IMPACT OF INTERNAL GOVERNANCE ON A CEO'S INVESTMENT CYCLE

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Abstract

Extant literature has found that CEOs follow an investment cycle wherein investments decrease just before CEO turnover and investments increase after CEO turnover. This paper tests the predictions of the Acharya, Myers and Rajan (2011) internal governance model on a sample of voluntary CEO turnovers. We find that the optimal level of sharing of tasks between the CEO and her top-management team, i.e., internal governance, is dependent on the CEO's age and distance from retirement age (65). Additionally, we find the effect of internal governance only matters for older CEOs. While confirming the investment cycle literature's results in our sample, we further test whether internal governance helps mitigate the CEO's investment horizon concern that results in a firm underinvesting as an older CEO approaches retirement. We find that the closer the internal governance is to the optimal level, the smaller the underinvestment that is normally empirically associated with an older retiring CEO. We also find that the new incoming CEO divests profitably the assets acquired under good internal governance. In addition, optimal internal governance is found to have positive effects on corporate innovation. Our results are robust to continuous matching by generalized propensity score and the inclusion of additional covariates controlling for a succession plan and pay duration.

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I. Introduction

Shareholder value maximization is widely considered the efficient goal of public corporations (e.g., Jensen and Meckling, 1976; Fama and Jensen, 1983a, 1983b; Jensen, 2000). In addition, managerial agency theory suggests that CEOs who own less than 100% of their firm deviate from shareholder value maximization because of moral hazard and/or asymmetric information issues. In particular, the misalignment of investment horizons between the CEO and her shareholders could be an important source of the owner-manager conflict. As predicted by Stein (1988 and 1989), when the CEO's horizon is shorter, she might forgo valuable long-term investments in the myopic belief that the benefit will only start to materialize long after her term and the heightened uncertainty will likely dampen earnings in the short run. Hence, it would be important for researchers and practitioners to explore innovative corporate governance mechanisms closely monitoring CEO myopia stemming from shortened executive horizons. In particular, we examine the role of the firm's internal governance from within the top management team in mitigating the potential myopic behavior of a retiring CEO.

Xu and Yan (2014) find that CEOs invest in less risky and more short-term R&D projects as they approach retirement. Weisbach (1995) finds that the probability of divesting poorly performing assets is high following CEO turnover, implying that the preceding CEO is likely to undertake investments that benefit the CEO at the expense of maximizing firm value. Moreover, Pan, Wang and Weisbach (2016) empirically document that a year or two before the CEO retires, the firm experiences a decrease in total investment, whereas both investment and divesture of underperforming assets increase after the new CEO leads the company. They call this pattern a CEO's investment cycle. In contrast, Murphy and Zimmerman (1993) find that capital expenditure decreases for poorly performing firms in the year of CEO turnover when compared to prior years. This result implies that companies that are performing well do not exhibit a decline in capital

expenditure prior to CEO turnover. Similarly, Denis and Denis (1995) find that capital expenditure is lower for CEOs who face forced turnover but not for those who relinquish power voluntarily. Accordingly, the empirical evidence on corporate investment during CEO transition is mixed in the extant literature. This would suggest that managerial myopia is not necessarily a universal problem as the CEO approaches retirement. Accordingly, this paper examines the extent of managerial myopia as a CEO approaches retirement.

An influential theoretical paper by Acharya, Myers and Rajan (2011; referred to as AMR) amends standard managerial agency theory by focusing on a CEO's transition period somewhat before the actual retirement of the current CEO, when the investment horizon of the CEO is much shorter than that of her subordinates and shareholders. Specifically, they state on page 690: **"**To understand how the differences among diverse agents lead to internal governance, we first consider a partnership **run by an old CEO who is about to retire** (emphasis added)". The AMR model predicts that with proper internal governance, the underinvestment problem resulting from CEO myopia is reduced. That is, AMR theorize that a subordinate manager, who is the successor to the CEO and thus has a longer horizon, through internal governance mitigates the horizon problem of the incumbent CEO during the transition period prior to the CEO's planned retirement. If the current CEO puts in place policies that destroy the capital and reputational stock of the firm, then the successor will find herself running a diminished firm in the future. Accordingly, the subordinate who hopes to succeed the current CEO will oppose myopic CEO policies designed for the short run. As such, to a certain extent, the current CEO must concede to the wishes of the subordinate in exchange for her assistance to support the operational activities necessary to boost the current earnings and stock price, both of which are important factors in the CEO's current compensation. On the other hand, the subordinate might be reluctant to expend managerial effort to increase the company's successful current valuation for which she does not fully benefit.

Moreover, since the CEO is essential to coordinating all efforts to ensure seamless operational activities throughout the firm, it would be value-damaging if too many administrative duties regarding the firm's business operations are conducted by the subordinate.

One can interpret the subordinate in the AMR model as the team of top executives in the firm, several of whom are potential successors of the current CEO. Accordingly, internal governance works best when neither the CEO nor the subordinates are dominant. AMR define a variable δ which is "the fraction of *tasks* assigned to the CEO" (p.700; italics added). A fully decentralized team would have $\delta = 0$, and one where the CEO makes all the contributions is where $\delta = 1$. AMR predicts that an optimal δ (i.e., optimal internal governance) that maximizes firm value is when both the CEO who is approaching retirement and her subordinates contribute to the firm. No such effect is predicted for young CEOs who are not planning to retire.

We test AMR's prediction using the firm's investment rate in the two years before the CEO's voluntary retirement. We empirically test the theoretical predictions of AMR using a manually collected large sample of *voluntary* CEO retirements from 1996 to 2017. We use a similar methodology to Parrino (1997) to identify voluntary CEO turnover. To proxy for the fraction of *tasks* assigned to the CEO (δ), we use the fraction of CEO titles divided by the total number of executive titles held by the top five executives. We regress our performance measure (industry-adjusted market value of equity to its book value) against δ, its squared term δ^2, the age of the CEO, their interactions and a wide set of control variables. We include CEO age variables because a younger CEO may voluntarily leave the firm to seek better opportunities. Accordingly, a younger CEO's motivation is more likely to be influenced by career concerns as suggested by Gibbons and Murphy (1992). We show that according to our estimated empirical specification, the dynamic optimal δ^* exists for older CEOs but not for younger CEOs. We argue that these results are consistent with the AMR implications since older CEOs are more likely to face the

agency problems of myopia. Younger CEOs are more concerned with their reputation and its impact on their career trajectory, consistent with the Gibbons and Murphy (1992) model. Furthermore, we find that firm performance is increasing and then decreasing in δ for older CEOs, in line with the implications of the AMR model. These results are consistent with the results of Aggarwal, Fu and Pan (2017, referred to as AFP).

Building upon the above empirical results and theoretical implications of AMR, we further examine whether optimal internal governance would ameliorate the CEO underinvestment problem as the older CEO's investment horizon shortens, thereby mitigating the investment cyclical pattern found by Pan, Wang and Weisbach (2016). Consistent with predictions of AMR, we find that optimal internal governance significantly enhances the firm's investment rates two years before retirement for outgoing older CEOs. The finding adds to reconciling the mixed literature on managerial myopia as the CEO approaches voluntary retirement. Moreover, to corroborate the empirical finding, we examine several additional testable hypotheses, albeit not directly predicted by AMR, but implied by their theory. First, since the flip side to understanding the under-investment problem is that CEOs might divest assets,[1] we examine the impact of internal governance on the firm's disinvestment rate and profitability in the year of the CEO's retirement. We find that good governance has a positive impact on the value and profitability of asset disposals for the first year of new CEOs. These findings suggest that with good internal governance, the older outgoing CEO is less likely to overpay for previously acquired assets.[2] Second, we find that older outgoing CEOs of firms with effective internal governance are more likely to conduct impactful and quality corporate innovation as measured by the number of total citations scaled by the number of patents for a firm in the fiscal year. Third, younger CEOs who leave voluntarily

[1] Pan, Wang and Weisbach (2016) also find that disinvestment increases during the fiscal year when the new CEO takes over from the exiting CEO.

[2] A potential reason why the new CEO is disposing of profitable older assets is due to the differential skill-asset match between the new CEO and the older outgoing CEO.

(presumably because they found other opportunities) are more likely to enhance R&D investment beginning two years prior to their retirement, and the R&D expenditure is proven to be more impactful as measured by the number of citations.

