factor for long-run economic growth. However, identifying the role of cultural individualism is challenging in cross-country studies because of wide country differences in education, social norms, demographics, infrastructure, and legal systems. In this chapter, I reduce these limitations by studying the role of cultural factors in decision-making at the firm level. I show that CEO individualism is positively related to corporate innovation output for U.S. firms and identify several mechanisms responsible for this relation.

I rely on the cultural individualism measure developed by Bazzi *et al.* (2020), who use the frontier experience during the westward expansion in American history to study its long-run impact on local culture. The frontier is the territorial line beyond which population density dropped below two people per square mile during the westward expansion, and a county's total frontier experience (TFE henceforth) is defined as the length of exposure to the frontier line between 1790 and 1890. Historians argue that the frontier experience has a causal impact on the local culture of individualism (Turner, 1921). I link CEOs to the TFE through the birthplaces and use it as a proxy for individualism. There are two aspects of how the local culture of the birthplace can be related to a person's preference. First, frontier locations tend to attract individualistic families and cultural individualism can be passed onto their children and future generations through family ties (Bisin and Verdier, 2000, 2001; Giuliano, 2007). Second, culture can be sticky and persistent in local areas (Guiso *et al.*, 2008), and historical factors can affect the values of local individuals even if their parents came from other places. Therefore, CEOs who have early-life exposure to the frontier are likely to exhibit individualistic preferences.

I establish a positive empirical relation between CEO individualism measured by TFE and firms' innovation. Individualists tend to possess a "mental freedom" that allows them to deviate from existing technologies, practices, and rules. For example, individualist CEOs may provide more flexibility in the workplace to their employees, value groundbreaking discoveries long-term success, and be more tolerant of early failure. Indeed, both theoretical and empirical work shows that a flexible and tolerant corporate environment is conducive to innovation (Manso, 2011; Acemoglu *et al.*, 2020). Specifically, I find that a one standard deviation increase in CEO individualism is associated with an approximately 3.89% increase in the number of patents and a 4.15% increase in the number of citations adjusted for class. Furthermore, the positive relation between CEO individualism and innovation measures remains robust to using an alternative measure of individualism based on Hofstede's model of cultural dimensions. Hofstede's measure is calculated by linking CEOs' last names to their countries of origin, following the methodology in Liu (2016) and Pan *et al.* (2020).

One potential concern about the interpretation of a positive relation between CEO individualism and firm innovation is that individualism may proxy for other CEO characteristics that are related to innovation. My results remain robust after I control for known determinants of innovation, including CEO overconfidence (Malmendier and Tate, 2008; Galasso and Simcoe, 2011; Hirshleifer *et al.*, 2012), CEO founder status (Hellmann and Puri, 2002), managerial incentives (Mao and Zhang, 2018), CEO general ability (Custódio *et al.*, 2019), and management team quality (Chemmanur *et al.*, 2019). Further, in contrast to cross-country studies,[1] I do not find evidence that CEO individualism measured by TFE is driven by higher risk-taking. Specifically, CEO individualism is unrelated to stock return volatility or the number of merger and acquisition (M&A) deals pursued by the firm.

Another concern is that a firm's board of directors may choose a CEO based on his or her characteristics. For example, CEO individualism may be related to firm innovation because the board picks more individualistic CEOs to run more innovative firms. The firm fixed effects absorb time-invariant characteristics, but it is still possible for a firm-CEO match to be affected by time-varying firm characteristics. To further alleviate this concern, I use a sample of CEO turnovers and conduct a difference-in-differences (DID) analysis.[2] Using a sample of CEO turnovers where the reason for

[1]Specifically, Chui *et al.* (2010) find that country-level individualism is positively related to volatility and trading volume, Li *et al.* (2013) find that standard deviation of ROA is higher in firms operating in countries with high individualism, and Ashraf *et al.* (2016) find that bank risk-taking is higher in countries with high individualism.

[2]Gentry *et al.* (2021) provide an open-source dataset of S&P 1,500 firms' CEO departures from

CEO departure is unrelated to firm performance, such as retirement or death. The DiD estimation shows that firms that experience an increase in CEOs' individualism after the turnover tend to generate more innovations than firms where CEOs' individualism declines. If firms do not consider individualism in hiring replacement CEOs, then the estimation using CEO turnovers supports the interpretation that individualism leads to more innovation. If individualism is factored into firms' hiring decisions because they want to promote innovation, this suggests that firms expect CEO individualism to affect innovation and the subsequent outcome would not go against this expectation.

Next, I investigate whether CEO individualism affects the types of patents filed by the firm by examining patent quality, originality, generality, and market values. Consistent with individualists pursuing breakthrough discoveries, I find that firms run by individualistic CEOs choose higher quality projects, as measured by patent citation counts that are among the top 1% or 5% in their patent class. Using the measures of patent originality and generality developed by Hall *et al.* (2001) and the market value of patents from Kogan *et al.* (2017), I also find that individualists are more likely to pursue innovation with widespread impact and high market value.

I then explore how individualist CEOs promote innovation through the corporate culture. Corporate culture is crucial in stimulating employees' creative thinking and in advancing their efforts to develop innovative projects (Li *et al.*, 2021; Graham *et al.*, 2017). Further, the literature has shown that CEO personality can affect corporate culture (O'Reilly *et al.*, 2014). Therefore I conjecture that CEO individualism increases corporate innovation by fostering an innovative corporate culture. I investigate three aspects of the corporate culture: employee work-life balance, text-based corporate culture from the conference call transcripts, and the tolerance of failure.

2000 to 2018, with detailed reasons for CEO turnover.

First, individualist CEOs' disutility of intervention helps create a flexible corporate environment. Using employee ratings from Glassdoor, I show that individualistic CEOs are associated with higher employee ratings of work-life balance. Groundbreaking discoveries come from employees who have more free time to explore and experiment without pressure. I then verify that employees' work-life balance indeed has a positive impact on innovation outcomes. Therefore, I conclude that CEO individualism promotes innovation by granting more freedom to employees and creating a flexible workplace environment.

The second aspect of corporate culture is tested using a text-based measure constructed from conference calls transcript. Individualistic CEOs' value of groundbreaking discoveries can be incorporated into their speeches. Therefore, individualistic CEOs can influence other managers and employees through daily interactions and conversations. To test this, I rely on innovative corporate culture measures developed by Li *et al.* (2021), who apply machine learning techniques to the transcripts of corporate earnings calls and extract several dimensions of the corporate culture. I find that individualistic CEOs promote corporate culture along the innovative dimension. This finding supports my hypothesis that individualistic CEOs improve corporate innovation by promoting an innovative corporate culture through communications.

The third aspect of corporate culture focuses on tolerance of failure. I test this aspect through the management of conglomerates. Individualists are less concerned about achieving harmony and overall efficiency. They also oppose redistribution and intervention (see, e.g., Gorodnichenko and Roland (2011) and Bazzi *et al.* (2020)). Individualistic CEOs' disutility of redistribution contributes to a low internal capital reallocation and conglomerate diversification. Manso (2011), and Seru (2014) argue that conglomerate diversification and reallocation hurt innovation because they make high-level managers fear the reallocation of resources by headquarters in the event of failure. Consequently, the management of individualistic CEOs provides a tolerance for failure and encourages division managers to be more innovative. Estimation results support this hypothesis that CEO individualism improves innovation by being more tolerant of failure as reflected in the management of conglomerates.

Manso (2011) predicts that debtor-friendly bankruptcy laws can improve innovation and motivate exploration since they reward the agent after failure. Creditor-friendly legal environments, however, are likely to discourage exploration. The management of individualistic CEOs can alleviate the negative impact of creditor-friendly bankruptcy laws and motivate innovative activities despite the consequence after failure. Therefore, the positive relation between CEO individualism and innovation should be stronger for firms in a lender-friendly legal environment. Following Mansi *et al.* (2009), I define that a firm is in a creditor-friendly legal environment if it is incorporated in Delaware and a firm is in a creditor-friendly legal environment if it is incorporated in New York or California. Consistent with my hypothesis, the positive relation between CEO individualism and corporate innovation is stronger in the creditor-friendly environment compared to the debtor-friendly environment.

The preference of individualistic CEOs can also be reflected in other decisions. For example, in M&A decisions, individualist CEOs are likely to choose target firms with less technological similarity since they tend to deviate from existing technologies. Based on a sample of M&A deals, I find that individualistic acquirer CEOs choose target firms with less technological linkage and proximities. Although such M&A deals can help increase the generality and originality of the patents produced by the firm, they are also value-destroying activities with lower announcement CARs.

This chapter contributes to several strands of literature. First, it extends the literature on individualism and innovation. Gorodnichenko and Roland (2011, 2012), Bukowski and Rudnicki (2019), and Boubakri *et al.* (2021) show that culture can affect economic growth and innovation on a national level. I add to this literature by providing firm-level evidence that CEO individualism drives corporate innovation, which highlights the importance of CEO preferences in a setting where the cultural attributes of other firm employees do not necessarily align with those of the CEO.

Second, this chapter adds to the literature on individualism and the frontier culture. Bazzi *et al.* (2020, 2021) and Bian *et al.* (2020) present evidence that a rugged individualistic culture hampered collective action in response to COVID-19. Locations with higher historical exposure to a frontier culture were associated with less social distancing, lower use of masks, a weaker government effort to control the virus, and lower charitable donations. In another chapter, Barrios *et al.* (2021) show that new business formation is largely explained by the geographic frontier experience and argue that individualist culture promotes entrepreneurship. My study shows that the early-life exposure to a frontier culture affects corporate managers' decision-making and preferences later in life and translates to greater innovation output by their firms.

Third, this chapter contributes to the literature relating CEO personal traits to corporate innovation (see a survey by He and Tian (2018)). For example, Malmendier and Tate (2005a,b), Galasso and Simcoe (2011), and Hirshleifer *et al.* (2012) examine the relation between managerial overconfidence, firm investment, and innovation. Sunder *et al.* (2017) study how a CEO's hobby of flying airplanes is related to the firm's innovation activities, and Custódio *et al.* (2019) explore the relation between general managerial skills and innovation. This chapter identifies CEO cultural individualism as an important personal characteristic related to innovation and highlights several mechanisms responsible for this relation. Finally, this chapter contributes to the literature on the importance of cultural factors in financial decision-making. For example, Chui *et al.* (2010) and Eun *et al.* (2015) document the effect of culture on investors and equity markets. Li *et al.* (2013), Liu (2016), and Pan *et al.* (2017, 2020) document that cultural factors are related to corporate decisions. In this chapter, I show that cultural individualism can affect corporate innovation.

The rest of the chapter is organized as follows. Section 1.2 provides background on the frontier culture and discusses the origins of cultural individualism. Section 1.3 describes sample construction and provides summary statistics. Section 1.4 presents the baseline results, and Section 1.5 describes the difference-in-differences tests. Section 1.6 explores the relation between CEO individualism and patent originality, generality, and market value. Section 1.7 discusses several potential mechanisms for the relationship between CEO individualism and corporate innovation. Section 1.8 discusses and concludes.

1.2 Rugged Individualism

Rugged individualism is a culture that is associated with nineteenth-century westward expansion and the frontier experience. Turner (1921) describes the frontier as a "meeting point between savagery and civilization" that promotes an individualistic culture in the local area. Low population density and lack of public facilities on the frontier required people to rely on their own wits and skills to survive and improve their living conditions. Such individualists tend to prefer taking responsibility for their own conditions and well-being over relying on government services and interventions (Bazzi *et al.*, 2020). Culture is sticky and persistent, and the historical exposure to frontier culture continues to influence people's preferences in the present day. For example, the geographic areas long associated with the frontier exhibited poor collective action during the COVID-19 crisis, such as less use of face masks and social distancing (Bazzi *et al.*, 2020; Bian *et al.*, 2020).

Individualists tend to favor a *laissez-faire* approach to business and societal norms and have weaker preferences for redistribution and regulation. During the COVID-19 pandemic, these preferences were found to hinder the collective actions (such as social distancing) and to result in less charitable giving (Bazzi *et al.*, 2020; Bian *et al.*, 2020). Individualistic managers tend to provide more flexibility to their employees without pressure on efficiency. In managing conglomerates, individualist CEOs maintain a low level of diversification and asset reallocation since they value less overall harmony and oppose redistribution of wealth. The flexible corporate environment and tolerance of the early failures are beneficial in encouraging employees and division managers to be more innovative (Manso, 2011; Seru, 2014).

Individualists view themselves as independent; they would rather stand out than blend in–for example, by choosing unusual names for their children (Bazzi *et al.*, 2020).[3] Individualists value personal achievement through novel discoveries and deviate from existing rules and technologies. Individualist CEOs tend to promote a corporate culture that emphasizes innovation, encourage employees to be explorative, acquire target firms with less technological overlap, and pursue original innovative activities with a broader impact. Barrios *et al.* (2021) show that the geographic distribution of frontier experience can also help explain the new business formation and entrepreneurship.

Individualists value equality of opportunities over equality outcomes (Alesina *et al.*, 2001). Individualists' tendency to oppose hierarchies and elites (Bazzi *et al.*, 2020) led some to distrust authorities during the COVID-19 crisis (Bazzi *et al.*, 2020). Individualists have also been found to communicate directly and unambiguously.

[3] (Bazzi *et al.*, 2020) define infrequent names as those names outside the top 10 within one's Census division.

1.3 Sample Construction and Summary Statistics

1.3.1 Data and Firm-CEO Sample Construction

I obtain a sample of 8,531 CEOs from Execucomp for 1992-2016, after excluding financial firms (SIC codes between 6000-6999) and utility firms (SIC codes between 4900-4999). I then collect birth county information for 2,065 U.S.-born CEOs.[4] CEOs' biographical information is obtained from public resources such as Wikipedia and the Notable Names Database (NNDB). I then match the birth county to the FIPS county code and link that to the total frontier experience (TFE) from Bazzi *et al.* (2020), who assign each county a number representing its duration as part of the frontier. Figure 1 shows the distribution of TFE in U.S. counties. Figure 2 shows the distribution of CEOs (adjusted by historical average population) in U.S. counties. The number of CEOs and TFE are negatively correlated, with a correlation of -0.04 and a p-value of less than 0.05.

I include the Hofstede individualism score as an alternative measure of individualism. Following the method in Liu (2016) and Pan *et al.* (2020), I map each CEO's last names to their countries of origin and then match to the Hofstede culture dimension of individualism. Another proxy is the distance between CEOs' home state and the state where they attended college. Individualistic CEOs tend to be self-reliant, hence are likely to travel farther from home for college.