To the best of our knowledge, Aggarwal, Fu and Pan (2017; AFP) is the only study that attempts to empirically investigate the theory of internal governance using executive titles and quadratic model specifications. Their paper shares the following similarities with our paper. One, using the Acharya, et. al (2011) model as motivation, AFP and our paper test the role of internal governance on investment. In doing so, both papers measure internal governance based on the relative balance of job responsibilities between the CEO and the rest of her team, while using job titles as a proxy for job responsibilities. Two, AFP and our study find a hump-shaped relation between internal governance and firm value. We are only ensuring that the hump-shaped relationship holds in our sample. However, we differ from the AFP in the following ways. One, we study the impact of internal governance on disinvestment and innovation whereas AFP do not. Two, for the reasons described above, we only examine voluntary turnover, whereas AFP's analysis includes forced CEO turnover. Three, Pan, Wang and Weisbach (2016) find evidence of an investment cycle wherein the investment rate of the firm declines as the older CEO nears retirement and then increases again with the new CEO. We examine the impact of internal governance on this investment cycle, thereby contributing to the reconciliation of the divided literature on CEO horizon and underinvestment. Four, our paper allows optimal internal governance to vary with CEO age or distance from retirement age so we can control for reputational and career concerns, which is not explicitly factored in the model specification of AFP. Based on the age-varying dynamic optimal δ^*, we define distance as the absolute difference between the firm's observed δ and the estimated dynamic optimal δ^*. We find that as the firm's internal governance variable approaches its optimum, the reduction in the investment rate is greatly

mitigated. Five, we examine the firm's disinvestment policy after the CEO retires and the new CEO enters, whereas AFP do not examine divestitures. As the flip side to understanding the under-investment problem, the findings are in support of the theoretical implications of Acharya, et. al (2011) and are complementary to the empirical evidence for Pan, Wang and Weisbach's (2016) CEO investment cycle. Sixth, we control for the potential confounding effect of the firm's succession planning, which is found to reduce the frictions related to CEO transition in the extant literature (e.g., Larker and Tayan, 2010, Tao and Zhao, 2017, Cvijanovic et al., 2022 and McConnell and Qi, 2022). We follow Cvijanovic et al. (2022) and create a dummy variable using textual analysis techniques to capture succession planning and our results are not affected by the inclusion of this dummy variable.

We believe that our results are not significantly affected by endogeneity concerns for several reasons. First, we include firm, industry and time fixed effects to control for time-invariant omitted variables. Second, we use Hirano and Imbens's (2007) continuous matching by the Generalized Propensity Scoring (GPS) method to confirm that our results do not suffer greatly from endogeneity concerns. The GPS approach could effectively balance covariates in the sample without relying on instrumental variables (IVs) of strict exclusion restriction. In fact, it is an extremely hard endeavor to find certain strong and valid IVs for internal governance. AFP use the financial crisis in 2008 and 2009 as an exogenous shock and finds the relationship is positive (negative) for firms whose internal governance measure is below (above) the median 2008 level. However, this methodology assumes that the only change in capital expenditure during the financial crisis is because of the change in internal governance. It seems reasonable that in the financial crisis, capital expenditure changes occurred for reasons that have nothing to do with internal governance (such as a lower ability for firms to obtain investment capital from outside sources). Nevertheless, GPS cannot address potential endogeneity due to unobservable covariates.

However, we also include a robust set of time-varying control variables that control for CEO characteristics, including CEO pay-performance sensitivity, firm succession planning, CEO's duration of pay, whether the former CEO is the founder of the company, governance characteristics (such as the percentage of outside directors on the board, the size of the board) and various firm characteristics.

In summary, our evidence suggests that good internal governance improves not only the deteriorating investment policy preceding myopic older CEO departure in terms of both the dollar amount and quality of assets acquired, but it ensures the asset disposals incurred at the beginning of a CEO's tenure are more likely to be profitable. Our results add to the growing literature on internal governance demonstrating the impact of the management team on corporate investment policy. Our paper complements the findings of empirical internal governance studies that do not examine firm investment policy. Specifically, Landier, et. al (2012) find that a firm's profitability increases with the number of executives appointed before the current CEO. Cheng, Lee and Shevlin (2016) find that the extent of real earnings management decreases with key subordinate executives' horizons. Jollineau, Vance and Webb (2012) document that subordinates' ethical standard reduces their willingness to accede to the CEO's request for income-increasing estimates. Jain, Jiang and Mekhaimer (2016) find that firms with better internal governance have lower information asymmetry and higher liquidity.

Our paper contributes to managerial myopia and monitoring literature. We demonstrate that myopia due to the older CEO's short investment horizon can be mitigated via the use of optimal internal governance. The empirical evidence we present may explain the conflicting results regarding the level of firm investment before and after CEO turnover. The findings of Xu and Yan (2014) and Pan, Wang and Weisbach (2016) imply that on average the level of firm investment decreases as the CEO approaches retirement, consistent with the myopia theory

espoused by Stein (1988) and (1989). On the other hand, Murphy and Zimmerman (1993) and Denis and Denis (1995) find that capital expenditures, on average, decline for poor performing firms or in the event of a forced CEO turnover, suggesting that managerial myopia as the CEO approaches natural retirement is not universal. Our results indicate that the change in the investment from years prior to the CEO turnover is related to the effectiveness of internal governance and that the "CEO investment cycle" is much less apparent during CEO transition for firms of good internal governance, thereby enlightening the substitutive or complementary roles of internal governance in ensuring that managers seek to value maximize for the long run. Additionally, managerial myopia is much less apparent with younger CEOs who voluntarily retire, perhaps because of their career and reputational concerns.

We also contribute to the internal governance literature by directly testing the theoretical model of AMR using executive titles and estimating a non-linear model specification. Previous studies often defined internal governance as the linear difference between the age of the CEO and the average age of the top management team (e.g., Feng, Ge, Luo; Shevlin, 2011; Jollineau, Vance and Webb, 2012; Jain, Jiang and Mekhaimer, 2016), and generally assume a linear functional relation between internal governance measure and variables of interest. In contrast, utilizing a proxy for task delegation across the top management team, which is consistent with the theoretical implications of AMR, we find a non-linear relationship between internal governance and firm performance incorporating CEO horizon measures. The resulting dynamic optimums in turn entail exploring the rich implications of internal governance for a wide set of essential corporate activities.

This paper proceeds as follows. Section II reviews the related literature and Section III describes our data, variable construction and sample characteristics. The empirical results are reported in Section IV and Section V presents our conclusions.

II. Literature Review

CEO Importance: Several papers have shown that CEOs have a large and significant impact on the investment and financial policies of the firms they lead. Bertrand and Schoar (2003) document that managerial styles represented by the biographical characteristics of individual executives have a significant effect on the financial outputs of the firm. They find that CEO fixed effects can substantially explain the heterogeneity in firm investment, financing and organization strategies and firm performance. Palia (2000) finds that CEOs of lower quality (who graduated from lower-ranked universities) are more likely to be CEOs of regulated companies than manufacturing firms who attract CEOs of higher quality (who graduated from higher-ranked universities). Additionally, he finds that the regulated industries offer their CEOs a lower pay-performance sensitivity than manufacturing CEOs. This suggests that labor markets sort lower (higher) quality CEOs into more regulated (non-regulated) industries. Heaton (2002) argues that over-optimistic managers believe that capital markets undervalue their firm's risky securities and may decline to invest in positive net present value projects that are externally financed. Malmendier and Tate (2005) find that overconfident managers overestimate the returns on their investment projects and view external funds as unduly costly. Thus, they overinvest when they have abundant internal funds, but curtail investment when they require external financing. Baker and Wurgler (2013), show that managerial biases and nonstandard preferences can have a significant impact on the firm's financing and investment decisions.

CEO Myopia and Turnover: Stein (1988 and 1989) demonstrates that a CEO might behave myopically by not making long-term investments if the CEO believes that the benefit of such investments would not materialize or is not recognized by the market until after the CEO has retired. The impact of the current long-term investments would be to depress current earnings and thus current stock price. Therefore, a manager more aligned with the short-term stock price may

turn down valuable investment opportunities. Managerial Myopia can become more acute if the investment horizon of the CEO is short compared to the stockholders of the firm. This is likely to be the case as CEOs approach retirement since the CEO obtains immediate benefits from increasing current earnings/cash flows at the expense of future earnings.[3]

Several studies find results that are consistent with Stein's (1988 and 1989) predictions. For example, Warner, Watts and Wruck (1988), Weisbach (1988) and Huson, Malatesta and Parrino (2004) find strong evidence that accounting earnings and market value of the firm decline before CEO turnover. Strong and Meyer (1987), Elliott and Shaw (1988), Dechow and Sloan (1991), Murphy and Zimmerman (1993) and Weisbach (1995) find that during the transition period, there are significant asset divestitures write-offs and reductions in capital expenditures. Strong and Meyer (1987), Elliott and Shaw (1988) and Dechow and Sloan (1991) find that the outgoing CEO tends to constrain discretionary expenditures such as R&D development and advertising to boost earnings-based compensations, resulting in declining R&D in the final years of the CEO's tenure.[4] Pan, Wang and Weisbach (2016) find that a year or two before the CEO retires the firm experiences a decrease in total investment. The new CEO then increases both investment and divestiture of underperforming assets.