I collect the patent data information from the U.S. Patent and Trademark Office (USPTO), where patents are matched to firms' CRSP permco. The market value of patents is obtained from Kogan *et al.* (2017). The patent information includes the filing date, citation, inventor, and technological classification. Firm-level variables are obtained from Compustat and CRSP. A CEO's characteristics such as gender,

[4] 1,508 CEOs' birthplaces for 1992-2012 are obtained from Bernile *et al.* (2017).

age, tenure, and compensation are collected from Execucomp. A CEO's educational background and management team quality variables are obtained from BoardEx. The general ability index (GAI) is obtained from Custódio *et al.* (2019). I obtain the corporate culture measures from Li *et al.* (2021). These measures of corporate culture are constructed using machine learning techniques and include innovative corporate culture. I obtain information about founder CEOs for the years 2008-2016 from Lee *et al.* (2017). Mergers and acquisitions information is collected from SDC M&A.

1.3.2 Summary Statistics of the Firm-CEO Sample

[Insert Table 1]

There are 14,772 observations for 1992-2019, corresponding to 2,065 CEOs and 1,550 firms. The average TFE is 0.841 (decade), and the median is 0.5. The average Hofstede individualism score is 77.15, and the median is 80. 53.2% of CEOs attended college in a different state from their birthplace. The average and median CEO age are 57. The proportion of female CEOs is 2.44%. The average CEO tenure is 8.7 years, and the median is six years. The average highest degree received for CEOs is 1.8 from a 0-3 scale (doctoral degree = 3; master's degree = 2; bachelor's degree = 1; 0 otherwise). The proportion of CEOs with a doctoral degree is 1.2%, a master's degree 75.8%, and a bachelor's degree 20%; 3% have no information about education. The proportion of CEOs who graduated from an Ivy League school is 33%. The average general ability index (GAI) is 0.187, and the proportion of overconfident CEOs is 9.3%. The proportion of founder CEOs is 17.9%. The average team size is 9, the average proportion of master's and doctoral degrees in the teams is 34.6% and 3.5%, respectively. The average size of the team network is 2,113, and the average team tenure is 5.2 years. The average proportion of team members with previous experience is 54.8%.

1.3.3 CEO Individualism and CEO Firm Characteristics

[Insert Table 2]

Table 2 presents the correlation of TFE with CEO, firm, and team characteristics. I split the sample into subsamples using CEO and firm variables. Then I compare the TFE for each subsample using the T-test. The results show that the CEOs' TFE score is positively correlated with Hofstede's score and the college distance. The TFE score is negatively correlated with the Ivy League degree and CEOs' network size. CEOs who work for small firms or receive lower total compensation tend to have high TFE. CEOs who work with well-connected management teams have lower TFE.

1.3.4 M&A Sample

There are 16,318 effective acquisitions for 1992-2019, initiated by 1,220 firms with the acquirer CEO TFE observable. Table 1, Panel B presents the descriptive statistics. The average percentage of shares owned after the acquisition is 91.87, and the average acquirer CEO's TFE is 0.802. This number is slightly lower than the firm-CEO sample, indicating that individualistic CEOs are not more likely to engage in acquisition activities.

There are 494 mergers where the target CEOs' TFE are also available. I use this sample to create a panel of M&A samples for three years before and after the years of effectiveness. There are 20 mergers with the replacement (acquirer) CEO less individualistic than the departing (target) CEO. There are 22 mergers with the replacement (acquirer) CEO more individualistic than the departing (target) CEO.

1.4 Empirical Results

1.4.1 CEO Individualism and Innovation

In this section, I estimate the relation of TFE and innovation to the firm-CEO sample:

$$\text{Innovation}_{i,t+2} = \alpha_i + \beta \cdot TFE_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i + \delta_t(\text{or} + \zeta_{t,ind_i}) + \epsilon_j. \quad (1.1)$$

The results are reported in Table 3, Panel A:

[Insert Table 3]

Here, i indexes firms, and j indexes the CEOs. Innovation measures include the logarithm of one plus the number of patents, the logarithm of one plus the number of citations, and the logarithm of one plus the number of citations adjusted by the class-year average. Innovation variables used are in year $(t+2)$.[5] $X_{j,t}$ represents the set of CEO characteristics, including age, gender, and tenure. $Z_{i,t}$ is the set of firm controls, including size, firm age, employment, R&D, and capital expenditures. Columns (1)-(3) include year (δ_j) and firm (η_i) fixed effects. η_i absorbs all time-invariant firm characteristics. Columns (4)-(6) include the firm and industry (SIC two-digit)-year (ζ_{t,ind_i}) fixed effects. ζ_{t,ind_i} accounts for time-varying industry-level controls. Standard errors are clustered at the manager level in all regressions.

The positive association between TFE and innovation is significant in all specifications. A one standard deviation increase in TFE predicts a 3.89% increase in the number of patents relative to the mean (column 1), a 2.91% increase in the number of citations relative to the mean (column 2), and a 4.15% increase in the adjusted

[5]Innovation takes time, hence I use years $(t+2)$. The results are robust to using $(t+1)$ and $(t+3)$.

number of citations relative to the mean (column 3).[6] The positive and significant estimation results in columns (4)-(6) show the robustness of the relation.

1.4.2 Alternative Explanations

[Insert Table 3]

One concern is that TFE may be a proxy for known determinants of innovation. To exclude alternative explanations, I estimate the relation between TFE and innovation in Table 3, Panel B with additional drivers of innovation included. The dependent variable is the logarithm of one plus the number of patents at year (t+2).[7] CEO and firm controls are identical to Table 3, Panel A. Column (1) controls for CEO education, including highest degree earned and a dummy for Ivy League degree. Column (2) controls for CEO overconfidence (Malmendier and Tate, 2008; Galasso and Simcoe, 2011; Hirshleifer *et al.*, 2012). Columns (3) control for compensation and CEO incentives (Mao and Zhang, 2018). Column (4) controls for an indicator of whether the CEO is the founder (Lee *et al.*, 2017; Hellmann and Puri, 2002). Column (5) controls for the general ability index (Custódio *et al.*, 2019), and column (6) controls for the management team quality variables (Chemmanur *et al.*, 2019). Firm and year fixed effects are included in all columns,[8] and standard errors are clustered at the CEO level.

The positive relation between TFE and innovation output is robust across all specifications, indicating that the result is not driven by these alternative drivers of innovation or other unobservable variables. Specifically, risk-taking is shown to be a

[6] Appendix Table A1 reports more robustness tests of baseline results.

[7] The results are robust to using citations and adjusted citations as dependent variables.

[8] The result is robust to using industry-year and firm fixed effects.

well-known driver of innovation and has a positive relation with individualism Chui *et al.* (2010), Li *et al.* (2013), and Ashraf *et al.* (2016). Column (3) in Table 3, Panel B controls for CEO risk-taking compensation incentives, and the result is unaffected. To further demonstrate that TFE is not a proxy for risk-taking, I show in Appendix Table A2 that CEO individualism measured by TFE does not increase the corporate risk-taking outcomes and activities, including stock return volatility and M&A deals.

[Insert Table A2]

The dependent variables in columns (1) and (2) are stock return volatilities. The dependent variables in columns (3) and (4) are the numbers of announced and effective acquisitions. None of these risk-taking measures increases with CEO individualism, suggesting that CEO individualism does not affect corporate innovation through risk-taking or overconfidence. In summary, CEO individualism measured by TFE does not proxy for known drivers of innovation. It improves corporate innovation through channels that are unique to managers' individualistic preferences.

Tables A1 includes more robustness tests for the baseline estimations.

1.4.3 Alternative Measure of Individualism

[Insert Table 3]

Table 3, Panel C reports estimation results using Hofstede's score as an alternative measure of individualism. The measure is calculated based on a CEO's last name and country of origin following Liu (2016) and Pan *et al.* (2020). Dependent variables, control variables, and fixed effects are identical to those in Table 3, Panel A. Standard errors are clustered at the level of CEO. The estimation coefficient is positive and significant across all specifications. A one standard deviation increase in CEO

Hofstede's individualism score predicts a 3.08% increase in the number of patents, a 3.24% increase in the number of citations, and a 4.54% increase in the number of adjusted citations relative to the sample mean. The positive association between CEO individualism and corporate innovation is robust to using the alternative measure of individualism.

1.5 Estimation Using CEO Turnovers

The selection of CEOs may be correlated with firm characteristics. Although the firm fixed effects absorb the time-invariant firm characteristics, the firm-CEO match could be related to the time-varying characteristics. To alleviate this concern, I use a sample of CEO turnovers to conduct difference-in-differences estimations. Gentry *et al.* (2021) provide a dataset of S&P 1500 firms' CEO dismissals from 2000 to 2018 that includes detailed reasons for the departures. I include dismissals that are uncorrelated to CEO performance. The reasons for CEO departures I include are death, illness, personal issues, retirement, new career driven opportunity, and M&A. There are 4,183 relevant events in the dismissal sample, 486 of which include the TFE for both the departing and the replacement CEOs. I define an event as "treated" ("control") if the replacement CEO has a higher (lower) TFE than the departing CEO. There are 176 treated events and 179 control events.[9] I define "post" as 1 (0) for 1-3 years after (before) the turnover. Then I estimate the following equation:

$$\begin{aligned}\text{Innovation}_{i,t+2} = \alpha_i + \beta \cdot \text{Treat} \cdot \text{Post} + \beta_1 \cdot \text{Treat} + \gamma \\ \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i(\text{or} + \lambda_k) + \delta_t + \epsilon_j.\end{aligned} \tag{1.2}$$

[Insert Table 4]

Table 4, Panel A reports the difference-in-difference estimation on the raw sample of 355 (=176+179) events. Innovation measures, CEO controls $X_{j,t}$ and firm controls $Z_{i,t}$ are identical to Table 3, Panel A. Columns (1)-(3) include firm (η_i) and year (δ_t) fixed effects, and columns (4)-(6) include event (λ_k) and year fixed effects. Standard errors are clustered at the firm level.[10] The estimated coefficients in the interaction

[9] There is no change in CEOs' TFE for the remaining 131 events.

[10] The result is also robust to clustering standard errors at the CEO level.

terms are positive and significant across all columns. Columns (1)-(3) report that firms with a more individualistic replacement CEO exhibit a 7.7% increase in the number of patents, a 6.8% increase in the number of citations, and an 8.7% increase in the number of adjusted citations relative to the sample mean compared to firms with a lower TFE replacement CEO.

Next, I create the treated and control samples using propensity score matching. I match 90 treated events with 45 control events. Table 4, Panel B verifies that the treated and control samples have similar firm characteristics and replacement CEOs' non-individualistic characteristics.

Table 4, Panel C verifies the parallel trend assumption of innovation measures for the pre-turnover period. Table 4, Panel D reports the difference-in-difference estimation for the matched sample. All specifications are identical to those in Table 4, Panel A. The coefficients estimated on the interaction terms are consistent with Table 4, Panel A and are positively significant across all specifications. Columns (1)-(3) show that treated events exhibit 14.5% more patents, 13.3% more citations, and 19.4% more adjusted citations relative to the sample mean than firms with a less individualistic replacement CEO.

Figure 3 displays the OLS regression coefficients β_t and 95% confidence intervals estimated from $\log(1+\text{number of patents})_{i,t+1} = \alpha_i + Z_{i,t} + \Sigma\ \beta_k \times \text{treat} \times \Delta\text{year} + \eta_i + \zeta_{t,ind_i} + \epsilon_j$. Δyear is the difference between year t and the turnover year. The graph shows estimated β_k for $\Delta\text{year} \in [-5, 5]$ years around the turnover. $Z_{i,t}$ is the set of firm controls, including size, R&D expenditures and capital expenditures. Treat is a dummy variable that equals to one if the replacement CEO is more individualistic than the departing CEO. η_i is the firm fixed effect. ζ_{t,ind_i} is the year-industry fixed effect.

In addition, I focus on the M&A driven turnovers and show the relation between individualistic acquirer CEOs and post-merger combined innovation. I collect a larger M&A sample from Thomson Reuter SDC from 1992-2019 and keep the deals where (1) acquirer and target firms CEOs' TFE information is available, (2) the deal is completed, and (3) the acquirer CEO replaced the target CEO. I define a deal as "treated" ("control") if the acquirer CEO has a higher (lower) TFE than the target CEO. There are 22 "treated" deals and 20 "control" deals. I then construct a panel of M&A deals using three years before and after the deal completion. The estimation period is [-3, -1] and [1, 3] years around the deal completion. Next, I estimate the following equation:

$$\begin{aligned} \text{Combined innovation}_{i,t+2} = \alpha &+ \beta \cdot \text{Treat} \cdot \text{Post} + \beta_1 \text{Treat} \\ &+ \gamma X_{j,t} + \delta Y_{i,t} + \eta_i (\text{or} + \lambda_k) + \delta_t + \epsilon_j \end{aligned} \tag{1.3}$$

Table 4, Panel E reports the regression results. Dependent variables are the combined innovation measures of acquirers and targets. I calculate the combined patents (citations, adjusted) number as the acquirer's number of patents plus the target firm's patents (citations, adjusted) number multiplied by the percentage owned. Control variables include acquirer CEOs' age, tenure, gender, education, acquirer firms' R&D expenditures, size, and capital expenditures. Pair controls include technological proximity, percentage of firm ownership after completion, and an indicator variable that equals one if the target and acquirer have the same 2-digit SIC code. Year and acquirer fixed effects are included in columns (1)-(3). Year and deal (λ_k) fixed effects are included in columns (4)-(6). Standard errors are clustered at the acquirer level. The positive coefficients estimated for the interaction term are significant and robust across all specifications in Table 4, Panel E. The results show that an increment of CEO individualism is associated with higher combined post-merger innovation.

Whether the selection of replacement CEOs is correlated with the candidates' individualistic characteristics is unknown. If firms do not consider candidates' individualism in replacing their CEO, then the difference-in-differences estimations would support the causality. If individualism is factored into firms' hiring decisions because they want to promote innovation, then firms expect CEO individualism to affect firm innovation. Moreover, the subsequent outcome does not go against this expectation. Further, the endogeneity of M&A-driven turnovers comes from the departing CEO (target selection) instead of the replacement CEO. None of the estimations is perfectly exogenous, but the consistent results across different resources of endogeneity collectively support the causality between CEO individualism and corporate innovation.

1.6 Innovation Quality, Originality and Generality, and Market Value

In this section, I further examine the impact of CEO individualism on other dimensions of innovation. I investigate the relations between CEO individualism and innovation quality, patent originality and generality, and market value. I use the proportion of top-quality patents to proxy for innovation quality. A patent is defined as a top-quality patent if the number of citations it receives is among the top 5% (or 1%) in the same year-class group. A higher proportion of top-quality patents indicates a higher overall quality of innovation by the firm in that year. I estimate the following equation:

$$\begin{aligned}\text{Proportion of top-quality innovation}_{i,t+2} = \alpha_i + \beta \text{TFE}_{j,t} + \gamma X_{j,t} + \delta Z_{i,t} \\ + \eta_i + \delta_t (\text{or} + \zeta_{t,ind_i}) + \epsilon_j.\end{aligned} \tag{1.4}$$

[Insert Table 5]

Table 5, Panel A reports the estimation results on innovation quality. The dependent variable of columns (1) and (3) is the proportion of top-quality innovation (top 5% of citations) in the year (t+2). The dependent variable of columns (2) and (4) is the proportion of top-quality innovation (top 1% of citations) in the year (t+2). Control variables and fixed effects are identical to those in Table 3, Panel A. Standard errors are clustered at the level of CEO. The relation between CEO individualism and innovation quality is positive across all columns. A one standard deviation increase in CEOs' TFE predicts a 12.4% increase in the proportion of the top 5% of innovations (column 1) and a 20.4% increase in the proportion of the top 1% of innovations (column 2) relative to the sample mean.

Next I investigate the impact on innovation originality and generality. Hall *et al.* (2005) define originality and generality as follows:

$$\text{Originality}_i = 1 - \Sigma_j^{n_i} s_{ij}^2, \tag{1.5}$$

where s_{ij} is the fraction of citations citing patent i that belong to patent class j, out of n_i patent classes. And

$$\text{Generality}_i = 1 - \Sigma_j^{n_i} t_{ij}^2, \tag{1.6}$$

where t_{ij} is the fraction of citations received by patent i that belong to patent class j, out of n_i patent classes. A patent with high originality cites previous patents from a broad knowledge base. A patent with high generality is cited by patents from broad patent classes. High generality indicates a greater impact (Hall *et al.*, 2005). I then estimate the following equation:

$$\text{Originality/generality}_{i,t+2} = \alpha_i + \beta \cdot \text{TFE}_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i + \delta_t(\text{or} + \zeta_{t,ind_i}) + \epsilon_j. \tag{1.7}$$

Table 5, Panel B reports the estimation results on innovation generality and originality. Control variables and fixed effects are identical to those in Table 3, Panel A. Standard errors are clustered at the level of CEO. The positive relations between CEO individualism and innovation originality/generality are robust across all columns. A one standard deviation increase in CEOs' TFE predicts a 1% increase in innovation originality (column 1) and a 1.9% increase in innovation generality (column 2) relative to the sample mean. The positive impact is consistent with estimations using industry-year and firm fixed effects (columns 3, 4).

Next I estimate the relation between CEO individualism and the market value of patents. The market value of patents is developed in Kogan *et al.* (2017); it links innovation to stock market reaction and measures the value of patents in terms of dollar value of patents. I estimate the following equation:

$$\text{Market value of patents}_{i,t+2} = \alpha_i + \beta \cdot \text{TFE}_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i + \delta_t (\text{or} + \zeta_{t,ind_i}) + \epsilon_j. \tag{1.8}$$

Table 5, Panel C reports the estimation results on the market value of patents. The dependent variable of columns (1) and (3) is the logarithm of the market value of the patent. The dependent variable of columns (2) and (4) is the logarithm of the market value of the patent scaled by the dollar amount of R&D expenses in the same year.[11] Control variables and fixed effects are identical to those in Table 3, Panel A. Standard errors are clustered at the level of CEO. The impact of CEO individualism on innovation quality is positive across all columns. A one standard deviation increase in CEOs' TFE predicts a 3.1% increase in the logarithm of the market value of the patent (column 1) and a 1.5% increase in the logarithm of the market value of the patent scaled by R&D expenditures relative to the sample mean. The positive impact is consistent with using alternative fixed effects (columns 3, 4).

[11] The market value of patent used here is the real value of the patent, but it is also robust to using nominal value of the patent.

1.7 Mechanism of Corporate Culture

In this section, I explore how individualist CEOs improve innovation. I show that individualistic CEOs promote corporate innovation by affecting several aspects of corporate culture. Corporate culture is defined as "a system of shared values defining what is important, and norms, defining appropriate attitudes and behaviors" (O'Reilly and Chatman, 1996). Corporate culture is important in stimulating employees' creative thinking and in advancing their efforts to develop innovative projects (Li *et al.*, 2021; Graham *et al.*, 2017) Schein (2010) argues that one of the important tasks of leaders is "to create and manage culture." O'Reilly *et al.* (2014) show that CEO personality affects business culture and that culture is subsequently related to corporate outcomes.

I show three aspects of corporate culture in this section. They are: employee work-life balance, text-based culture measure from conference call transcripts, and tolerance of failure.

1.7.1 Employee Work-life Balance

The first aspect of corporate culture is related to the workplace environment and the flexibility granted to employees. Breakthrough innovations come from employees who have more flexibility and free time. For example, Jack Kilby invented the first integrated circuit during a vacation while working at Texas Instruments (TI) in 1958. "*Innovation comes about by and large when people aren't working when people have time-like Jack did during that July vacation period-to think about things without a lot of pressure... As corporations get leaner and meaner people to work harder and more efficiently. Every minute is filled with some productive work and there's little time* *left to innovate*", according to Jay Lathrop's interview.[12] Individualistic CEOs care less about static efficiency and dislike intervention. Therefore they are likely to grant more flexibility to employees without putting a lot of pressure on them to encourage exploration.

To investigate this hypothesis, I rely on the employee ratings from Glassdoor for 2007-2019. There are several dimensions of ratings, and I focus on the ratings of work-life balance. The rating scale is from 0 to 5. Then I estimate the following:

$$\text{Employee Ratings}_{i,t+1} = \alpha_i + \beta \cdot \text{TFE}_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i + \delta_t(\text{or} + \zeta_{t,ind_i}) + \epsilon_j. \quad (1.9)$$

[Insert Table 6]

Table 6 reports the estimation results of CEO individualism and employee ratings. The dependent variable in column (1) is the overall rating in the year (t+1). The dependent variable in columns (2)-(4) is the work-life balance rating in the year (t+1). Control variables include the firm controls, CEO controls, and the logarithm of the number of evaluations. All columns include the firm fixed effect. Columns (1)-(3) include year fixed effect and column (4) include industry-year fixed effect. Standard errors are clustered at the CEO level. Individualistic CEOs tend to receive a higher overall rating from Glassdoor, indicating they are likely to increase employees satisfaction. Specifically, CEO individualism tends to improve employees' work-life balance, which is related to a flexible environment with less pressure and more free time.

Columns (5) and (6) show that employees' work-life balance can indeed improve corporate innovation. The dependent variable of columns (5)-(6) is the logarithm of the number of patents at year (t+2). Firm and year fixed effects are included in both

[12]See Oral-History by Jay Lathrop from Engineering and Technology History Wiki.

columns. Standard errors are clustered at the firm level. Put together, individualistic CEOs improve corporate innovation by allowing more flexibility and free time to employees.

1.7.2 Corporate Innovative Culture

The second aspect of corporate culture is tested using a text-based culture measure constructed from conference call transcripts. Individualistic CEOs' preference for novel discoveries can be reflected in their daily speeches and influence on their colleagues. In addition, O'Reilly *et al.* (2014) show that corporate culture affects firm performance. Li *et al.* (2021) show that an innovative corporate culture is positively related to innovation activity. Therefore I hypothesize that individualistic CEOs promote an innovative corporate culture which helps improve innovation. I rely on the measure of corporate culture developed in Li *et al.* (2021), who apply machine learning techniques to the transcripts of corporate earnings calls and construct innovative corporate culture. And I estimate the following:

$$\text{Corporate innovative culture}_{i,t+2} = \alpha_i + \beta \cdot \text{TFE}_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Y_{i,t} + \eta_i + \delta_t + \epsilon_j. \tag{1.10}$$

[Insert Table 7]

The estimation results are reported in Table 7. The dependent variable is the innovative corporate culture at year (t+2). Column (2) controls for CEO controls. CEO controls include age, tenure, gender, and education. Column (3) controls for CEO controls and general ability index (GAI). Column (4) controls additional firm control variables. Firm controls include size, R&D expenditures, firm age, capital expenditures, and employment. Firm and year fixed effects are included in all columns. Standard errors are clustered at the manager level. The coefficients estimated are positive and significant across all columns. I find that individualistic CEOs can promote an innovative corporate culture and motivate corporate innovation.

1.7.3 Tolerance of Failure and Conglomerate Management

The third aspect is related to the tolerance of failure, and I examine this channel through the management of conglomerates. Seru (2014) shows that diversification and capital reallocation can hinder innovation because high-level managers fear a reallocation of resources by headquarters in the case of failure and will be reluctant to invest in novel projects. Manso (2011) predicts that a lack of active internal capital reallocation foster an environment that tolerates failures and encourages innovation. Individualist CEOs have a low value of harmony and dislike redistribution. Therefore they are likely to maintain lower internal capital reallocation and conglomerate diversification. To establish this channel, I restrict the sample to conglomerates and estimate the following model:

$$\begin{aligned}\text{Reallocation/Diversification}_{i,t+1} = \alpha_i + \beta \cdot \text{acquirer TFE}_{j,t} + \gamma \\ \cdot X_{j,t} + \delta \cdot Y_{i,t} + \eta_i + \delta_t + \epsilon_j.\end{aligned} \tag{1.11}$$

The internal capital reallocation measure is defined following Rajan *et al.* (2000) and Seru (2014):

$$\text{Reallocation}_i = (\Sigma_j^n |I_j - CF_j| - |\Sigma_j^n (I_j - CF_j)|)/\text{Assets}, \tag{1.12}$$

where i indexes for firm and j indexes for the segment of the firm. I_j is the investment in segment j, and CF_j is the cash flow of segment j. Assets represents the total assets of the conglomerate, and n is the number of segments. Diversification is defined as follows:

$$\text{Diversification}_i = \frac{1}{\Sigma_j^n \left(\frac{Sales_j}{\Sigma_j^n Sales_j}\right)^2}, \tag{1.13}$$

where $Sales_j$ is segment j's sales, and n is the number of segments.

[Insert Table 8]

Table 8 reports the estimation results of CEO individualism on conglomerate management. The dependent variables in columns (1) and (2) are reallocation and logarithm of reallocation in the year (t+1). Dependent variables in columns (3) and (4) are diversification and logarithm of diversification in the year (t+1). Control variables include CEO age, gender, tenure, education, firm size, R&D expenditures, capital expenditures, and employee. Firm and year fixed effects are included in all columns. Standard errors are clustered at the CEO level. Coefficients estimated show that individualistic CEOs can reduce the internal capital reallocation and maintain a low level of corporate diversification. This impact can be interpreted as the tolerance of failures and therefore encourage division managers to engage in more risky innovative projects.

1.8 Heterogeneous Impact of Legal Environment

Manso (2011) predicts that debtor-friendly bankruptcy laws can improve innovation by rewarding the agent after failure, and creditor-friendly bankruptcy laws are likely to discourage exploration since there are no exemptions of debt after failure. Therefore, I hypothesize that the effect of CEO individualism is more pronounced for firms in a creditor-friendly environment. A company is subject to the laws of the state of incorporation. Following Mansi *et al.* (2009) define the environment to be debtor-friendly (Creditor-Friendly = 0) if the company is incorporated in Delaware, and creditor-friendly if the company is incorporated in California or New York (Creditor-Friendly = 1). The state of incorporation and state of location for firms is obtained from Cohen (2012) and Gormley and Matsa (2016). Then I estimate the following:

$$\begin{aligned}\text{Innovation}_{i,t+2} = \alpha_i + \beta_1 \cdot TFE_{j,t} \cdot \text{Creditor-Friendly}_i + \beta_2 \cdot TFE_{j,t} + \beta_3 \\ \cdot \text{Creditor-Friendly}_i + \gamma \cdot X_{j,t} + \delta \cdot Z_{i,t} + \eta_i + \delta_t (\text{or} + \zeta_{t,ind_i}) + \epsilon_j.\end{aligned} \tag{1.14}$$

[Insert Table 9]

Table 9 reports the heterogeneous estimation of the legal environment of bankruptcy laws. Dependent variables are the logarithm of one plus number of patents, citations, and adjusted citations at year (t+2). Control variables include CEO age, gender, tenure, education, firm size, R&D expenditures, capital expenditures, employee, and credit ratings. Firm fixed effect is included in all columns. Year fixed effect is included in columns (1)-(3). Industry-year and headquarter state-year fixed effects are included in columns (4)-(6). Standard errors are clustered at the CEO level. The positive coefficients estimated at the interaction terms are significant and robust across all columns, supporting my hypothesis that the positive impact of CEO individualism on innovation is more pronounced for firms in a legal environment where the bankruptcy law is more creditor-friendly.

1.9 Type of M&A Deals

The preference of individualistic CEOs can also be reflected in other decisions made by the firm. For example, individualistic CEOs do not increase the risk-taking M&A activities, but they acquire different target firms since they like to deviate from existing technologies. I find a negative relation between acquirer CEOs' TFE and technological similarity on a sample of M&A deals for 1992-2019, obtained from SDC M&A. 16,318 of the deals have the acquirer CEOs' TFE available. Descriptive statistics of the M&A sample are reported in Table 1, Panel B. Following Jaffe (1986) and Bena and Li (2014), I calculate the technological proximity, target technology overlap, and acquirer overlap to proxy for the technology linkage between acquirers and targets. Innovation proximity is defined as the correlation coefficient computed as

$$\frac{S_{acq}S'_{tar}}{\sqrt{S_{acq}S'_{acq}}\sqrt{S_{tar}S'_{tar}}}, \tag{1.15}$$

where the vector $S_{acq} = (S_{acq,1}, \ldots, S_{acq,K})$ captures the scope of innovation activity for the acquirer, the vector $S_{tar} = (S_{tar,1}, ..., S_{tar,K})$ captures the scope of innovation activity for the target firm, and $k \in (1, K)$ is the technology class index. $S_{acq,k}(S_{tar,k})$is the ratio of the number of patents awarded to the acquirer (the target firm) in technology class k with application years from ayr-3 to ayr-1 to the total number of patents awarded to the acquirer (the target firm) in all technology classes applied over the same three-year period.