Internal Governance: Internal governance is considered a monitoring mechanism that arises from the needed contributions of CEO subordinates to run the company. One influential paper of which is Acharya, Myers and Rajan (2011; AMR). AMR model a firm with a two-level managerial hierarchy – a CEO who is old, and her subordinate who will become CEO in the next period. The myopic CEO creates moral hazard problems because she has little incentive to leave

[3] Age has been widely used as a proxy for the executives' employment horizon (see, for example, Brickley et al., 1999, Dechow and Sloan, 1991, Gibbons and Murphy, 1992, Matějka et al., 2009 and Jain, Jiang and Mekhaimer, 2016).

[4] Butler and Newman (1989) find contrary evidence.

behind any capital stock after she retires. As such, the outgoing CEO tends to put in place policies that are designed to boost short-term earnings probably at the cost of the long-term capital and reputational stock of the firm. However, the subordinate who hopes to succeed the current CEO will oppose such CEO policies with which the successor will find herself running a diminished firm in the future. As such, the current CEO is "forced" to abide by the wishes of the subordinate, since the current CEO needs the assistance of the subordinate to produce current earnings that support the current stock price, which is an important factor in the CEO's current compensation. Moreover, the subordinate who exerts managerial effort to materialize CEO policies could learn from the process to become a more productive CEO in the future. On the other hand, if many administrative duties regarding the firm's business operation are conducted by the subordinate and the success of the company is so dependent on the effort exerted by the subordinate, then she is neither motivated to carry out the wishes set from the top nor learn to become a more productive CEO since as the subordinate, she cannot internalize the successful current valuation and earnings.

The theoretical model of Landier, Sraer and Thesmar (2009) has a different setting than AMR. In Landier, Sraer and Thesmar (2009), the vertical organizational structure consists of an informed Decision Maker (DM), in charge of selecting projects and an uninformed Implementer (I) who is in charge of the project's execution. In the face of a dissenting and unmotivated I, DM chooses to use objective information in the selection of projects to ensure successful outcomes. Preference heterogeneity between DM and I (or dissent), leads to more informed decision making and less self-serving activities by the DM, which results in higher profitability.

Several empirical papers have found that internal governance is beneficial in other (non-investment-related) contexts. Landier, et. al (2012) measure good internal governance by the number of executives appointed before the current CEO and find that firm's profitability increases with that number. Jain, Jiang and Mekhaimer (2016), measure internal governance as the

difference in horizons between a CEO and his immediate subordinates and find that firms with better internal governance have lower information asymmetry and higher liquidity. Finally, Cheng, Lee and Shevlin (2016) use the number of years to retirement to capture key subordinate executives' horizon incentives and their compensation relative to CEO compensation to capture their influence within the firm. They find that the extent of real earnings management decreases with key subordinate executives' horizon and influence. In all of these papers, there appears to be a linear relationship between the internal governance metric and the output performance metric (profitability, information asymmetry, liquidity and earnings management).

IV. Data, Variable Construction and Sample

AMR model a firm wherein the CEO knows that at the end of the period she will leave the firm to subordinates. Therefore, we restrict our sample to voluntary turnover by excluding any performance-related forced turnover. To distinguish between the events of voluntary retirement and forced turnover we use the procedure of Parrino (1997). According to Parrino (1997), a forced departure of a CEO is identified through any of the following three steps. First, forced departure is identified if a news release explicitly announces that the CEO leaves office due to forced termination, policy differences, or any other reasons (such as sales or profits being less than expected, etc.). Second, if there is no explicit news release of termination, Parrino assumes that individuals who are above the age of 60 years leave office voluntarily. For those under the age of 60 years, CEO turnover is considered forced if a) there is no public disclosure regarding her death, poor health, or acceptance of another position, or b) no public disclosure of retirement at least six months before the succession. Third, forced departures classified in the second procedure are reexamined using information surrounding the transition period and records in the individual's biography. Turnover is reclassified as voluntary if the individual takes a comparable position elsewhere or departs for ex-ante undisclosed reasons unrelated to the firm's policy and performance,

such as personal interest confirmed by the departing CEO's biography or subsequent press releases. The CEO's age and the date of departure are obtained from ExecuComp. We obtain information regarding CEO turnover from various sources such as Bloomberg's Executive Profile and Biography, Wikipedia, SEC filings and Factiva.

According to AMR, internal governance works best when neither the CEO nor their subordinate managers are dominant. The authors define a variable $\delta = f/(f+g)$, which is the fraction of tasks assigned to the CEO. A fully decentralized team would have $\delta = 0$, and one where the CEO makes all the contributions is where $\delta = 1$. To operationalize this metric, we follow the procedure used by Aggarwal, Fu and Pan (2017). We first calculate the number of executive titles of the CEO (f) scaled by the total number of executive titles carried by the entire top management team of five executives ($f + g$). We utilize the technique of regular expression (*regex*) to calculate the number of titles for each executive. We use three steps to find δ. First, we use the *regex* procedure to provide a preliminary number of titles for each executive. Second, we recognize that *regex* has limitations when the title string is irregularly structured. For these companies, we manually check the title string given by ExecuComp. Third, we manually checked for a random sample of firm-years, and the *regex* procedure correctly captured the titles. To conserve space in the main text, we delineate the exact procedure using *regex* in Appendix B.

To determine the optimal level of internal governance, we need suitable performance metrics. Since the main channel through which internal governance mitigates agency problems is to constrain the CEO's myopic motives of under-investing in the firm's capital stock, our performance proxy should be able to efficiently recognize the growth potential rather than only focus on current cash earnings. Following the convention of the extant literature, we use a proxy for market performance defined as the market value of equity divided by the book value of equity

(M/B).[5] M/B is winsorized at the 1% level in the Compustat universe. According to Chakravarthy (1986), M/B is an ideal measure for the success of strategic management, which ensures the firm's long-term adaptation to its business environment in the face of potential distortions from management. Additionally, M/B is a more forward-looking measure than ROA, as it incorporates the market's perception of the firm's growth opportunities. Given that M/B is also strongly associated with the condition of the industry in which it operates, we use the industry-adjusted performance measure of M/B at the two-digit SIC level. We regress our performance measures (industry-adjusted market value of equity to its book value) against δ, the age of the CEO, their interaction and a wide set of control variables. We include CEO age variables because a younger CEO may voluntarily leave the firm to seek better opportunities. Accordingly, a younger CEO's motivation is more likely to be influenced by career concerns as suggested by Gibbons and Murphy (1992).

Accordingly, we empirically estimate the following regression specification.

$$\begin{aligned} Performance_{it} \\ &= \beta_0 + \beta_1\delta_{it} + \beta_2\delta_{it}^2 + \beta_3\delta_{it} \times \theta_{it} + \beta_4\delta_{it}^2 \times \theta_{it} + \beta_5\theta_{it} \\ &+ \beta' X_{it} + \gamma_i + \lambda_t + \epsilon_{it} \end{aligned} \quad (1)$$

The dependent variables are the industry-adjusted firm performance variable *M/B*. We include a linear and squared term for δ given that the optimal internal governance as measured by the fraction of titles held by the CEO as posited by the theory should be non-linear. To estimate the coefficients, we initially use OLS with firm fixed effects. In the knowledge that the CEO's age may potentially influence δ, one may interpret Equation (1) as a reduced form of the endogenous relation between our internal governance variable and our CEO's age variables, θ_{it}. θ is either the

[5] We get similar results using Tobin's Q defined as the (book value of total assets – deferred taxes - book value of stockholders' equity + market value of equity)/book value of total assets. These results are not reported for brevity but are available from the authors upon request.

age of the CEO, denoted as *Age*, or the CEO's horizon, denoted as *Horizon*. *Horizon* is defined as the time to retirement measured $Max(65 - Age, 0)$, assuming 65 is the normal age for retirement. The standard errors of all the fixed effects models are two-way clustered by firm and year. X_{it} represents a robust set of covariates controlling for firm fundamentals, CEO characteristics, external corporate governance variables, and γ_i and λ_t are firm and year fixed effects, respectively. Once we obtain the estimates for Equation (1), we can find the first-order condition as a function of δ and θ by taking the first derivative of performance with respect to δ, setting it equal to zero to find δ^*. We then take the second derivative of performance with respect to δ to check if δ^*maximizes firm performance. As such, the effectiveness of a company's internal governance can be measured as the distance to the dynamic optimum, *Distance*, which is computed as the absolute value of its δ minus the dynamic optimum δ^* taking into account CEO age variables such as *Age* or *Horizon*.