The knowledge base overlap is defined following Bena and Li (2014). The first step is to determine the set of patents that received at least one citation in any of the acquirer's patents with award years from ayr-3 to ayr-1 ("the acquirer's knowledge base"), the set of patents that received at least one citation in any of the target firm's patents awarded over the same three-year period ("the target firm's knowledge base"), and the intersection of these two sets (the set of patents cited by both the acquirer and the target firm–"the common knowledge base"). I then compute the number of patents in "the common knowledge base."

The acquirer's (target's) base overlap is defined following Bena and Li (2014). The first step is to compute the number of citations from any of the acquirer's (target firm's) patents with award years from ayr-3 to ayr-1 made to the patents in "the common knowledge base." Second, I scale the number from the first step by the number of citations from any of the acquirer's (the target firm's) patents with award years from ayr-3 to ayr-1 made to the patents in "the acquirer's knowledge base" ("the target firm's knowledge base").

Table 1, Panel B reports the descriptive statistics of the M&A sample. The average acquirer CEO TFE is 0.80, which is slightly lower than the firm-CEO sample. The average technological proximity is 0.044 with a median of 0. The average acquirer technological overlap is 0.044 with a median of 0. The average target technological overlap is 0.038 with a median of 0. In the sample of M&A deals, on average 0.044 of the deals have positive proximity. 0.046 of the deals have positive acquirer (target) technological overlap. 15.3% of the deals occur between acquirers and targets within the same industry (same SIC 2-digit code).

I then estimate the following equations:

$$\text{Technology linkage}_{i,t+2} = \alpha_i + \beta \cdot \text{Acq TFE}_{j,t} + \gamma \cdot X_{j,t} + \delta \cdot Y_{i,t} + \eta_i + \delta_t + \epsilon_j. \quad (1.16)$$

[Insert Table 10]

Table 10 reports the regression results between acquirer CEO individualism and innovation similarity. The dependent variable in column (1) is the technology proximity. The dependent variable in column (2) is an indicator variable that equals one if the technology proximity is positive. The dependent variables of columns (3) and (4) are the ratios of knowledge base overlap scaled by the target and acquirer knowledge base, respectively. The dependent variable of column (5) is an indicator variable that equals one if the pair of firms have the same 2-digit SIC code. The dependent variable of column (6) is the daily cumulative abnormal return around the announcement day of acquisition. Control variables include acquirers' firm size, R&D expenditures, and capital expenditures. Acquirer and year fixed effects are included in columns (1)-(6). Standard errors are clustered at the acquirer level. The negative coefficients estimated in columns (1)-(4) support my hypothesis that individualistic CEOs pursue new knowledge by acquiring firms with less technological similarity. The estimation coefficient in (5) shows that individualistic CEOs have more diversifying acquisitions. After the diversifying M&As, individualistic CEOs do not actively reallocate the assets, so the overall conglomerate diversification does not increase. But such M&As can help broaden the technology base and improve the originality and generality of the patents produced by the firm. Further, these activities can also be value-destroying, and the estimation coefficient in column (6) shows that the announcement CARs are significantly lower.

1.10 Conclusion and Discussion

The culture literature posits a positive relationship between individualism and innovation on a national level. This chapter provides firm-level evidence of how CEO individualism affects innovation output. Using the frontier experience of CEO birthplaces to proxy for individualism, I establish a positive relation between CEO individualism and corporate innovation. The association is not driven by alternative explanations, including risk-taking, overconfidence, founder status, managerial incentives, general ability index, and management team quality. Difference-in-difference estimations that exploit CEO turnovers provide supportive evidence for the causality argument.

I find three mechanisms in corporate management to explain the findings: employee work-life balance, innovative corporate culture, and failure tolerance. Individualistic CEOs allow more flexibility to employees, promote an innovative corporate culture, and maintain low internal capital reallocation. This management is effective in motivating employees and other managers to be explorative. The positive relation between CEO individualism and innovation is more pronounced for firms in a creditor-friendly legal environment. Individualistic CEOs tend to acquire target firms with low technological similarity.

Individualistic CEOs increase corporate innovation, which improves firms' financial health and long-term performance. However, the impact cannot directly translate to short-term performance for the following reasons. First, although the patents produced have higher market value as shown in Table 5, Panel C, firms cannot fully appropriate the economic value due to knowledge spillovers and imperfect protection of intellectual property rights. Second, individualists are good at early-stage inventions, but collectivists are good at finishing up the production process and transferring the inventions to profits (Gorodnichenko and Roland, 2011). Third, individualists care less about harmony and efficiency. Therefore, the management of individualistic CEOs includes inefficient decisions, e.g. less pressure on employees, lower resource reallocation within the conglomerate, and value-destroying acquisitions. Hence the overall impact of CEO individualism on firm performance is inconclusive, and this chapter solely focuses on the early stage of innovation (filing patents).

Similarly, CEO individualism can hardly affect overall corporate risk-takings and volatility. On the one hand, innovation activities are risky and costly. On the other hand, successful innovation can improve the firms' financial stability. Moreover, firm risk can also be reduced by other decisions including diversifying acquisitions. Unlike other CEO characteristics which increase innovation through risk-taking, cultural individualism has a mixed impact on firm risk.

Chapter 2

BOARDROOM COMMUNICATION WITH OUTSIDE DIRECTORS

2.1 Introduction

The board plays an essential role in shaping the decisions and policies made by the firm. The advisory from outside directors is particularly important given that their diverse expertise can help firms with decision-making. On the one hand, literature (Adams and Ferreira, 2007) emphasizes the importance of directors' advisory. Dass *et al.* (2014); Cai and Sevilir (2012); Chang and Wu (2021) emphasize the benefit of the outside directors' valuable information. Further, Malenko (2014) and Carter and Lorsch (2003) show that effective communication can enhance coordination and is key to firm success. On the other hand, Duchin *et al.* (2010) question the effectiveness of outside directors, Chhaochharia and Grinstein (2007) show that board dependence can sometimes harm the firm value, and Matsusaka (2017) expresses the concern that higher board independence may expose the firm to higher competition. In this chapter, I develop a model to study when are the outside directors beneficial. Specifically, I focus on the directors' advising role to show how the optimal board structure can depend on information transmission through communication.

There are two types of directors in the model: inside (he) and outside (she) directors. I define outside directors as those who are related to potential competitor firms. Outside directors can be independent directors and interlocking directories. The presence of outside directors can also be achieved by social networks, outside employment, and human capital mobility. Outside directors can bring valuable advice and cause information leakage to potential competitors.[1] A recent reveal of emails between Steve Jobs and Adobe CEO Bruce Chizen reveals that recruiting managers and employees from competitor firms is one of the top concerns of the firms.[2] This model focuses on the directors' advisory role and features two directions in information transmission: valuable advice and information leakage.

I study a two-period model ($t = 0, 1$) using the random-dictator rule (Malenko, 2014) in the decision-making process. The model has two pairs of trade-offs. The inside director faces the first trade-off at $t = 1$, assuming there is an outside director on the board. The inside director needs to determine whether to disclose his information during the communication. If he communicates his observation, the firm receives better advice and is subject to a potential loss from future competition due to information leakage. The firm decides whether to have outside directors on the board at $t = 0$. The second trade-off is between the outside director's valuable advice versus the cost of having her. The cost can be either information leakage or the inside director's reluctance to communicate in the presence of the outside director. The model produces three equilibria: the firms (i) have no outside directors, (ii) have the outside directors and the inside directors do not communicate their information, and (iii) have the outside directors and the inside directors communicate with them.

[1] For example, a former Google employee Anthony Levandowski has pleaded guilty to stealing company trade secrets related to Google self-driving technology and later joining Uber. "Former Uber Executive Pleads Guilty to Trade Theft," New York Times, March 1, 2020. Also, "Vanguard Logistics Services (USA) Inc accused Fraser Robinson of conspiring with another former Uber executive to steal algorithms, data, and other intellectual property in 2018 to create their "copycat" London-based company, Beacon Technologies Ltd."

[2] Steve Jobs and Bruce Chizen argued about whether to recruit employees from each other. Between Apple and Adobe, the recruitment of top managers are explicitly excluded according to their emails.

When the outside director's information is less valuable than the cost of having outside directors, it is optimal for the firm to have (i). When the outside and the inside directors' information is more valuable than the cost of information leakage, it is optimal for the firm to have (iii). When the value of outside inside director's information and the cost of information leakage is higher than the value of the inside director's advice, it is optimal for the firm to have (ii).

This model has the following implications. First, it shows that the information characteristics are important determinants for optimal board structure and communication. Existing literature (Adams and Ferreira, 2007; Harris and Raviv, 2005, 2008) focuses on board members' monitoring and controls. This model solely focuses on the directors advise roles. Moreover, Ferreira *et al.* (2011) study how the information environment can affect the board structure. Armstrong *et al.* (2014) show how board structure can affect corporate governance. This model shows that board structure and communication are both determined by the information characteristics. Although information transmission is typically prohibited by the confidentiality and non-disclosure agreements, new businesses often replicate or modify ideas from others (Bhide, 2003). Knowledge and ideas are not always material information, and the loss from information leakage can be substantial. The protection of ideas and other intellectual property is especially difficult given the high mobility of human capital (Babina, 2020) and large social and professional networks. Therefore, understanding how the information transmission can affect corporate governance is a firms' priority concern when intangible assets are highly valuable.

Second, the model shows that firms with different characteristics can react differently to external changes. For example, an exogenous increase in the presence of outside directors only discourage communication for firms whose costs from information leakage are huge. The increment in board outside directors can improve the performance of firms that benefits more from their advice while hurting the firms that are sensitive to information leakage. As the market competition increases, some firms will still keep the outside directors and reduce the communication. However, other firms may exclude outside directors from their boards. The key to reconciling the different predictions is to improve the knowledge about firms' information characteristics. These characteristics include the value of the inside and outside directors' advice and the cost of potential information leakage. These important determinants are challenging to measure empirically and are understudied in existing theoretical models. But these characteristics play an important role in shaping the modern corporate boards and governance.

The third implication is about the combination of board structure and communication. On the one hand, regulations require a higher presence of independent directors, and social networks increase the outside directors through the connection to competitor firms' management teams. Human capital mobility exacerbates the information spillover. On the other hand, governance experts keep emphasizing the importance of open communication, and investors command transparency. Failing to consider the board structure and communication together will falsely encourage all firms to hire outside directors and communicate with them. Some firms will get hurt if outside directors and communication are both enforced. For example, explorative innovation comes from firms at an early stage of their life cycles. These firms usually have difficulties competing with their mature and large counterparts.[3] Excluding outside directors and shutting down communication can be two protections against competitions from information leakage. Forcing all firms to include outside

[3] Large and mature firms have better platforms to promote their products. For example, Airtag and Tile use similar technology, but Airtag can be connected to Apple services and devices. Large and mature firms also have better legal teams and can easily protect themselves from the competition.

directors and communicate with them will cause an increase in market concentration, discourage innovation from young firms, and decrease social welfare.

The chapter proceeds as follows. Section 2.2 literature review. Section 2.3 model descriptions. Section 2.4 empirical predictions and applications. Section 2.5 concludes and discusses.

2.2 Literature

This chapter contributes to the following literature. First, it contributes to the literature on board structure and corporate governance. Demsetz and Lehn (1985); Hermalin and Weisbach (1988, 1998); Adams *et al.* (2010); Coles *et al.* (2012) show that the corporate board structure is affected by many factors. Adams and Ferreira (2007) study the substitution between board monitoring and advising roles. Harris and Raviv (2005, 2008) study the directors' control and decision-making. This chapter focuses on the advisory role of directors and studies how information transmission can affect the corporate board structure.

Second, it contributes to the literature on communication. Malenko (2014) studies how to open ballot voting can improve boardroom communication. Chemmanur and Fedaseyeu (2018) analyze the coordination and communication in the corporate board. This model shows how communication can be affected by the information related firm characteristics and directors' advisory. Different from the existing papers, my model shows that communication can sometimes hurt firms' value, and it needs to be endogenized with the board structure.

Third, the chapter contributes to the literature on corporate connectedness and information spillover. Cai and Sevilir (2012) show that board connections can benefit the M&A decisions made by the firm. Dass *et al.* (2014) show that directors from related industries can improve the firm's information advantage. Chang and Wu (2021) show that the board network can improve corporate innovation. However, human capital mobility is associated with a certain extent of information spillover Babina (2020). As firms encourage hiring inventors and technicians as board members, such concern also exists among the management teams. Matsusaka (2017) expresses that higher board independence may expose the firm to higher competition. This pressure makes the other board members reluctant to disclose their information and contributes to the environment where directors feel less comfortable expressing their views freely. In a similar vein, Huang *et al.* (2021); Allen *et al.* (2022) address concerns from other aspects of information spillover. This model characterizes how corporate boards react to the changes in the information environment and connectedness. The model sheds light on corporate governance for new businesses and the innovative sectors.

2.3 Model

2.3.1 Model Overview

The board consists of two types of directors. I simplify them to two directors, one inside director (he) and one outside director (she). The first tradeoff is faced by the inside director who needs to determine whether to reveal his privately observed information to the outside director. If he discloses, the firm receives higher-quality advice but is subject to a possible future loss from information leakage. The second tradeoff is faced by the firm when determining whether to allow outside directors in the first place. The tradeoff is better advising from outside directors versus the cost of (i) loss from the information leakage or (ii) strategic disclosure of the inside directors. I show that both the board structure and the boardroom communication can also be affected by the primitives. The model predicts three outcomes: (1) the board has no outside director; (2) the board has the outside director, and the inside director does not communicate; and (3) the board has the outside director, and the inside director communicates.

2.3.2 Model Setup

I adopt the firm value and information structure from Harris and Raviv (2005); Adams and Ferreira (2007); Harris and Raviv (2008); Malenko (2014). The firm value is equal to

$$V(a, \theta) = -(a - \theta)^2 - c \cdot D_I.$$

a is the action chosen by the board, and θ is the random the future state. Let $\{x_I, x_O\}$ be the private signals observed by the inside and outside directors, respectively. x_I and x_O are independently distributed on compact supports Ω_I and Ω_O. The real-world outcome θ can be decomposed as

$$\theta = x_I + x_O + \varepsilon.$$

where x_I and x_O are independent and ε is some noise with $E[\varepsilon] = 0$. The future outcome is reflected by internal information and external information. The inside director observes x_I, and the outside director observes x_O. Let σ_I^2, σ_O^2 be the variances of x_I and x_O, respectively. Hence σ_I^2, σ_O^2 are the potential value of information by the two directors. If they disclose their observation, then the firm makes an accurate decision. The reduction of the variance in the quadratic form represents the value of information. The ε is some noise with a mean zero.

c is the potential loss from future competition. I define $D_I(D_O)$ to be the indicator variables that equal to one if the inside (outside) director discloses his (her) information.