To determine if optimal internal governance mitigates agency problems caused by the shortening of the investment horizon of the CEO, we examine the relationship between the investment rate and our internal governance metric as described above. *Investment rate* is defined as the sum of capital expenditures and acquisitions at the end of the period divided by total assets at the beginning of the period. We calculate the investment rate variable from Compustat. Although Aggarwal, Fu and Pan (2017; AFP) also find a hump-shaped relationship between capital expenditure and internal governance more prominently for older CEOs (age 56 and over), AFP does not use the hump-shaped relationship between capital expenditure and internal governance to determine the optimal δ^*. Finding the age or horizon varying optimal internal governance allows us to explicitly model the economic ramifications of deviating from effective internal governance and simultaneously account for the executive horizon, the key influential factor in the theoretical framework of AMR. Additionally, this model specification enables us to explore the

widely spreading effect of internal governance on essential corporate activities such as innovation input (R&D) and output (citations per patent).

Our multivariate regressions include many control variables. The first control variable is firm size and to mitigate any skewness issues we take the natural logarithm of total assets (*Size*). One might expect agency costs to increase with leverage (Jensen and Meckling, 1976 and Green and Talmor, 1986). We include the variable *Leverage* defined as the sum of long-term debt plus short-term debt in current liabilities divided by beginning period total assets. We also control for other governance mechanisms as characterized by board characteristics, which are expected to play a role in constraining the CEO's discretion and are a potential substitute for internal governance. To do so, we collect data from ISS on board characteristics (number of directors and the fraction of outside directors on the board). We hence merge ExecuComp, Compustat and ISS to construct our sample. Because the distribution of managerial responsibility might be a function of firm complexity and firm age, we include as additional control variables, the number of business segments (*Segments)* and firm age (*FirmAge*) defined as the difference between the current year and the first year the firm appears in Compustat. To control for the power of the CEO, we include a dummy variable *Chair* that equals one if the CEO is also the chair of the board of directors and zero otherwise. Additionally, we include an indicator variable *Founder* that equals one if the CEO is the founder of the company and zero otherwise. Another proxy for CEO power is the relative pay of the CEO, and we include *Payslice,*[6] defined as the ratio of the total compensation of the CEO to the total compensation of the top five highest-paid executives.[7] Since the data in the ISS

[6] CEO pay slice has been used to capture tournament incentives (Kale, Reis and Venkatesaran (2009), or CEO power and entrenchment (Bebchuk, Cremers and Peyer, 2011 and Feng, et. al, 2011).

[7] For our robustness tests, we include a metric for long-term incentive pay and an indicator variable if the firm has a formal succession plan.

legacy database starts in 1996, our sample starts from 1996. Table 1 summarizes the definitions of each of our variables used in the empirical analyses.

*** Table 1***

We begin the sample construction by obtaining the job titles and employment history of the CEO and the other top four subordinate managers of S&P 1500 firms from ExecuComp for the years 1996 to 2017. We use the ExecuComp variables CEOANN and TITLEANN to help identify CEO and executive titles, respectively, for each firm-year observation. For this empirical study, we omit any observations from the sample if we cannot construct an internal governance measure (δ) for the firm. For example, we drop firm-year observations that report less than five executives, have missing values of executive total compensation (TDC1), report more than one CEO, or whose CEO identity cannot be clearly identified. To be consistent with the theoretical framework of AMR, we also ensure for each CEO turnover, the succeeding CEOs stay in office for at least two years to avoid accounting for turnover events in transition to interim CEOs who naturally have short executive horizons. Spanning fiscal years 1996 to 2017, the sample covers 3,127 CEO turnovers, 3,216 distinct firms and a total of 6,518 unique CEO-firm combinations. Detailed summary statistics of our sample are shown in Table 2.

*** Table 2***

Specifically, the average fraction of corporate titles of the CEO is 0.263, which is slightly greater compared with that in AFP. The increase in sample mean may reflect the larger time span of our sample since we include several years of data beyond the 2008 financial crisis.[8] The sample distribution of δ is quite symmetric with extreme values ranging from smallest 0.055 to largest 0.643. The 1% percentile value is 0.111 and the 99% percentile value is 0.428, with a median value

[8] Our data extends to 2017 but the AFP study primarily ended in 2008,

of 0.25 which is very close to average values of 0.26. Concerning both internal governance and other corporate financial variables, we have roughly similar means, medians, and standard deviations to those in Pan, Wang and Weisbach (2016) and AFP. Additionally, we find that the variation of δ is more due to the variation of responsibility of non-CEO executives, indicating our internal governance variable is not simply the inverse of the definition of CEO power used by Adams, Almeida and Ferreira (2005). Furthermore, this last finding indicates that the distribution of tasks is more concentrated upon giving more responsibilities to subordinates than the CEO amassing more titles for herself.

AMR predicts that investments are shareholder value-maximizing when there is a division of tasks (δ) between the CEO and her subordinates. But is δ just another proxy for CEO power (such as CEO pay slice) or other governance mechanisms (such as board size, proportion of outsiders on the board and CEO pay-performance sensitivity)? Table 3 presents the correlation matrix between δ, proxies for other governance structures (board size, proportion of outsiders on the board and CEO pay-performance sensitivity) and CEO power (pay slice and whether the CEO is the founder). We find that internal governance as defined by tasks/titles has a very low correlation with the proxies of other governance structures and CEO power. In no case is the correlation coefficient greater than 0.15. Accordingly, in our regressions below, we examine the impact of our internal governance measure while controlling for the other governance and CEO power variables.

*** Table 3***

V. Empirical Results

V.1. Proxy for Internal Governance

We begin by estimating the relationship between internal governance and firm performance for each firm-year observation, utilizing the quadratic model specification introduced by AFP. The

panel regressions employ firm and year fixed effects as described in Equation (1). The regressions use our entire sample between 1996 and 2017, including non-transition years. The theory of AMR suggests that internal governance works best to motivate the older myopic manager's under-investment problem.

Table 4 summarizes the results of regressing firm performance variables (current year's industry-adjusted market-to-book ratios) on the internal governance variable δ and other control variables other than our CEO age variables. Please refer to Table 1 for variable definitions. Column (1) presents the results for the entire sample. Note that we do not obtain the predicted non-linear relationship between firm performance and our internal governance variable when we use the entire sample. Following the empirical specifications of AFP, age is considered an important variable to measure the executive horizons of CEOs. As the originally far-sighted CEO becomes older, her executive horizons will naturally become shorter, and the executive may turn myopic. Provided that the original population of CEOs is a combination of far-sighted and myopic executives, splitting the sample by CEO age might give us a better sample of myopic executives. Column (2) presents the results for older CEOs with a shorter horizon (*Horizon* $\leq$9 years) and column (3) presents the results for younger CEOs with a longer horizon. According to the AMR model, we would expect to find that the coefficient on the linear δ term to be significantly positive and the coefficient on the δ^2 square term should be significantly negative only when CEOs are myopic. In column (3) (the sub-sample of younger CEOs), we find no statistically significant relationship between firm performance and the internal governance variables of δ and δ^2. However, in column (2) (the sub-sample of older CEOs), there is a statistically significant positive relationship between firm performance and δ, followed by a statistically negative relationship with δ^2. These results are consistent with the theory of AMR and with the empirical results of AFP.

*** Table 4***

However, the optimal internal governance may be a function of the CEO's age or horizon. Although proper internal governance is needed for older CEOs to mitigate CEO myopia, a younger CEO's motivation is more likely to be influenced by career concerns as suggested by Gibbons and Murphy (1992). Hence, we regress our performance variable against δ and δ^2, the age of the CEO, their interaction and a wide set of control variables as delineated in Equation (1) above. Note that when we include the interaction term of the CEO's *Age* or *Horizon* with δ and δ^2, we allow for the optimal internal governance variable to be a function of the CEO's age or horizon.

In Table 5, we find δ and δ^2 and their interaction terms are statistically significantly different from zero. Columns (1) and (2) report the coefficients when we use a CEO's *Horizon* or *Age*. For both specifications, we take the derivative of the firm's market value with respect to δ and set the derivative equal to zero. The optimal internal governance $\delta^*$is given by:

$$\delta^* = (6.908 - 0.524\, Horizon)/(17.828 - 1.446\, Horizon) \quad (2)$$

$$\delta^* = (-25.582 + 0.490\, Age) \,/\, (1.342\, Age - 71.64) \quad (3)$$

We then take the second derivative of the first-order conditions with respect to δ and evaluate the sign of the second derivative at δ^* with respect to *Age* or *Horizon*. It can be easily shown that when *Horizon* is less than 12 (corresponding to the CEO age of 53) the second derivative is positive, indicating that δ^* does not optimize firm value. However, the second derivative is negative for CEOs who are 53 or older. Accordingly, δ^* minimizes firm value for younger CEOs but maximizes firm value for those older than 53.[9] The finding that internal governance only maximizes firm value for older CEOs is consistent with the theoretical model of AMR.

[9] The break-even CEO age for the second derivative turning from positive to negative is 54 if we use the specification incorporating *Age* instead of *Horizon*.

Table 5

V.2 Impact of Internal Governance on a CEO's Investment Cycle

We perform univariate analysis to examine the trend of *Investment rate* during the transition period of CEO in Table 6. We examine the change in the investment rate for the entire sample to check whether we have similar results to those in Pan, Wang and Weisbach (2016). The change in the investment rate is the difference between the investment rate two years prior to turnover year 0 and year t, where t = -1, 0, 1 and 2. Table 6 and its accompanying figure summarizes the univariate results. For the entire sample, we observe a decreasing investment rate from t = -2 to t = 0 and 1. The scale of the investment rate is given by the vertical left side. This result is consistent with the results reported by Pan, Wang and Weisbach (2016). That is, the positive difference indicates that the investment rate is greater 2 years before the CEO retires than thereafter until the first year that the new CEO takes over.

*** Table 6***

We further explore if the reduction in investment as she approaches voluntary retirement is reversed with proper internal governance using regression analysis for the sample of firms undergoing voluntary retirement of their *older* CEOs. Recall that given our parametric estimates of Equation (1), the second derivative evaluated at δ^* is negative for CEOs older than 53 or 54. For younger retiring CEOs, the second derivative is positive indicating that δ^* minimizes firm value. Accordingly, our primary variable of interest for the older CEO group is *Distance*, which is defined as the absolute value of the difference between δ and the estimated dynamic optimal δ^* as given by Equations (2) and (3). For the younger CEOs, *Distance* is set to zero. We, therefore, add a dummy variable, *Young*, which equals one if the CEO is younger than 53 and zero otherwise. In particular, the regression model and the key variable of interest are specified as follows. Age^* is the break-even CEO age by which the second derivative turns from positive to negative. The

multivariate regression with firm and year fixed effects includes all control variables of Table 4 and the standard errors are two-way clustered by firm and year. Note that a significantly positive regression coefficient on *Distance* implies that good internal governance reverses or mitigates the under-investment problem.

$$\Delta InvestmentRate_{it} = \beta_0 + \beta_1 Distance_{it} + \beta_2' X_{i,t-1} + \beta_3' Young + \gamma_i + \lambda_t + \epsilon_{it} \quad (4)$$

$$Distance = \begin{cases} |\delta^* - \delta| & Age \geq Age^* \\ 0 & Age < Age^* \end{cases} \quad (5)$$

Table 7 summarizes our results. Columns (1) and (2) summarize the results for the change in the investment rate between two years prior to the turnover event and in the year of the turnover event for variables *Horizon* and *Age,* respectively. Columns (3) and (4) summarize the results for the change in the investment rate between two years prior to the turnover event and in the year prior to the turnover event for variables *Horizon* and *Age,* respectively. For all four regressions, the *Distance* variables' coefficients are positive indicating that the further the internal governance of the firm is from the optimum given the age or horizon of the CEO, the greater the likelihood that the investment rate decreases. Moreover, the coefficients are significantly positive between years -2 and -1, a time at which the new CEO has not been appointed and is not currently working on the transition with the older CEO. Accordingly, our results support the notion that internal governance greatly mitigates CEO myopia for outgoing older executives. Interestingly, the coefficients of the dummy variable, *Young,* are positive but only significant for Columns (1) - (2), implying that firms may experience underinvestment during the transition year even for younger outgoing CEOs who have career and reputation concerns. This could be attributable to the fact that the investment policy during the turnover year is jointly determined by the exiting and entering

CEOs, which in turn explains the statistically insignificant coefficients of *Distance* between years -2 and 0. Moreover, younger CEOs who leave their employers for better opportunities may face heightened transition frictions, which they may not be experienced in handling, resulting in a severe reduction in long-term investments. Nevertheless, it is possible that younger CEOs who voluntarily retire may want to underinvest, and internal governance is ineffective in that their subordinates do not anticipate retirement because of their age.

Table 7

The flip side to understanding the under-investment problem is that CEOs might divest assets. Pan, Wang and Weisbach (2016) find that disinvestment increases during the fiscal year when the new CEO takes over from the exiting CEO. In Table 6, we also examine the percentage change in the divestment rate. The divestment rate is defined as the ratio of dollar property sales to beginning period assets during the transition period of the CEO. Although the changes in divestment rates are statistically insignificant, the signs and the figure are strictly analogous to that found by Pan, Wang and Weisbach (2016) (see their Figure 1, pg. 2965). The scale of the divestment rate is given by the vertical right side of the figure. Essentially, the divestment rate increases during the year the new CEO comes on board and continues until the end of her first full fiscal year. Afterward, the divestment rate begins to fall. In Table 8, we explore, in a multivariate setting, the impact of internal governance on the divestment rate and the gains obtained from the sale of assets. In Columns (1) and (2), we use as our dependent variable property sales (Compustat item SPPE) that is scaled by beginning period assets and internal governance is defined for the outgoing CEO for the fiscal year when the new CEO takes over. All other control variables are the same as before. The main explanatory factors are again *Distance1* and *Distance2*. Note that the coefficients for our *Distance* variables are not significant.

There are two possible explanations for why the new CEO wishes to divest assets of the firm. The first explanation is that the new CEO recognizes that the old CEO made poor investment decisions, which the new CEO is correcting. If this were the case, we would expect the firm to recognize losses upon the disposal of these assets. The second explanation is that the outgoing CEO made appropriate acquisitions during her tenure, but the asset mix does not match well with the skill set of the incoming CEO. If this were the case, then the divested assets should not incur any loss and perhaps even a gain; the beneficial effect of good internal governance on investment policy is further strengthened, in that it not only mitigates the underinvestment problem but also improves the quality of acquired assets. To examine these twin explanations, we regress the gains/losses of property sales (Compustat item SPPIV) scaled by the beginning period assets. Note that according to Compustat when SPPIV is a positive number, it represents the losses incurred from an asset disposal. The regression results are presented in Columns (3) and (4) of Table 8. Note that both coefficients for our *Distance* variables are positive, indicating that the further the distribution of tasks before the new CEO takes over is from its optimum, the greater the loss the firm incurs when it sells its assets. This indicates that good internal governance reduces the probability that the new CEO is disposing of assets at a loss. Taken together, the empirical evidence of Tables 6 – 8, suggests that good internal governance improves the deteriorating investment policy of the outgoing myopic CEO in terms of both dollar amount and quality of assets acquired, and the asset disposals incurred at the beginning of a CEO's tenure are likely due to mismatch between the old asset mix and the skill set of the new CEO.

*** Table 8***

We now examine whether internal governance has an impact on a firm's innovation activities during the two years prior to the voluntary retirement of the CEO. We use two proxies to define a firm's innovation activities. The first proxy captures the firm's input into innovation,

namely, *R&D*, defined as the amount of R&D expenditure divided by the total assets at the beginning of the fiscal year. The second proxy captures the firm's output from innovation, namely *Impact*, measured as the number of total citations scaled by the number of patents for a firm in the fiscal year. Columns (1) and (2) of Table 9 summarize the regression results of the change in the R&D investment rate beginning from two years prior to turnover year 0 to year t. Similarly, Columns (3) and (4) of Table 9 present the change in *Impact* beginning from two years prior to turnover year 0 to year t. Panel A presents the results for t = 0 and Panel B presents the results for t = -1. Again, our main explanatory variable is our *Distance* variables and the coefficients on *Distance* are negative for *R&D* whilst positive for *Impact*. Moreover, the *Distance* coefficients for *Impact* are significantly positive for t = -1, a period when the older CEO is not working with the incoming new CEO on the transition strategy. Recall since we are taking the difference between t = -2 and either -1 or 0, a positive *Distance* coefficient for *Impact*, implies a reduction in patent citations, whereas a negative *Distance* coefficient for *R&D*, implies a tendency for *R&D* overspending. Hence, the positive *Distance* coefficients imply that as the firm's internal governance departs from the optimum given the horizon of the older CEO, the more likely the firm will render inferior corporate innovation outcomes at the same, if not higher, level of R&D expenditures. In addition, between the period of two years prior to the turnover event and one year prior to the turnover event, the coefficients for *Young* are significantly negative for all the regressions. We interpret these results as indicating that driven by career and reputation concerns, younger CEOs who leave voluntarily (presumably because they found other opportunities) are more likely to enhance R&D investment beginning two years prior to their retirement and the R&D expenditure is proven to be more impactful as measured by the number of citations. We interpret these results to be consistent with the career concerns model of Gibbons and Murphy (1992).

Table 9

V.3 Endogeneity

Because our control variables and δ can be jointly determined by some unobserved omitted variables, our empirical estimates of Table 5 could be affected by endogeneity. However, we believe that our results are not materially affected by endogeneity concerns for several reasons. First, we include firm, industry and year fixed effects to control for time invariant omitted variables. Second, we use Hirano and Imbens's (2007) continuous matching by the Generalized Propensity Scoring (GPS) method to confirm that our results do not suffer from endogeneity concerns. GPS approach could effectively balance covariates in the sample without relying on instrumental variables (IVs) of strict exclusion restriction. The Appendix will describe in more detail the GPS methodology. In Table 10, we report the GPS-adjusted and GPS-unadjusted *t*-statistics for each of our covariates. Note that the GPS-adjusted *t*-statistics are generally less than the GPS-unadjusted *t*-statistics. Since the GPS-adjusted *t*-statistics are generally insignificant, we find that the mean values of our covariates are persistent across different levels of δ. Hence, GPS generally improves the independence of our internal governance variable.