Decision making

I assume there is no fixed decision-maker and the board members make the decision collectively.[4] With probability q, the decision will be made by the outside director. And with probability $p = 1 - q$, the decision will be made by the inside director. Denote a_I, a_O be the decisions or actions for the inside and outside director, respectively. Combined with this decision rule, the firm value is equal to

$$V(a_I, a_O, \theta) = -(1-q)(a_I - \theta)^2 - q(a_O - \theta)^2 - c \cdot D_I.$$

Power or control of the directors (board structure q henceforth)

p, q are the probabilities that the inside director and the outside director are the decision-makers, respectively. p can be interpreted as the power of the inside director, and q is the power of the outside director. Whoever gets the control has higher power, as discussed in Harris and Raviv (2008). q can also be viewed as the proportion of outside directors if there are more than two directors on the board. The potential value of the outside director's information is related to q. Duchin *et al.* (2010) argues that the outside directors face a cost in acquiring information. Although the definition of the outside director is different in this context, the cost of acquiring information exists. I assume the higher power of the outside director q is associated with the higher potential value of information brought by her. If q stands for the proportion of outside directors, then higher q means more outside directors, hence the board is more knowledgeable about the external environment.[5] In the extreme case where $q \approx 1$,[6] the maximum potential value of the outside director is represented by σ^2 and

[4] See Malenko (2014) about the "random dictator" rule.

[5] Throughout the chapter I treat the board size as a constant.

[6] $0 \leq q < 1$, and q is as large as possible, close to 1

I scale $\varepsilon^2 = 0$. If $q = 0$, then $\varepsilon^2 = \sigma^2$ where σ^2 is the total uncertainty of external environment $x_O + \varepsilon$. For simplicity, let $\sigma_O^2(q) = q\sigma^2$ and $\varepsilon^2 = (1-q)\sigma^2$. The value of the inside director's information is a constant σ_I^2.

Utilities and conflict

The inside director's utility is identical (a constant multiplier is ignored here) to the firm value since he only receives compensation from the firm value, i.e.

$$U_I = -p(a_I - \theta)^2 - q(a_O - \theta)^2 - c \cdot D_I.$$

The outside director gets compensated from both the firm and its (future) competitor. The optimized decision for the firm may hurt the competitor firm's value, hence does not optimize the outside director's value. Let b be the bias from the competition. Her utility is equal to

$$U_O = -p(a_I - \theta - b)^2 - q(a_O - \theta - b)^2.$$

Timeline

The timeline is as follows: both directors observe their private information. Then there is one round of communication, where the directors choose the D_I, D_O simultaneously. Then they choose their actions. The final decision is made by the inside (outside) director with probability p (q). Payoffs are realized.

Proposition 1. *The outside director always discloses her observation.*

This proposition shows that the sender (outside director) will benefit from disclosing her observations since there is no loss for her and the firm receives better advice.

Proposition 2. *The inside director discloses when $q \cdot \sigma_I^2 > c$ and does not disclose when $q \cdot \sigma_I^2 < c$.*

The intuition is straightforward. If $c > q \cdot \sigma_I^2$, then the benefit from the inside directors' advising does not exceed the cost from information leakage. Hence the inside director will not disclose his information. However, if the inside directors' advising is valuable, he would like to disclose it despite the potential loss from future competition.

Proofs of Proposition 1 and 2 are in Appendix.

2.3.3 Optimal Board Structure q^* and Communication

Equilibrium

Definition 2.3.1. *For a set of given $(b, c, \sigma_I^2, \sigma^2)$, the set (q, D_I, D_O) is an equilibrium if*

- *$q \in [0, 1)$ maximizes the firm value $V(q)$, and*
- *$D_I = \phi$ if $q = 0$,[7] and $D_I \in \{0, 1\}$ if $q > 0$.*
- *Given q, D_O is chosen such that the inside director maximizes $E_\theta[u_O]$, and*
- *Given q, D_I is chosen such that the inside director maximizes $E_\theta[u_I]$.*

By Proposition 1, $D_O = 1$, i.e. the outside director always discloses her observation. Simple calculation shows that the expected firm value is

$$\begin{aligned} V(q) &= -qb^2 - c \cdot D_I - (1 - D_I)q\sigma_I^2 - \varepsilon^2 \\ &= -qb^2 - c \cdot D_I - (1 - D_I)q\sigma_I^2 - (1 - q)\sigma^2 \end{aligned}$$

[7] In the absence of outside director, it doesn't matter whether the inside director discloses or not.

Next I solve for the optimal board structure q^* to maximize the firm value. Denote $q^D \equiv \frac{c}{\sigma_I^2}$. By Proposition 2, if $q < q^D$ then $D_I = 0$. If $q > q^D$, then $D_I = 1$.

Proposition 3. *q^* is determined as follows:*

1. *If $\sigma_I^2 < \min\{\sigma^2 - b^2, c\}$, then $0 < q^* < 1$ and $D_I = 0$.*

2. *If $c < \min\{\sigma_I^2, \sigma^2 - b^2\}$ then $0 < q^* < 1$, and $D_I = 1$.*

3. *If $\sigma^2 - b^2 < \min\{c, \sigma_I^2\}$ then $q^* = 0$.*

Proof of Proposition 3 is in Appendix.[8]

Interpretation

When determining D_I, the inside director faces a tradeoff between the value of his advice and the cost of information leakage. If the inside director does not disclose and the decision is made by the outside director, the firm value is decreased by $-\sigma_I^2$. q^D is the cutoff that the inside director discloses or not.

Back to the stage of determining the board structure q, the firm faces a tradeoff between the (net) value of information brought by the outside director ($\sigma^2 - b^2$) and the cost. The cost is either the cost c by information leakage or the loss of the inside director's information σ_I^2 when he is reluctant to disclose.

In Proposition 3, (1) states the case where both the net value of outside director ($\sigma^2 - b^2$) and the cost of disclosure c exceed the inside director's value of disclosing. Therefore it is valuable for the firm to have the outside director but the inside director will not communicate. The cost of information leakage is high, too. But the lost from

[8]If $0 < 1^* < 1$, then denote $q^* = 1 - \underline{\varepsilon}$. The infinitesimal $\underline{\varepsilon}$ is to avoid the corner solution. In the case where $\underline{\varepsilon}$ cannot be arbitrary small, the proposition is stated in Appendix. This case does not affect the intuition but makes the analysis complete.

the inside director's reluctance of disclosure is low. (2) states the case where both the net value of outside director and the inside director's value of information exceed the cost of information leakage c. Therefore it is valuable for the firm to have the outside director and communicate. The cost of information leakage is low, and the inside director's disclosure is valuable. (3) states that both the cost of information leakage c and the inside director's value of information exceeds the net value of the outside director. In this case, the firm will not have the outside director.

2.4 Applications

This section shows the empirical applications based on the model. The first application is about the impact of increasing the outside directors. The second application is about the impact of increasing market competition and costs from information leakage. Both applications produce different results for firms with different characteristics. The third application focuses on the combination of outside directors.

2.4.1 Impact of Increasing Outside Directors

Regulations such as SOX have required an exogenous increase of independent (outside) directors. Enhanced network connections also increase the number of outside directors on the board. According to the model, such changes can generate different results on the corporate board. If $\sigma^2 - b^2 < \min\{c, \sigma_I^2\}$, then the firm are force to pursuit the sub-optimal equilibria $0 < q^* < 1$ and $D_I \in \{0, 1\}$. If $c > \sigma_I^2$, then the inside directors need to stop communicating to prevent further loss. If $c < \sigma_I^2$, then the inside directors will communicate. In either case, the firm value is lower than the case of no outside directors. If $\sigma^2 - b^2 > \min\{c, \sigma_I^2\}$, then the firm will not be affected.

2.4.2 Impact of Increasing Market Competition and Loss from Information Leakage

Despite the many advantages of board connectedness, information leakage is also a critical concern for modern businesses (Babina, 2020; Huang *et al.*, 2021; Allen *et al.*, 2022). The rise of market competition and innovation spillover increases the cost of information leakage c. An increase in c can have two possible impacts. (1) $\sigma_I^2 < \sigma^2 - b^2$, $q^* > 0$ and $D_I = 1$. As c increases, the firm will still have $q^* > 0$, but D_I becomes 0. In this case, the board still likes to have the outside directors' advice but will reduce the communication. The cost c does not change board structure but decreases the corporate transparency. (2) $\sigma^2 - b^2 < \sigma_I^2$, $q^* > 0$ and $D_I = 1$. As c increases, the firm will have $q^* = 0$. In this case, the board will exclude the outside directors. Therefore, the cost c changes the board structure.

2.4.3 The Combination of Outside Directors and Communication

Regulations require a higher presence of outside directors, and social networks increase the connectedness of corporations through management teams. Human capital mobility exacerbates the information spillover. At the same time, if corporate managers and experts encourage open communication, then the firms with $\sigma^2 - b^2 < \sigma_I^2$ or $\sigma^2 - b^2 < c$ will suffer the losses from information leakage. Therefore, the combination of outside directors and communication can be detrimental for firms that are sensitive to information loss or have difficulty realizing the value of outside directors' advice.

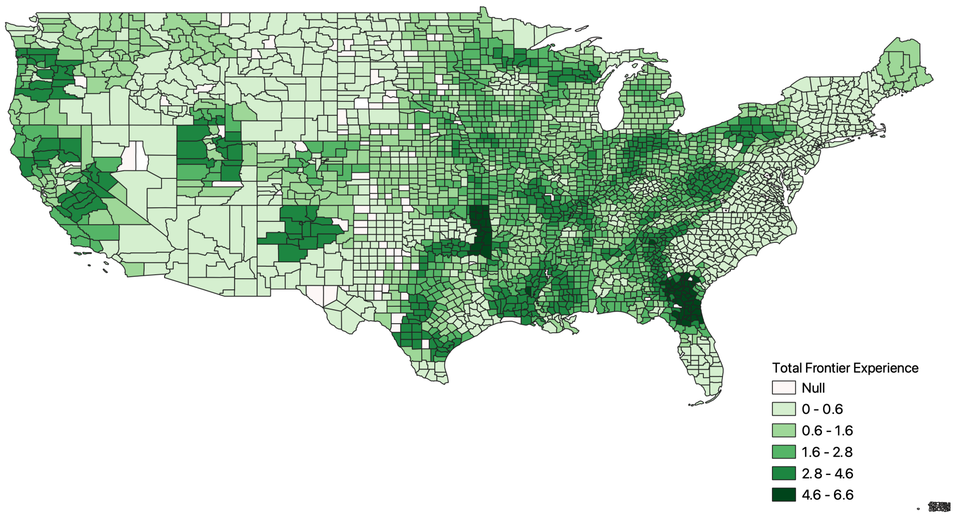
2.5 Conclusion and Discussion

In this chapter, I develop a model of boardroom communication with outside directors. I explicitly characterize the conditions for the optimal board structure and communication strategies. The inside directors' communication strategy depends on the trade-off between their better advice to the firm and information leakage. The presence of outside directors depends on the trade-off between outside directors' valuable information and the cost of inside directors' strategic communication.

The model produces several implications. First, the information environment and the directors' advisory role are important determinants for board structure and communication. Second, firms that differ in information characteristics react to changes in corporate governance differently. Third, outside directors and communication can be both beneficial to firms in separate studies. But communicating with outside directors can be detrimental to some firms.

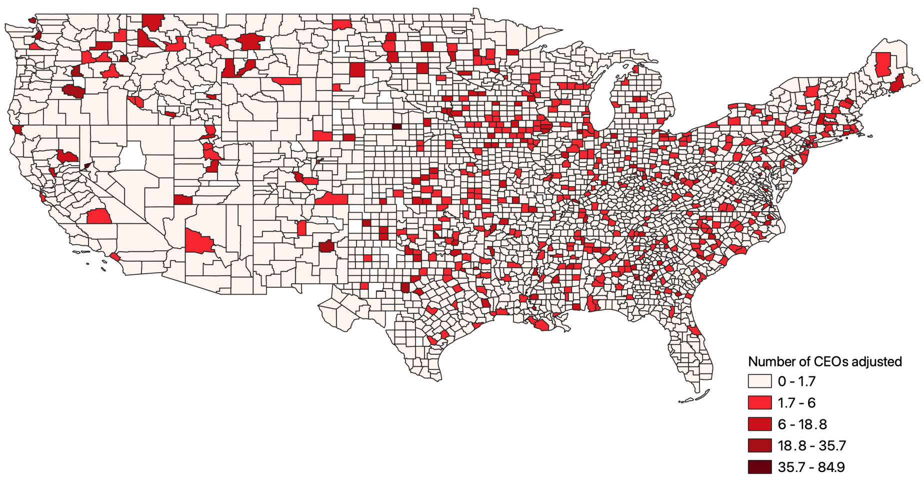
The model has several extensions. First, the simple disclosing strategy is far from realistic. Frameworks including cheap-talk (Crawford and Sobel, 1982) and Bayesian persuasion (Kamenica and Gentzkow, 2011) can be useful in modeling communication. Neither framework can change the core trade-offs in the base model, and the conclusions are robust to different models. A second extension would be incorporating the monitoring role of the directors. It is interesting to understand the interaction between the directors' monitoring and advising roles. A third extension is the costly communication model. In the simple model, the outside directors always communicate. However, there exist various costs for both directors' advisory. The model with costly communication can produce richer implications.