Table 10

Table 11 summarizes the regression coefficients of our model given by Equation (1) after we include the flexible function of GPS. Columns (1) and (2) summarize the results with *Horizon* as one of our control variables and Columns (3) and (4) summarize the results when we use *Age* as our control variable. Note, the results in Table 11 are analogous to those of Table 5. We obtain similar first-order conditions as before and moreover, the second derivative results lead to the same conclusion that internal governance is important to mitigate CEO myopia for older outgoing CEOS.

Table 11

Nevertheless, GPS cannot address potential endogeneity due to unobservable covariates. However, we also include a robust set of time-varying control variables that control for CEO

characteristics (such as CEO pay-performance sensitivity, whether the former CEO is the founder of the company), governance characteristics (such as the percentage of outside directors on the board, the size of the board) and various firm characteristics.

V4. Robustness Tests

In this subsection, we report the results of several robustness tests. It is possible that our internal governance variable may substitute for succession planning which can reduce the friction and inefficiency of management transition. Consistent with Cvijanovic et. al (2022), we create a dummy variable that captures succession planning. Specifically, we examine the proxy statements (DEF-14A) for each firm in our sample using a computer script to identify disclosure of succession plans. We search for keywords and/or phrases such as "leadership development," "succession plan(s)," and "succession planning," "plan(s) for succession". We create a unitary dummy variable equal to one if the proxy statement includes such terms. As a robustness test, we include this dummy variable as an independent variable in the regression used in Table 5. The results are reported in Table 12. Essentially, we have the same results that we obtained in Table 5 and our succession variable is not significant.

Table 12

Gibbons and Murphy (1992) derive the optimal contract as a trade-off between explicit incentives and implicit contracts such as career concerns. Specifically, CEOs are implicitly incentivized early in their career from their reputation in the labor market, which could partially substitute for a higher explicit incentive contract. During these years, CEOs would be more willing to undertake costly unobservable managerial actions to correctly increase the market's assessment of their ability. Later in their career, CEOs require a higher explicit pay-performance sensitivity to compensate them for reduced career concerns. However, explicit pay-for-performance may not be enough to cure CEO myopia and the Board of Directors may include horizon contracting to

combat the short-sightedness of CEOs who plan to retire soon. Accordingly, we now control for the compensation duration as defined by Gopalan, et, al (2014) who calculate compensation duration as follows.

$$Duration = \frac{(Salary + Bonus) \times 0 + \Sigma_{i=1}^{n_1} Restricted\ stock_i \times t_i + \Sigma_{j=1}^{n_2} Option_j \times t_j}{Salary + Bonus + \Sigma_{i=1}^{n_1} Restricted\ stock_i + \Sigma_{j=1}^{n_2} Option_j} \quad (6)$$

We use BoardEx to obtain the contract details (vesting periods) for all components of the CEO's managerial contracts. In Table 13, we report the results of including *Duration* as an added independent variable to the regressions reported in Table 5. The coefficient of *Duration* is positive indicating that firm value increases with contractual arrangements that mitigate CEO myopia problem. Nevertheless, the quadratic relationship between δ and market value and the significance of the interaction variables with *Horizon* and *Age* are qualitatively similar to what we obtained in Table 5. We also examine the second derivative properties of the empirical specification and find as before that δ^* minimizes firm value for younger CEOs but maximizes firm value for older CEOs.

Table 13

Our final robustness test is to use a proxy for succession planning. In particular, we consider the possibility that some senior subordinate executives are being groomed for the succession of the retiring CEO. We consider two such executives: the Chief Operating Officer (COO) and the Chief Financial Officer (CFO), respectively. For each executive, we substitute our definition of δ for the ratio of the number of tasks given to the CEO compared to either the COO or CFO. The results are summarized in Table 15, and we see the coefficients for these alternative internal governance mechanisms are not significant.

Table 15

VI. Conclusions

The existing literature finds evidence for a CEO's investment cycle wherein a firm experiences a decrease in total investment a year or two before the CEO retires, followed by an increase in investment and asset divestitures when the new CEO takes over (Pan, Wang and Weisbach (2016). AMR theorize that internal governance may mitigate the CEO horizon problem and that the optimal internal governance would trade off responsibilities or tasks between the CEO and the top executives. This paper empirically tests the predictions of the AMR model relating internal governance on the CEO's investment cycle using a sample of firms wherein CEO turnover is voluntary. Our empirical specification allows us to consider the reputational and career concerns of younger CEOs who leave voluntarily and who presumably do not have a myopia problem. We find a dynamic optimal internal governance that varies by age for older CEOs, whereas optimal internal governance does not exist for younger CEOs. These results are consistent with AMR since older CEOs are more likely to face the agency problems of myopia. Younger CEOs are more concerned with their reputation and its impact on their career trajectory, consistent with the Gibbons and Murphy (1992) model. Furthermore, we find that firm performance is increasing and then decreasing in δ for older CEOs, in line with the implications of the AMR model. These results are consistent with the results of Aggarwal, Fu and Pan (2017). These results are robust to controlling for i) endogeneity concerns of internal governance (using generalized propensity scoring), ii) measures of other governance mechanisms (i.e., the board size, proportion of outsiders on the board, CEO pay slice, founder, CEO pay-performance sensitivity, pay duration and succession planning).

We find that good internal governance helps reduce older CEOs under-investing before their exit, whereas bad internal governance does not. We also find that the divestment activity in the first fiscal year of the new incoming CEOs is profitable. Such findings are consistent with the

theoretical predictions of AMR wherein the internal governance mechanism is effective only if the CEO is myopic. Additionally, we find that older outgoing CEOs of firms with effective internal governance are more likely to conduct impactful and quality corporate innovation as measured by the number of total citations scaled by the number of patents for a firm in the fiscal year.

Future research might examine if internal governance has an impact on other managerial decisions such as payout policy, merger strategies and managerial disclosure policies.

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Appendix A: Continuous Matching by Generalized Propensity Score

In the knowledge that any potential instrumental variables for δ may directly affect firm performance and investment policy, and thus violate exclusion restriction, we use an alternative approach, continuous matching by Generalized Propensity Score (Hirano and Imbens 2007), to mitigate endogeneity. Assuming that the conditional distribution of δ on the instruments *Horizon* and *Age* and other covariates (X) is a normal distribution, we could denote the relation between explanatory variables and covariates as follows.

$$\delta_{it} \mid X_{it} \sim N(\beta_0 + \beta_1' X_{it}, \sigma^2) \tag{A1}$$

The above expression also assumes that the mean level of δ is a function of covariates X_{it} while the variance (σ^2) does not. We use maximum likelihood estimation to estimate the coefficients of the above model and use the parameter estimates to calculate the conditional probability density function of δ for levels of treatment (Generalized Propensity Score or GPS) as follows. The parameter estimates are summarized in Table A1.

$$GPS_{it} = r(\delta, X) = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} \exp\left(-\frac{1}{2\hat{\sigma}^2}(\delta_{it} - \beta_0 - \beta_1' X_{it})^2\right) \tag{A2}$$

As suggested in Hirano and Imbens (2007), we validate the generalized propensity score (GPS) by checking the effect of GPS on the balance of the covariates. If in general GPS could moderate mean differences of covariates across different levels of δ, the first stage specification for GPS does ameliorate endogeneity concerns. We calculate the GPS-adjusted *t*-statistics for the difference of means across different groups (treatment levels) of the variable of interest, δ. If the *t*-statistics are in general insignificant, namely, the means of the covariates are largely equal across

different δ groups, the balancing property of GPS is effective and we can claim that δ is independent of the covariates, X, conditional on GPS, i.e., $\delta \perp X \mid r(\delta, X)$. Specifically, the test could be organized as follows: (a) Sort δ into three groups: low, middle and high; (b) For each group t, we approximate GPS by evaluating it at the median δ of the group. We then sort the GPS into quintiles ($k_t = 1,2, \dots, 5$) for each group t; (c) For each GPS quintile k_t determined by an explanatory variable group t, we test the mean difference of covariates X_i between values with $\delta \in t$ and values $\delta \notin t$, resulting in five *t*-statistics; (d) Given an explanatory variable group t, we combine the five differences in means weighted by the number of observations in each GPS quintile (W_{k_t}) as follows,

$$GPS - tstat = \sum_{k_t=1}^{5} \frac{W_{k_t}}{\sum_{k_t}^{5} W_{k_t}} Stat_{k_t} \quad \text{(A3)}$$

where $Stat_{k_t}$ is the unadjusted GPS, is the *t*-statistic for each *t*-test of the quintile group; (e) If GPS-adjusted *t*-statistics are generally insignificant, we could argue that the mean values of our covariates are persistent across different levels of δ. Hence, GPS generally improves the independence of our internal governance variable. As will be shown in the following section, the GPS-adjusted *t*-statistics are generally insignificant. As a result, we control GPS as a flexible function in the model specification of our interest to examine the severity of endogeneity. For example, let R_{it} be the GPS score for each firm observation, we estimate the hump-shaped relationship between performance and δ, and the regression is as follows.