Figure 1: Distribution of TFE



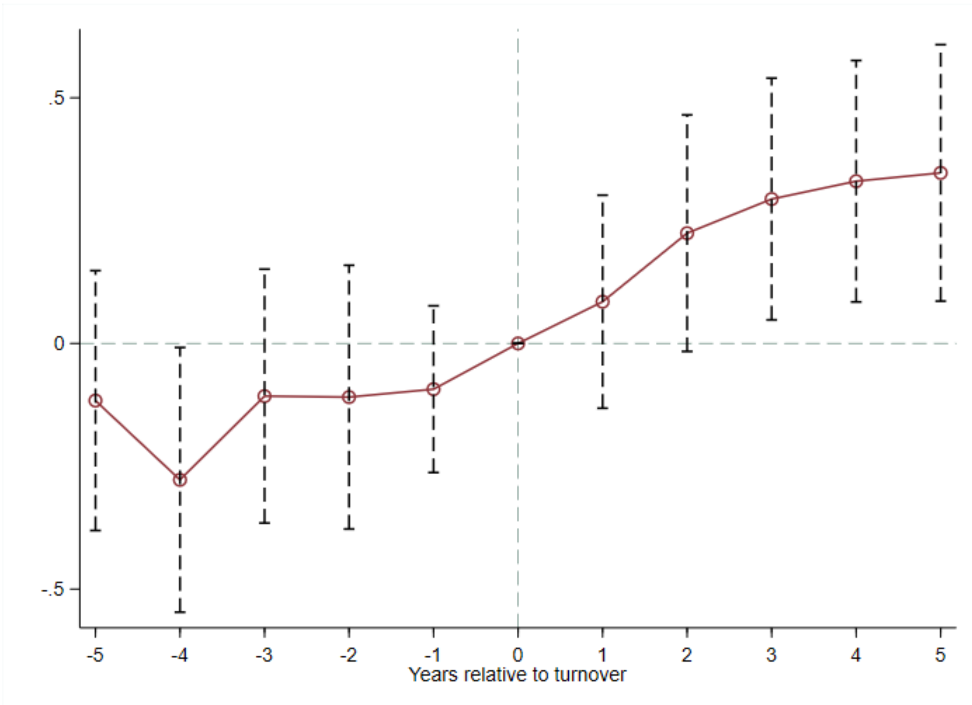
The figure shows the spatial distribution of total frontier experience and the number of CEOs in the sample.

Figure 2: Distribution of CEO



The figure shows the spatial distribution of the number of CEOs scaled by historical average population $\times 10^5$ in the sample.

Figure 3: Innovation Around CEO Turnovers



This figure displays the OLS regression coefficients β_k and 95% confidence intervals estimated from the following model: $\log(1 + \text{number of patents})_{i,t+1} = \alpha_i + Z_{i,t} + \Sigma\ \beta_k \times \text{treat} \times \Delta\text{year} + \eta_i + \zeta_{t,ind_i} + \epsilon_j$. Here Δyear is the difference between year t and the turnover year. The graph shows estimated β_k for $\Delta\text{year} \in [-5, 5]$ years around the turnover. $Z_{i,t}$ is the set of firm controls, including size, R&D expenditures and capital expenditures. Treat is a dummy variable that equals to one if the replacement CEO is more individualistic than the departing CEO. η_i is the firm fixed effect. ζ_{t,ind_i} is the year-industry fixed effect. Standard errors are clustered at the level of managers.

Table 1: Descriptive Statistics

Panel A: Firm-CEO sample

	Obs.	Mean	Std.Dev.	P10	P50	P90
CEO characteristics						
Total frontier experience (TFE)	14,772	0.841	1.120	0	0.500	2.500
Hofstede score	8,267	77.15	13.61	67	80	89
College distance	8,959	610.3	917.9	0	229.0	1,895
Out-of-state college	8,966	0.532	0.499	0	1	1
Female CEO	14,772	0.0244	0.154	0	0	0
CEO age	14,555	57.13	8.438	47	57	67
Tenure	13,667	8.695	8.330	1	6	20
Degree (doctoral = 3; master's= 2; bachelor's = 1; other = 0)	9,015	1.759	0.815	1	2	3
Ivy League degree	9,015	0.333	0.471	0	0	1
General ability index (GAI)	8,158	0.187	1.037	-1.033	0.0618	1.542
Overconfidence	14,772	0.0934	0.291	0	0	0
Founder	6,637	0.179	0.384	0	0	1
Delta	14,179	1,142	2,253	36.87	344.6	2,732
Vega	14,136	180.6	269.3	0	66.00	512.5
Management team quality						
Team size	7,864	9.001	3.114	5	9	13
Team MBA	7,864	0.346	0.198	0.100	0.333	0.600
Team PhD	7,864	0.0345	0.0719	0	0	0.125
Team network	7,862	2,113	1,322	661.3	1,853	3,872
Team experience	7,864	0.548	0.281	0.125	0.583	0.889
Team average tenure	7,864	5.156	2.748	1.800	4.909	8.917
Innovation variables (at t+2)						
Number of patents	4,602	131.5	424.7	1	18	272
Number of citations	4,445	2,313	8,590	8	209	4,555
Number of adjusted citations	4,445	112.9	373.0	0.706	14.16	231.4
Proportion of tail (top 5%) innovation	4,445	0.0548	0.145	0	0	0.158
Proportion of tail (top 1%) innovation	4,445	0.0112	0.0616	0	0	0.0118
Log of (1+number of patents)	5,007	3.131	1.804	0.693	2.944	5.613
Log of (1+number of citations)	4,836	5.331	2.347	2.197	5.354	8.430
Log of (1+number of adjusted citations)	4,836	2.893	1.865	0.534	2.739	5.449
Originality	4,429	0.567	0.136	0.415	0.578	0.720
Generality	4,445	0.364	0.243	0	0.424	0.645
Market value of patent	4,170	1,959	6,146	6.545	216.2	4,614
Market value of patent scaled by R&D	3,348	8.644	2.618	5.072	8.921	11.86

Panel A (continued): Firm-CEO sample

	Obs.	Mean	Std.Dev.	P10	P50	P90
Culture variables						
Innovation corporate culture	7,017	1.843	1.206	0.719	1.535	3.343
Document length	6,415	14,037	6,901	4,563	14,431	22,798
Glassdoor variables						
Work-life-balance rating (t+1)	3,142	3.259	0.663	2.500	3.253	4
Compensation and benefits rating (t+1)	3,142	3.180	0.605	2.500	3.174	3.983
Number of evaluations	2,744	124.8	334.9	2	25	307
Firm characteristics						
Total assets	14,686	29,784	133,102	343.2	4,096	47,143
Employment	14,505	33.98	76.70	1.265	10.60	82
Capital expenditures	13,973	0.0538	0.0492	0.00646	0.0414	0.113
R&D expenditures	14,666	0.0333	0.0864	0	0	0.110
Firm age	14,722	30.29	16.96	9	29	54
Number of segments	13,556	2.602	1.679	1	2	5
Stock return volatility (t+2)	13,112	0.0216	0.0138	0.00978	0.0181	0.0371
Idiosyncratic volatility (t+2)	13,112	0.0199	0.0129	0.00892	0.0166	0.0341
Number of announced acquisitions (t+2)	4,509	2.747	2.777	1	2	6
Number of effective acquisitions (t+2)	3,657	3.053	2.761	1	2	6
Creditor-friendly	6,116	0.0352	0.184	0	0	0
Conglomerate variables (Number of segments ≥ 1						
Internal asset reallocation (t+1)	1,488	0.0312	0.434	0	0	0.0481
Conglomerate diversification (t+1)	8,344	2.335	1.070	1.172	2.048	3.839
Internal asset reallocation (t+2)	1,648	0.0278	0.412	0	0	0.0425
Conglomerate diversification (t+2)	7,924	2.335	1.088	1.136	2.055	3.858

Panel B: M&A sample

	Obs.	Mean	Std.Dev.	P10	P50	P90
Technological proximity	16,318	0.0438	0.204	0	0	0
Proximity indicator	16,318	0.0439	0.205	0	0	0
Acquirer technological overlap	16,318	0.0369	0.187	0	0	0
Target technological overlap	16,318	0.0381	0.188	0	0	0
Overlap indicator	16,318	0.0463	0.210	0	0	0
Same industry indicator	16,318	0.153	0.360	0	0	1
Acquirer CEO TFE	16,318	0.802	1.097	0	0.400	2.600
Acquirer R&D	16,317	0.0646	2.422	0	0.00110	0.136
Acquirer capital expenditures	15,363	0.0492	0.0508	0.00595	0.0364	0.100
Acquirer total assets	16,318	72,918	237,826	648.6	8,607	121,271

Table 2: TFE and CEO Firm Characteristics

This table shows the comparison of TFE for different subsamples. I split the sample into subsamples using CEO and firm characteristics and compare the average TFE for each subsample. CEO characteristics include the Hofstede culture individualism score calculated following Liu (2016) and Pan *et al.* (2020), the distance between hometown and college, a dummy variable whether the CEOs obtain the Ivy League degrees, network size, and total compensation (TDC). Firm characteristics include the firm size and the management team network size. The high Hofstede cultural individualism score and longer college distance subsample have a higher average TFE, indicating a positive correlation between TFE and these characteristics. CEOs who have Ivy League degrees, larger networks, and higher compensations tend to have less TFE on average. CEOs in large firms or surrounded by management teams with large networks tend to have lower average TFE.

	Average	TFE	T-Test	
Split sample by X	High X	Low X	High minus Low	p-value
X = Hofstede score	0.881	0.746	0.135	0.000
X = College distance	0.873	0.803	0.070	0.001
X = Ivy League degree	0.776	0.915	-0.139	0.000
X = CEO network size	0.831	0.868	-0.037	0.075
X = Team network size	0.795	0.967	-0.172	0.000
X = Firm size	0.798	0.885	-0.087	0.000
X = TDC	0.790	0.893	-0.103	0.000

Table 3: Innovation and CEO Individualism: OLS Estimation

Panel A reports the regression of innovation on the CEO's total frontier experience (TFE). Measures of innovation are the logarithm of one plus the total number of patents at year (t+2); logarithm of one plus the total number of citations at year (t+2); logarithm of one plus the total number of citations adjusted by the year-patent class average of the year (t+2). Columns (1) and (4) report the regression results for the number of patents, columns (2) and (5) report the regression results for the number of citations, and columns (3) and (6) report the regression results for the adjusted number of citations. Control variables include CEO characteristics: log CEO age, female indicator, and log tenure. Firm characteristics include firm size, capital expenditures, R&D expenditures, and the logarithm of firm employment. Firm fixed effect and year fixed effect are included in columns (1)-(3). Firm and industry-year fixed effects are included in columns (4)-(6), and standard errors are clustered at the manager level. Panel B excludes the alternative explanations of the impact of CEO individualism on innovation. CEO and firm controls are identical to Panel A. The dependent variable is the logarithm of the number of patents in the year (t+2). The result is robust to using citations as dependent variables. Column (1) controls CEO education, including the highest degrees obtained and a dummy variable of Ivy League degrees. Column (2) controls for CEO overconfidence. Columns (3) controls for the logarithm of Delta and Vega. Column (4) controls for an indicator that the CEO is the firm founder. Column (5) controls for the general ability index (GAI) from Custódio *et al.* (2019). Column (6) controls for the management team quality calculated following Chemmanur *et al.* (2019). Firm and year fixed effects are included in all columns. Standard errors are clustered at the manager level. Panel C reports the estimation of Panel A using Hofstede cultural score as an alternative measure of CEO individualism. The dependent variables, control variables, and fixed effects are identical to Panel A. Standard errors are clustered at the manager level. In all panels, T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Individualism and innovation output

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
TFE	0.092***	0.120***	0.089**	0.098***	0.135***	0.096**
	(3.628)	(2.936)	(2.546)	(3.343)	(2.760)	(2.098)
Log CEO age	-0.006	-0.003	0.181	-0.181	-0.036	0.031
	(-0.027)	(-0.009)	(0.607)	(-0.675)	(-0.093)	(0.084)
Female CEO	-0.370**	-0.385**	-0.384***	-0.326*	-0.400*	-0.359*
	(-2.395)	(-2.247)	(-2.945)	(-1.894)	(-1.664)	(-1.779)
Log tenure	-0.082**	-0.090**	-0.092**	-0.073**	-0.082**	-0.086**
	(-2.532)	(-2.196)	(-2.424)	(-2.397)	(-1.964)	(-2.121)
Size	0.185***	0.202*	0.256***	0.254***	0.291**	0.315***
	(2.608)	(1.797)	(2.694)	(2.940)	(2.384)	(2.956)
R&D expenditures	0.061	-0.566	-0.074	-0.231	-0.717	-0.291
	(0.106)	(-0.628)	(-0.097)	(-0.381)	(-0.718)	(-0.359)
Capital expenditures	0.510	0.207	0.190	0.494	0.926	0.672
	(0.703)	(0.205)	(0.222)	(0.716)	(0.899)	(0.784)
Log firm age	-0.146	-0.272	-0.074	-0.145	-0.280	-0.168
	(-1.045)	(-1.463)	(-0.445)	(-1.196)	(-1.615)	(-1.166)
Employment	0.460***	0.450***	0.359***	0.301***	0.256*	0.230*
	(5.726)	(3.244)	(3.253)	(2.760)	(1.720)	(1.785)
Observations	4,154	4,007	4,007	3,753	3,600	3,600
Adjusted R-squared	0.892	0.862	0.863	0.901	0.874	0.875
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE				Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Alternative explanations

	(1) log(patent) (t+2)	(2) log(patent) (t+2)	(3) log(patent) (t+2)	(4) log(patent) (t+2)	(5) log(patent) (t+2)	(6) log(patent) (t+2)
TFE	0.092***	0.092***	0.095***	0.094**	0.064**	0.061**
	(2.937)	(3.629)	(3.686)	(2.234)	(2.339)	(2.008)
Degree	0.003					
	(0.056)					
Ivy League degree	-0.010					
	(-0.128)					
Over-confidence		0.088				
		(1.512)				
Log Delta			0.002			
			(0.104)			
Log Vega			0.013			
			(0.745)			
Founder				0.352*		
				(1.890)		
General Ability Index					0.042	
					(1.226)	
Log team size						-0.239*
						(-1.717)
Team MBA						0.238
						(1.181)
Team PhD						0.126
						(0.201)
Log team network						0.155*
						(1.676)
Team experience						-0.145
						(-0.780)
Team average tenure						-0.019
						(-0.155)
Observations	3,199	4,154	4,038	1,901	3,025	2,393
Adjusted R-squared	0.892	0.892	0.891	0.919	0.909	0.912
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: Alternative measure of individualism.

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
Hofstede score	0.006*	0.011***	0.008**	0.007**	0.013***	0.010***
	(1.860)	(2.725)	(2.431)	(2.484)	(3.442)	(3.312)
Observations	3,285	3,188	3,188	2,906	2,819	2,819
Adjusted R-squared	0.895	0.875	0.872	0.902	0.888	0.885
CEO controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE				Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Difference-in-Differences Estimations Using CEO Turnover

This table reports results of difference-in-difference tests using a sample of non-performance-driven CEO turnover to generate variations of individualism. A firm is defined as "treated" ("control") if the replacement CEO has a higher (lower) TFE than the departing one. Panel A reports regression results on the raw sample of 355 turnovers, and the event window is [-3, -1] and [1, 3]. Dependent variables and control variables are identical to Table 3 Panel A. Columns (1)-(3) include firm and year fixed effects. Columns (4)-(6) include event and year fixed effects. Standard errors are clustered at the firm level. Panels B, C, and D report the estimation using propensity score matching. Panel B shows that the matched samples are similar in firm characteristics and the replacement CEOs' non-individualistic characteristics in the pre-turnover period. Panel C verifies the parallel trend assumption of innovation measures for the pre-turnover period. Panel D reports the difference-in-difference estimation on the matched sample. Columns (1)-(3) include firm and year fixed effects. Columns (4)-(6) include event and year fixed effects. Panel E reports the difference-in-difference estimation on the panel sample of M&A. I keep the deals that satisfy the conditions that (1) both acquirer and target CEOs' TFE are available, and (2) the acquirer CEOs replace the target CEO after the completion of the deal. The time window is three years before and after the completion. Dependent variables are the combined innovations of the acquirer and the target. Acquirer and year fixed effects are included in columns (1)-(3). Deal and year fixed effects are included in columns (4)-(6). Standard errors are clustered at the (acquirer) firm-level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Difference-in-differences on the raw turnover sample

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
Treat * Post	0.240**	0.365**	0.252*	0.253**	0.345**	0.241**
	(2.054)	(2.286)	(1.917)	(2.372)	(2.280)	(1.990)
Post	-0.026	-0.100	-0.027	0.037	-0.029	0.062
	(-0.277)	(-0.882)	(-0.280)	(0.201)	(-0.122)	(0.316)
Treat	-0.159	-0.374**	-0.240**			
	(-1.383)	(-2.546)	(-1.998)			
Observations	550	547	547	550	547	547
Adjusted R-squared	0.942	0.920	0.929	0.950	0.924	0.935
CEO controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes			
Event FE				Yes	Yes	Yes
Cluster by Firm	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Comparison of matched samples in pre-turnover period

	Size	R&D expenditures	Capital expenditures	Firm age	Degree	Ivy	Employment	CEO age
Control Mean	8.712	0.040	0.074	30.648	1.885	0.520	54.320	58.342
Treat Mean	8.839	0.031	0.070	32.980	1.928	0.440	77.432	59.654
Control -Treat	-0.127	0.009	0.004	-2.332	-0.043	0.080	-23.112	-1.312
T-test p-value	0.460	0.208	0.520	0.190	0.682	0.191	0.061	0.12

Panel C: Parallel Trends

Change in patents	Treat	Control	Control minus Treat	Control minus Treat
	mean	mean	Difference	p-value
t-3 to t-2	0.030	0.057	0.027	0.683
t-2 to t-1	0.045	0.000	-0.045	0.477
t-1 to t	0.056	0.034	-0.022	0.738
Change in citations				
t-3 to t-2	-0.135	-0.093	0.042	0.744
t-2 to t-1	0.001	-0.123	-0.124	0.285
t-1 to t	-0.026	-0.045	-0.019	0.880
Change in adjusted citations				
t-3 to t-2	-0.041	0.022	0.063	0.502
t-2 to t-1	0.044	-0.035	-0.079	0.382
t-1 to t	0.044	0.013	-0.031	0.745

Panel D: Difference-in-differences test using matched samples

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
Treat * Post	0.453***	0.708***	0.561***	0.482***	0.725***	0.573***
	(2.728)	(3.746)	(3.528)	(3.104)	(4.007)	(3.692)
Post	-0.228	-0.491**	-0.303	-0.494**	-0.703***	-0.439**
	(-1.141)	(-2.167)	(-1.605)	(-2.231)	(-2.678)	(-2.020)
Treat	-0.245	-0.707***	-0.492**			
	(-1.053)	(-2.735)	(-2.274)			
Observations	346	344	344	346	344	344
Adjusted R-squared	0.938	0.927	0.934	0.942	0.928	0.936
CEO controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes			
Event FE				Yes	Yes	Yes
Cluster by Firm	Yes	Yes	Yes	Yes	Yes	Yes

Panel E: Difference-in-differences estimation on M&A driven turnovers.

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
Treat * Post	0.727**	1.450***	1.059***	0.736**	1.298***	1.059***
	(2.534)	(6.714)	(4.539)	(2.683)	(6.133)	(4.306)
Treat	-1.124	0.714	0.179			
	(-0.904)	(0.282)	(0.101)			
Post	0.335	-0.455*	0.092	0.270	-0.598**	-0.008
	(1.163)	(-2.130)	(0.399)	(0.983)	(-2.824)	(-0.031)
Acquirer CEO age	24.243	64.509	48.723			
	(0.544)	(0.682)	(0.738)			
Acquirer tenure	-3.986	-11.168	-8.166			
	(-0.642)	(-0.848)	(-0.888)			
Acquirer R&D expenditures	66.036	156.271	119.537			
	(0.950)	(1.060)	(1.161)			
Acquirer size	0.162	-2.045	-1.011			
	(0.071)	(-0.425)	(-0.301)			
Acquirer capital expenditures	-126.890	-291.274	-224.002			
	(-0.872)	(-0.943)	(-1.039)			
Observations	85	84	84	85	84	84
Adjusted R-squared	0.954	0.896	0.923	0.962	0.937	0.945
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Acquirer FE	Yes	Yes	Yes			
Deal FE				Yes	Yes	Yes
Cluster by Acquirer	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Tail Innovation, Originality and Generality, and Market Value of Patents

This table reports the estimation results of CEO total frontier experience on innovation quality, originality and generality, and market value. Panel A reports the relation between TFE and innovation quality. Dependent variables are the proportion of top-quality innovations in the year (t+2). A patent is defined as a top-quality innovation if the number of citations it receives is among the top 5% (1%) in the same class-year group. Panel B reports the relation between TFE and originality/generality. Panel C reports the relation between TFE and the market value of patents. The dependent variable in columns (1) and (3) is the logarithm of one plus the total market value of the patent in the year (t+2). The dependent variable in columns (2) and (4) is the logarithm of one plus the total market value of patent scaled by the dollar value of R&D in the year (t+2). CEO controls include log CEO age, gender, log tenure, and education. Firm controls include size, R&D expenditures, capital expenditures, and log employees. Fixed effects are identical to Table 3 Panel A. Standard errors are clustered at the manager level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Top-quality innovations

	(1) Proportion of top 5% patents (t+2)	(2) Proportion of top 1% patents (t+2)	(3) Proportion of top 5% patents (t+2)	(4) Proportion of top 1% patents (t+2)
TFE	0.006*	0.002**	0.008**	0.005**
	(1.955)	(2.358)	(2.068)	(2.155)
Observations	3,085	3,085	2,761	2,761
Adjusted R-squared	0.525	0.299	0.552	0.363
CEO controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE			Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes

Panel B: Originality and generality

	(1) Originality (t+2)	(2) Generality (t+2)	(3) Originality (t+2)	(4) Generality (t+2)
TFE	0.005*	0.006*	0.009**	0.010***
	(1.660)	(1.666)	(2.420)	(2.916)
Observations	3,079	3,085	2,750	2,761
Adjusted R-squared	0.369	0.863	0.418	0.876
CEO controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE			Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes

Panel C: Market value of patents

	(1) Market value in (t+2)	(2) Market value scaled by R&D in (t+2)	(3) Market value in (t+2)	(4) Market value scaled by R&D in (t+2)
TFE	0.145***	0.112*	0.132**	0.123*
	(2.739)	(1.709)	(2.222)	(1.655)
Observations	2,913	2,419	2,592	2,180
Adjusted R-squared	0.899	0.898	0.912	0.900
Firm controls	Yes	Yes	Yes	Yes
CEO controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE			Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes

Table 6: Mechanism: Employee Work-Life Balance.

This table reports the results of CEO individualism and the corporate environment measured by employee work-life balance. The dependent variable in column (1) is the overall employees rating at Glassdoor in the year (t+1). The dependent variable in columns (2)-(4) is the work-life balance ratings in the year (t+1). Columns (5) and (6) verify that the work-life balance rating from Glassdoor can improve corporate innovation. The dependent variable in columns (5) and (6) is the logarithm of one plus the number of patents in the year (t+1). CEO controls include log CEO age, gender, and log tenure. Firm controls include size, R&D expenditures, capital expenditures, log employees, and log number of evaluations on Glassdoor. Firm and year fixed effects are included in columns (1)-(3) and (5)-(6). Firm and industry-year fixed effects are included in column (4). Standard errors are clustered at the CEO level in columns (1)-(4) and the firm level in columns (5)-(6). T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Overall rating in (t+1)	(2) Work-life-balance in (t+1)	(3) Work-life-balance in (t+1)	(4) Work-life-balance in (t+1)	(5) log(patent) (t+2)	(6) log(patent) (t+2)
TFE	0.107***	0.075**	0.081**	0.091**		
	(3.047)	(1.977)	(2.342)	(2.413)		
Work-life-balance					0.043*	0.041*
					(1.767)	(1.683)
Log #evaluations	-0.060*	0.007	0.025	0.028	-0.010	-0.053
	(-1.860)	(0.191)	(0.667)	(0.644)	(-0.257)	(-1.487)
Observations	2,441	2,574	2,441	2,261	2,832	2,812
Adjusted R-squared	0.469	0.448	0.441	0.432	0.898	0.901
Firm Controls	Yes	Yes	Yes	Yes		Yes
CEO Controls	Yes		Yes	Yes		
Year FE	Yes	Yes	Yes		Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE				Yes		
Cluster by CEO	Yes	Yes	Yes	Yes		
Cluster by Firm					Yes	Yes

Table 7: Mechanism: Corporate Innovation Culture

This table reports the impact of CEOs' total frontier experience on innovative corporate culture. The measure of innovative corporate culture is from Li *et al.* (2021). CEO controls include age, tenure, gender, and education. Firm controls include size, R&D expenditures, firm age, capital expenditures, and employment. Firm and year fixed effects are included in all columns. Standard errors are clustered at the manager level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Innovation culture (t+2)	(2) Innovation culture (t+2)	(3) Innovation culture (t+2)	(4) Innovation culture(t+2)
TFE	0.090**	0.108**	0.150***	0.148***
	(2.121)	(2.338)	(3.530)	(3.522)
Document length	-0.006	-0.043	-0.037	-0.038
	(-0.171)	(-1.001)	(-0.845)	(-0.847)
GAI			-0.093*	-0.101*
			(-1.706)	(-1.844)
Observations	4,280	3,837	2,410	2,394
Adjusted R-squared	0.693	0.699	0.661	0.661
CEO controls		Yes	Yes	Yes
Firm controls				Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes

Table 8: Mechanism: Tolerance of Failure through Conglomerate Management

This table reports the results of CEO individualism and conglomerate management. The sample is restricted to firms with more than one segment. Dependent variables in columns (1) and (2) are capital reallocation defined following Seru (2014) and the logarithm of capital reallocation in the year (t+1). Dependent variables in columns (3) and (4) are diversification and logarithm of diversification in the year (t+1). CEO controls include log CEO age, gender, log tenure, and education. Firm controls include size, R&D expenditures, capital expenditures, and log employees. Firm and year fixed effects are included. Standard errors are clustered at the CEO level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) reallocation in (t+1)	(2) log reallocation in (t+1)	(3) diversification in (t+1)	(4) log diversification in (t+1)
TFE	-0.009**	-0.008**	-0.342**	-0.083**
	(-1.987)	(-2.006)	(-2.024)	(-2.074)
Observations	1,045	1,045	1,045	1,045
Adjusted R-squared	0.996	0.924	0.793	0.810
Firm controls	Yes	Yes	Yes	Yes
CEO controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes

Table 9: Heterogeneous Estimation along Legal Environment

This table reports heterogeneous impacts on creditor-friendly bankruptcy laws. The dependent variables, control variables, and fixed effects are identical to Table 3, Panel A. Creditor-friendly equals 1 if the firm is incorporated in California or New York, and equals 0 if the firm is incorporated in Delaware. Control variables are identical to Table 3, Panel A. In addition, I control for credit rating, which is a categorical variable constructed using the rating letters (from AAA to D). Firm and year fixed effects are included in columns (1)-(3). Firm, industry-year, and headquarter state-year fixed effects are included in columns (4)-(6). Standard errors are clustered at the manager level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) log(patent) (t+2)	(2) log(citation) (t+2)	(3) log(citation) (t+2) adj	(4) log(patent) (t+2)	(5) log(citation) (t+2)	(6) log(citation) (t+2) adj
Creditor-Friendly * TFE	1.068**	1.391***	1.826***	1.369**	1.678**	2.009***
	(2.281)	(2.694)	(3.964)	(2.403)	(2.508)	(3.532)
TFE	0.029	0.111	0.024	0.030	0.087	0.021
	(0.550)	(1.508)	(0.401)	(0.355)	(0.782)	(0.234)
Creditor-Friendly	0.481	0.770**	-0.217	0.390	0.658	-0.225
	(1.632)	(2.273)	(-0.735)	(0.871)	(1.225)	(-0.503)
Credit rating	0.038	0.025	0.029	0.044	0.035	0.028
	(1.576)	(0.837)	(1.200)	(0.794)	(0.586)	(0.550)
Observations	1,264	1,254	1,254	824	815	815
Adjusted R-squared	0.901	0.880	0.891	0.891	0.889	0.895
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
CEO Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes			
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE				Yes	Yes	Yes
HeadQuarterState-Year FE				Yes	Yes	Yes
Cluster by CEO	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: CEO Individualism and Type of M&A Deals

This table reports estimation results between CEO individualism and type of M&A deals. The dependent variable in column (1) is the technology proximity. The dependent variable in column (2) is an indicator variable that equals one if the technology proximity is positive. The dependent variables of columns (3) and (4) are the ratios of knowledge base overlap scaled by the target and acquirer knowledge base, respectively. The dependent variable of column (5) is an indicator variable that equals one if the pair of firms have the same 2-digit SIC code. The dependent variable of column (6) is the announcement CAR of the deals. Control variables include the acquirer firms' size, R&D expenditures, and capital expenditures. Acquirer and year fixed effects are included in columns (1)-(6). Standard errors are clustered at the acquirer level. Standard errors are clustered at the acquirer level. T-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Proximity	Proximity indicator	Target overlap	Acquirer overlap	Same-ind indicator	Announcement CAR
Acquirer CEO TFE	-0.021***	-0.021***	-0.019***	-0.018***	-0.032***	-0.068*
	(-4.390)	(-4.342)	(-4.006)	(-3.739)	(-3.842)	(-1.686)
Acquirer R&D expenditures	0.000	0.000	0.000*	0.000*	-0.001***	-0.045*
	(1.408)	(1.424)	(1.759)	(1.768)	(-3.749)	(-1.766)
Acquirer size	-0.003	-0.003	0.000	0.001	-0.006	-0.046
	(-0.560)	(-0.539)	(0.102)	(0.120)	(-0.761)	(-1.223)
Acquirer capital expenditures	0.022	0.021	0.018	0.022	-0.092	-1.006
	(0.367)	(0.346)	(0.289)	(0.352)	(-0.733)	(-1.508)
Observations	15,363	15,363	15,363	15,363	15,363	14,322
Adjusted R-squared	0.093	0.092	0.102	0.104	0.142	0.068
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Acquirer FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by Acquirer	Yes	Yes	Yes	Yes	Yes	Yes