$$\begin{aligned} OutcomeVariable_{it} &= \beta_0 + \beta_1 \delta_{it} + \beta_2 \delta_{it}^2 + \beta_3' X_{it-1} + \beta_4 R_{it} + \beta R_{it}^2 \times \delta_{it} + \lambda_i + \mu_t \\ &+ \varepsilon_{it} \end{aligned} \quad \text{(A4)}$$

Table A1: Regression of Internal Governance Measure δ on Covariates

This table summarizes the first-stage results of GPS regression. Please refer to Table 1 for variable definitions. Our sample period is from 1996 to 2017. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t-statistics* are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denotes statistical significance at the 1%, 5% and 10% levels, respectively.

	GPS First Stage
Horizon	-0.003***
	(-6.70)
Age	-0.003***
	(-8.52)
Size	0.001
	(0.90)
Leverage	0.001
	(0.21)
Firmage	-0.002***
	(-4.69)
Segments	0.000
	(0.50)
Director	-0.001**
	(-2.32)
Outsider	0.021***
	(5.60)
Chair	0.036***
	(28.41)
Founder	-0.027***
	(-6.77)
Payslice	0.037***
	(5.47)
PPS	-0.000
	(-1.02)
FF10 FE	Yes
Year FE	Yes
Firm FE	Yes
Adj.R^2	0.463
N	19454

Appendix B: Construction of the Internal Governance, δ, Measure

Following the approach in Aggarwal, Fu and Pan (2017), δ is calculated as the number of executive titles of CEO scaled by the total number of executive titles carried by the entire top management team of five executives. We split the title string of each executive using four delimiters or conjunction words: 1) ",", 2) ";", 3) "&", 4) "and". Then the number of pieces split from the title string is the number of corporate titles held by the executive. Moreover, as is done by Aggarwal et al (2017), we eliminate terms such as "R&D", ", LLC", ", U.S.", etc., which can cause biases in counting the titles. However, according to the result of our manual checking, the above data processing procedures are still insufficient to generate a clean measure of the CEO's fraction of corporate titles, leading to serious measurement errors and misspecifications. For instance, in the fiscal year 2004, the executive title of Mark McDonald of AAR Corp. is recorded as "group vp-structures & systems, maintenance, repair and overhaul". The mechanical application of the aforementioned method would count five titles of the executive, who is the group vice president of a certain division with only 1 corporate title. As such, when dealing with our sample of extended longitudinal data from 1996 to 2017 with a varied cross-section of titles, the above method would result in quadrupling or quintupling the number of titles, introducing substantive biases into the primary proxy. In the knowledge of such an empirical challenge, we develop a well-rounded framework of title counting, utilizing the features and functions based on *regular expression* in R for string processing.

Regular expression or *regex* is a special string representation for abstracting and describing common patterns of multiple strings. R, as a powerful statistical computing language, enables us to effectively process title strings using *regex* and thus is chosen as the primary programming language to develop the title-processing system for our paper. Based on intensive experiment, sampling and manual checking, we recognize the five most common patterns as the building blocks

to constitute more complex strings that often trigger biased title counts: 1) "of … and …", 2) "of…,… and", 3) " of … and … and", 4) "of … and … of", 5) "… and … officer or head". Each of the above patterns represented by certain *regex* codes requires a particular form of treatment when computing the number of executive titles. The first *regex* is to identify the title strings in which the string contains "of" followed by at least one "and". For instance, in fiscal year 2003, Alan J. Black of GREAT ELM CAPITAL GROUP INC carried the executive title recorded as "senior vp; managing director of Europe, Middle East and Africa", which is clearly captured by the first pattern. To fix the problem, we need to know whether or not, or if so, how many commas or/and "and" appear in that structure. Thus, we need to further utilize the second and third *regex* to figure out the detailed composition of the title string. Given the fact that the common patterns of the title string in the above example only contain one comma between "of" and "and", the correct number of titles can be calculated algorithmically as the number of split parts minus the sum of one and the number of commas, generating the result of two titles. Similar to the second and third common patterns, the fourth pattern is also closely associated with the first *regex* pattern. The fourth *regex* flags titles such as "Chairman, Chief Executive Officer, President, Chairman of American Airlines Inc, Chief Executive Officer of American Airlines Inc and President of American Airlines Inc", held by Gerard J. Arpey of AMERICAN AIRLINES GROUP INC, in the fiscal year 2009. The fourth pattern identifies title strings in which the word "and" connects multiple independent corporate titles, such as "Chief Executive Officer of American Airlines Inc" and "President of American Airlines Inc." Accordingly, we should follow the method of splitting purely by delimiters, resulting in 6 distinct titles. The last regular expression captures the corporate titles whose name contains the word "and" or the symbol "&". For example, "executive vp, general counsel, chief ethics & compliance officer" held by Paul R. Shlanta of SOUTHERN CO GAS in 2005 falls into this last category. The fifth *regex* pattern adjusts the word "and" or "&" in the title

of "chief ethics & compliance officer" as one corporate title. Thus, based on the above five regular expressions, we could develop a title-processing system, which identifies all the trouble-making patterns and automatically fixes the majority of the miscounting.

Although *regex* is useful in minimizing misspecification, some highly complex titles can be identified by the system but can't be resolved algorithmically, and therefore we rely on manual correction.[10] For instance, D. Bryan Jordan carries the executive title "Chairman, Chief Executive Officer, President, Member of Credit Policy & Executive Committee, Member of Executive & Risk Committee, Chief Executive Officer of First Tennessee Bank, President of First Tennessee Bank and Director of First Tennessee Bank", which is a mixture of patterns one, two, three and four. Furthermore, throughout the entire timeframe from 1992 to 2017, we observe two distinct styles of recording executive titles. In early data, especially before 2000, the title field of executives commonly used symbols and abbreviations, such as using "-", "&", "offr." and "vp" to represent "of", "and", "officer" and "vice president"; in more current data, especially after 2007, the title field primarily use full words and expressions to record annual title. Our title-processing framework can deal with two recording styles simultaneously. We also use the program to identify and eliminate individuals who only held advisory positions, membership of committees and nonexecutive titles such as chairman. The specific definition, example and variation of the above-mentioned regular expressions are addressed in detail in the following table:

	Fiscal Year	CEO name	Company Name	Title String	Title Number
[1] "of … and …"	1996	John P. Jones, III	AIR PRODUCTS & CHEMICALS INC	"exec. v-p-gases & equip."	1
	2004	Gary F. Kennedy, Esq.	AMERICAN AIRLINES GROUP INC	"senior vp, general counsel & chief compliance officer-AMR and American"	3
	2012	Carlos Alban	ABBOTT LABORATORIES	"Senior Vice President of Proprietary Pharmaceutical Products and Global Commercial Operations"	1
[2] "of… [,]… and"	2003	Alan J. Black	GREAT ELM CAPITAL GROUP INC	"senior vp; managing director of Europe, Middle East and Africa"	2

[10] We still had to manually check over 1,000 titles.