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APPENDIX A

VARIABLE DEFINITIONS IN CHAPTER 1

Panel A: CEO characteristics	
Variable	Description
TFE	Total frontier experience. Defined as the duration of frontier experience at the county level. Obtained from Bazzi *et al.* (2020).
Hofstede score	The individualism score developed using Hofstede's framework. Identified using CEOs' last names and linked to the country of origin.
College distance	The distance between CEOs' home state and college state (where CEOs earned bachelor's degrees or first attended college). The college information is obtained from BoardEx.
Out-of-state college	An indicator variable equals one if the CEO leaves the home state for college, zero if the CEO stays in the home state for college.
Female CEO	An indicator equals one if the CEO is female, zero if the CEO is male.
CEO age	Age of the CEO.
Tenure	Tenure of the CEO. Calculated as the number of years as CEO plus one. Obtained from Execucomp.
Degree	The highest degree earned by the CEO. Doctoral degree = 3, master's degree = 2, bachelor's degree = 1, 0 otherwise.
Ivy League degree	CEOs attended an Ivy League school.
GAI	General ability index developed by Custódio *et al.* (2019).
Overconfidence	An indicator variable equals one for all years after the CEO's options exceed 67% moneyness and zero otherwise, as defined in Hirshleifer *et al.* (2012) and Islam and Zein (2020). Specifically, I obtain the total value per option of the in-the-money options by dividing the value of all unexercised exercisable options by the number of options in Execucomp. Next I divide this value per option by the price at the end of the fiscal years in Compustat.
Founder	An indicator variable equals one if the CEO is the founder of the firm. Obtained from Lee *et al.* (2017).
TDC1	Total compensation from Execucomp.
Delta	The dollar change in a CEO's stock and options portfolio with a 1% change in stock price. Obtained from Coles *et al.* (2006).
Vega	The dollar change in a CEO's option holdings with a 1% change in stock return volatility. Obtained from Coles *et al.* (2006).
Panel B: Management team quality (calculated following Chemmanur et al. *(2019)*	
Team size	The size of the firm's top management team. The team is defined as managers with the title of vice president or higher.
Team MBA	Fraction of management team with an MBA degree.
Team PhD	Fraction of management team with a PhD degree.
Team network	The average number of connections of the management team.
Team experience	The percentage of the management team that served in a top management team prior to joining the current firm.
Team average tenure	The average tenure of the management team.

Panel C: Innovation variables (at year t+2)	
Variable	Description
Number of patents	Total number of patents that a firm files in the year.
Number of citations	Total number of patent citations that a firm receives in the year.
Number of adjusted citations	Total number of patent citations that a firm receives in the year scaled by year-class average. The class is the 3-digit patent class.
Proportion of tail (top 5%) innovation	Proportion of tail patents that a firm files in the year. Tail patents are defined as the top 5% of cited patents.
Proportion of tail (top 1%) innovation	Proportion of tail patents that a firm files in the year. Tail patents are defined as the top 1% of cited patents.
Originality	$$\text{Originality}_i = 1 - \Sigma_j^{n_i} s_{ij}^2$$ where s_{ij} is the fraction of citations citing patent i that belong to patent class j, out of n_i patent classes.
Generality	$$\text{Generality}_i = 1 - \Sigma_j^{n_i} t_{ij}^2$$ where t_{ij} is the fraction of citations received by patent i that belong to patent class j, out of n_i patent classes.
Patent market value	Total market value of patents by a firm in the year. Obtained from Kogan *et al.* (2017) and Compustat.

Panel D: Firm characteristics

Variable	Description
Firm size	The logarithm of the book value of assets (at).
Firm age	The number years the firm exists in Compustat.
R&D expenditure	The ratio of R&D expenses (xrd) to net sales (sale); it is equal to zero when R&D expenses (xrd) are missing.
Capital expenditures	The ratio of capital expenditures (capx) to total assets (at).
Employment	Logarithm of the number of people employed by the company (in thousands).
Innovative culture	Measure of innovative corporate culture from Li *et al.* (2021).
Document length	Logarithm of the documents length from Li *et al.* (2021).
Work-life-balance rating	Employees rating of work-life-balance from Glassdoor.
Compensation and benefit rating	Employees rating of compensation and benefits from Glassdoor.
Number of evaluations	Number of evaluations from Glassdoor.
Creditor friendly	Creditor-friendly environment. Equals to 1 if incorporated state is California or New York, 0 if Delaware.
Number of segments	Number of business segments for conglomerates.
Reallocation	Internal asset reallocation defined as $\Sigma_j \lvert I_j - CF_j \rvert - \lvert \Sigma_j (I_j - CF_j) \rvert$/Assets as defined in Seru (2014). j indexes for the segments, I_j is the capital expenditure, and CF_j is the cash flow of segment j.
Diversification	$$\frac{1}{\Sigma_j^n \left(\frac{Sales_j}{\Sigma_j^n Sales_j} \right)^2}$$ where $Sales_j$ are segment j's sales, and n is the number of segments.
Stock return volatility	Daily stock return volatility of the year.
Idiosyncratic volatility	Daily idiosyncratic stock return volatility of the year estimated using Fama-French-Carhart factors.

Panel E: M&A sample variables	
Variable	Description
Shares owned (%) after acquisition	Percentage of shares owned after transaction
Technological proximity	Following Jaffe (1986) and Bena and Li (2014), technological proximity is calculated as the correlation coefficient $$\frac{S_{acq}S'_{tar}}{\sqrt{S_{acq}S'_{acq}}\sqrt{S_{tar}S'_{tar}}}$$ where the vector $S_{acq} = (S_{acq,1}, \ldots, S_{acq,K})$ captures the scope of innovation activity for the acquirer, the vector $S_{tar} = (S_{tar,1}, ..., S_{tar,K})$ captures the scope of innovation activity for the target firm, and $k \in (1, K)$ is the technology class index. $S_{acq,k}(S_{tar,k})$is the ratio of the number of awarded patents to the acquirer (the target firm) in technology class k with application years from ayr-3 to ayr-1 to the total number of awarded patents to the acquirer (the target firm) in all technology classes applied over the same three-year period.
Knowledge base overlap	Defined following Bena and Li (2014). First step is to determine the set of patents that received at least one citation from any of the acquirer's patents with award years from ayr-3 to ayr-1 ("the acquirer's knowledge base"), the set of patents that received at least one citation from any of the target firm's patents awarded over the same three-year period ("the target firm's knowledge base"), and the intersection of these two sets as the set of patents cited by both the acquirer and the target firm ("the common knowledge base"). I then compute the number of patents in "the common knowledge base."
Acquirer's (Target's) base overlap	Defined following Bena and Li (2014). First step is to compute the number of citations from any of the acquirer's (target firm's) patents with award years from ayr-3 to ayr-1 made to the patents in "the common knowledge base." Second, I scale the number from the first step by the number of citations from any of the acquirer's (the target firm's) patents with award years from ayr-3 to ayr-1 made to the patents in "the acquirer's knowledge base" ("the target firm's knowledge base").
Proximity indicator	An indicator equals one if proximity is positive.

APPENDIX B

PROOFS IN CHAPTER 2

Proof of Proposition 1

Proof. If $D_O = 1$, then the inside director's action is $a_I^* = x_I + x_O$. The outside director's ex ante expected payoff is

$$U_O = E_{x_I,x_O,\varepsilon}[-p(x_I + x_O - x_I - x_O - \varepsilon)^2 - q(a_O^* - \theta)^2] = -p\varepsilon^2 - qE_{x_I,x_O,\varepsilon}[(a_O^* - \theta)^2].$$

If $D_O = 0$, then the inside director's action is $a_I^* = x_I + E[x_O] = x_I + m_O$.

$$U_O = E_{x_I,x_O,\varepsilon}[-p(x_I+x_O-x_I-m_O-\varepsilon)^2-q(a_O^*-\theta)^2] = -p(\varepsilon^2+\sigma_O^2)-qE_{x_I,x_O,\varepsilon}[(a_O^*-\theta)^2].$$

Hence the outside director always benefit from disclosing her observation. $D_O = 1$. □

Proof of Proposition 2

Proof. If $D_I = 1$, then the inside director's action is $a_O^* = x_I + x_O + b$. The inside director's payoff is

$$\begin{aligned} U_I &= E_{x_I,x_O,\varepsilon}[-p(a_I^* - \theta)^2 - q(x_I + x_O + b - x_I - x_O - \varepsilon)^2 - c] \\ &= -pE_{x_I,x_O,\varepsilon}[(a_I^* - \theta)^2] - q(b^2 + \varepsilon^2) - c. \end{aligned} \tag{B.1}$$

If $D_O = 0$, then the inside director's action is $a_O^* = E[x_I] + x_O + b = m_I + x_O + b$.

$$\begin{aligned} U_I &= -pE_{x_I,x_O,\varepsilon}[(a_I^* - \theta)^2] - q(m_I + x_O + b - x_I - x_O - \varepsilon)^2 \\ &= -pE_{x_I,x_O,\varepsilon}[(a_I^* - \theta)^2] - q(b^2 + \sigma_I^2 + \varepsilon^2). \end{aligned} \tag{B.2}$$

Hence the inside director discloses his observation if $q \cdot \sigma_I^2 > c$. □

Proof of Proposition 3:

Proof. **Case 1:** $c > \sigma_I^2$. Hence $q^D > 1$. Then $D_I \equiv 0 \ \forall q \in [0, 1)$

(i) $q = 0$. The case where there is no outside director.

$$V(0) = -\varepsilon^2 = -\sigma^2$$

(ii) $q \in (0, 1)$. $D_I = 0$.

$$V(q) = -qb^2 - q\sigma_I^2 - (1 - q)\sigma^2 = -\sigma^2 - q(b^2 + \sigma_I^2 - \sigma^2)$$

(iia) If $\sigma^2 - b^2 > \sigma_I^2$, then $q^* = 1^-$.
(iib) If $\sigma^2 - b^2 < \sigma_I^2$, then $q^* = 0^+$.
Let $\underline{\epsilon} > 0$ be the smallest possible control assigned to either director.
For (iia), $V(q^*) = V(1 - \underline{\epsilon}) = -\sigma^2 + (1 - \underline{\epsilon})(\sigma^2 - b^2 - \sigma_I^2) > V(0)$.
For (iib), $V(q^*) = V(\underline{\epsilon}) = -\sigma^2 + \underline{\epsilon}(\sigma^2 - b^2 - \sigma_I^2) < V(0)$.

Case 2: $c < \sigma_I^2$. Then $q^D < 1$.
(i) $q = 0$. The case where there is no outside director.

$$V(0) = -\varepsilon^2 = -\sigma^2$$

(ii) $q \in (0, q^D]$. $D_I = 0$.

$$V(q) = -qb^2 - q\sigma_I^2 - (1-q)\sigma^2 = -\sigma^2 - q(b^2 + \sigma_I^2 - \sigma^2)$$

(iia) If $\sigma^2 - b^2 > \sigma_I^2$, then $q^* = q^D$.
$V(q^*) = V(q^D) = -\sigma^2 + \frac{c}{\sigma_I^2}(\sigma^2 - b^2 - \sigma_I^2) > V(0)$.
(iib) If $\sigma^2 - b^2 < \sigma_I^2$, then $q^* = 0^+$.
Then $V(q^*) = V(\underline{\epsilon}) = -\sigma^2 + \underline{\epsilon}(\sigma^2 - b^2 - \sigma_I^2) < V(0)$.
(iii) $q \in (q^D, 1]$. $D_I = 1$.

$$V(q) = -qb^2 - c - (1-q)\sigma^2 = -\sigma^2 + q(\sigma^2 - b^2) - c$$

(iiia) If $\sigma^2 - b^2 > 0$, then $q^* = 1^-$.
$V(q^*) = V(1-\underline{\epsilon}) = -\sigma^2 + (1-\underline{\epsilon})(\sigma^2 - b^2) - c$.
If $\sigma^2 - b^2 > c$ then $V(q^*) > V(0)$. If $\sigma^2 - b^2 < c$, then $V(q^*) < V(0)$.
(iiia) If $\sigma^2 - b^2 < 0$, then $q^* = q^D$.

$$V(q^*) = -q^D b^2 - c - (1-q^D)\sigma^2 = -\sigma^2 + \frac{c}{\sigma_I^2}(\sigma^2 - b^2 - \sigma_I^2) < V(0)$$

Then the conclusions are natural.

□

Special Cases for Proposition 3: In the case where $\min\{1-q^D, q^D\} < \underline{\epsilon} < \max\{q^D, 1-q^D\}$, the minimum possible control assigned to either director is not small enough. Hence Proposition 3 is modified accordingly.

Proposition (3'). *(I) $1-q^D > q^D$. Then $q^D < \underline{\epsilon} < 1-q^D$. q cannot be inside $[0, q^D]$. The conclusion is identical to Proposition 3.*

(II) $q^D > 1-q^D$. Then $1-q^D < \underline{\epsilon} < q^D$. q cannot be inside $[q^D, 1)$. Hence either $D_I = 0$ or the inside director is indifferent between $D_I = 0$ or $D_I = 1$.

1. *If $c > \sigma_I^2$ and $\sigma^2 - b^2 > \sigma_I^2$, then $q^* = q^D$.*
2. *If $c > \sigma_I^2 > \sigma^2 - b^2$, then $q^* = 0$.*
3. *If $0 < c < \sigma_I^2 < \sigma^2 - b^2$ then $q^* = q^D$.*
4. *If $0 < c < \sigma^2 - b^2 < \sigma_I^2$ then $q^* = 0$.*
5. *If $\sigma^2 - b^2 < 0 < c < \sigma_I^2$ then $q^* = 0$.*
6. *If $0 < \sigma^2 - b^2 < c < \sigma_I^2$ then $q^* = 0$.*