[3] " of … and … and"	2013	Paul H. Grazewski	AMERICAN SCIENCE ENGINEERING	"Senior Vice President of Product Management, Marketing & Strategy"	1
	2017	Thomas P. Gibbons	BANK OF NEW YORK MELLON CORP	"Vice Chairman & CEO of Clearing, Markets and Client Management"	2
	2006	Susan L. Decker	ALTABA INC	"head of advertiser and Publisher group & chief finance officer"	2
	2007	Steven E. Buller, CPA	BLACKROCK INC	"managing director, head of accounting policy and controls & former chief finance officer"	2
	2012	Guy H. Kerr	BELO CORP - SER A COM	"Executive Vice President of Law & Government and Secretary"	2
[4] " of … and … of"	2009	Gerard J. Arpey	AMERICAN AIRLINES GROUP INC	"Chairman, Chief Executive Officer, President, Chairman of American Airlines Inc, Chief Executive Officer of American Airlines Inc and President of American Airlines Inc"	6
	2013	Gary F. Kennedy, Esq.	AMERICAN AIRLINES GROUP INC	"Chief Compliance Officer, Senior Vice President, General Counsel, Chief Compliance Officer of American Airlines Inc, Senior Vice President of American Airlines Inc and General Counsel of American Airlines Inc"	6
	2016	Donald E. Brandt, CPA	PINNACLE WEST CAPITAL CORP	"Chairman, Chief Executive Officer, President, Chairman of Arizona Public Service Company, Chief Executive Officer of Arizona Public Service Company and President of Arizona Public Service Company"	6
[5] "… and … officer or head"	2000	Robert R. Herb	ADVANCED MICRO DEVICES	"executive vp, chief sales and marketing officer"	2
	2007	Paul R. Shlanta	SOUTHERN CO GAS	"executive vp, general counsel & chief ethics and compliance officer"	3
	2014	David W. Meline	AMGEN INC	"Executive VP, CFO and Principal Financial & Accounting Officer"	3
[1]+[2]+[3]	2012	D. Bruce Sewell	APPLE INC	"Senior Vice President of Legal & Government Affairs, General Counsel and Secretary"	3
	2014	Peter W. Quigley	KELLY SERVICES INC - CL A	"Senior Vice President of Employment Law & Litigation, Contracts Administration, Government Affairs & Risk Management and General Counsel"	2
	2017	Susan Louise Spradley	VIAVI SOLUTIONS INC	"Executive Vice President, General Manager of Business Operations & P&L and General Manager Product Line Management & Design, Network Enablement & Service Enablement"	3
[1] + [2] + [4]	2011	Steven Jackson Sell	HEALTH NET INC	"President of Western Region Health Plan, Health Net, Inc. and President of Health Net of California, Inc."	2
	2013	Jonathan David Kantor	CNA FINANCIAL CORP	"Executive Vice President, Secretary, General Counsel, Executive Vice President of CNA Insurance Companies, General Council of CNA Insurance Companies and Secretary of CNA Insurance Companies"	6
	2015	Valrie Hermann	RALPH LAUREN CORP	"Global Brand President of Luxury, Women's Collections, and World of Accessories"	1
[1]+[2]+[3]+[4]	2012	P. Kelly Tompkins	CLEVELAND-CLIFFS INC	"Executive Vice President of Legal, Government Affairs and Sustainability and President of Cliffs China"	2
	2013	John J. Tracy	BOEING CO	"Chief Technology Officer, Senior Vice President of Operations, Engineering & Technology and Member of Executive Council"	3

Table 1: Variable Definitions

This table reports the variables used in our empirical analysis and their definitions.

Variable	***Description***
M/B	The current year's industry-adjusted market-to-book ratio is defined as the firm's market-to-book ratio minus the industry's median market-to-book ratio. The median is calculated at the two-digit SIC industry-year level using the Compustat universe.
δ	Denotes the current year's fraction of executive titles held by the CEO and proxies for the relative contribution of the CEO to the entire cash flow of the firm. It is calculated as the number of executive titles of CEO (f) scaled by the total number of titles carried by the top management team of the top five managers including the CEO ($f + g$). The number of titles is calculated using our screening method built upon ReGex.
f	Current year's number of executive titles carried by the CEO including chair and membership of board and executive committees.
g	Current year's number of executive titles carried by the top four non-CEO executives ranked by total compensation.
IG	Indicator of effective internal governance, which is defined as a dummy variable that takes the value of one if δ falls within the optimal range. The optimal range is based upon the relationship between δ and firm performance using the average inflection point as shown in Table 8 based upon the coefficients of δ and δ^2 as reported in Tables 4 and 5.
Investments	Current year's capital expenditures rate (capital expenditures/ beginning of period assets) + acquisition rate (acquisitions/ beginning of period assets)
Sppe	Current year's property sales/ beginning of period assets
Sppiv	Current year's gains or losses of property sales/beginning of period assets.
Leverage	One-year lagged values of (long-term debt + debt in current liabilities)/ beginning of period assets
Size	One-year lagged values of the natural logarithm of assets
R&D	The amount of research and development expenditures/ beginning of period assets
Segments	One-year lagged values of the number of business segments where the firm operates.
Firm Age	One-year lagged value of the number of years that a firm has data available in Compustat.
Directors	Total number of directors serving on the board in the current year
Outsiders	Fraction of outside directors serving on the board in the current year.
Chair	A dummy variable takes the value of unity if the outgoing CEO is the chair of the board of directors in the current year.
Founder	A dummy variable takes the value of unity if the outgoing CEO is the founder of the firm in the current year.
Tenure	Number of years the CEO is in office in the current year.
Age	Age of the CEO in the current year.
Horizon	Distance to retirement is measured as $Max(65 - Age, 0)$, a proxy for the executive horizon of the CEO in the current year.
Payslice	Fraction of total CEO compensation out of the total compensation for the whole management team in the current year.

PPS	Pay performance sensitivity is measured as the CEO's total portfolio delta (in thousands) in the current year.
Distance	*Distance1* is the absolute value difference between the firm's δ and the optimum δ^* given by Equations (2) of the paper as a function of *Horizon* and *Distance2* is the absolute value of the difference between the firm's δ and the optimal δ^* given by Equation (3) as a function of the *Age*, assuming the CEO is older than 54. If the CEO is younger than 54, the *Distance* variables are set equal to zero.
Impact	The impact of patenting activities is measured as the number of total citations scaled by the number of patents for a firm in the fiscal year
Young	A dummy variable that is equal to one if the CEO is younger than 54. Otherwise, it equals zero.
Succession	A dummy variable that takes the value of unity if the firm includes a CEO succession plan in its proxy statement and zero otherwise. This measure follows Cvijanović, Gantchev and Li (2022) and McConnell and Qi (2022) to determine whether or not a succession plan is in place for a firm in a given year.
Duration	The duration of CEO compensation follows Gopalan et al. (2013).

Table 2: Descriptive Statistics

This table reports the descriptive statistics of our sample for the period from 1996 to 2017. See Table 1 for variable definitions.

	N	Mean	Median	p25	p75	Std. Dev.	Skewness	Kurtosis
δ	28268	0.263	0.250	0.222	0.300	0.069	0.566	3.848
f	28268	2.646	2.000	2.000	3.000	1.042	2.135	10.759
g	28268	10.103	10.000	8.000	11.000	2.807	1.948	10.769
Tenure	28268	7.617	5.000	2.000	10.000	7.281	1.925	8.027
Age	27896	55.650	56.000	51.000	60.000	7.122	0.239	3.780
Horizon	27896	9.716	9.000	5.000	14.000	6.361	0.385	2.681
Chair	28268	0.579	1.000	0.000	1.000	0.494	-0.322	1.104
Founder	28268	0.028	0.000	0.000	0.000	0.166	5.701	33.497
CPS	28266	0.331	0.332	0.292	0.372	0.083	-0.188	7.340
PPS	27164	635.331	198.883	73.593	533.267	1510.539	5.385	35.847
M/B	28028	1.632	0.425	-0.204	1.645	43.381	79.630	10129.030
Size	28255	7.761	7.662	6.538	8.890	1.716	0.318	3.150
Leverage	28254	0.246	0.223	0.073	0.359	0.247	15.921	956.478
R&D	28255	0.029	0.000	0.000	0.029	0.066	6.821	104.487
Firm Age	28268	29.618	26.000	16.000	42.000	16.648	0.530	2.289
Segments	28268	2.867	2.000	1.000	4.000	2.407	1.750	7.151
Directors	20154	9.503	9.000	8.000	11.000	2.498	0.975	6.480
Outsiders	20154	0.719	0.778	0.600	0.875	0.195	-1.036	3.353
Investments	16004	0.102	0.058	0.026	0.117	0.173	8.742	164.148
Sppe	19410	0.004	0.000	0.000	0.002	0.033	80.243	8980.798
Sppiv	25257	-0.003	0.000	-0.001	0.000	0.049	-74.148	7240.234
Impact	9416	5.577	2.500	0.800	6.179	11.478	9.497	162.794
Intensity	26554	0.008	0.000	0.000	0.000	0.023	4.083	25.164
Percentage	26556	0.147	0.000	0.000	0.000	0.325	1.991	5.297
Duration	9796	1.136	1.055	0.620	1.534	0.816	10.724	448.118
Succession	30072	0.283	0.000	0.000	1.000	0.451	0.963	1.927

Table 3: Correlation Matrix Between Internal Governance and Other Governance Variables
This table reports the matrix of correlation coefficients for the internal governance variable (δ), other governance mechanisms (board size, proportion of outsiders on the board and CEO pay-performance sensitivity) and CEO power (pay slice and whether the CEO is the founder). See Table 1 for variable definitions. ***, ** and * denotes statistical significance at the 1%, 5% and 10% levels, respectively.

	δ	*Director*	*Outsiders*	*PPS*	*Payslice*	*Founder*
δ	1					
Director	0.048***	1.0000				
Outsiders	0.143***	0.064***	1			
PPS	-0.033***	0.016**	-0.019***	1		
Payslice	0.062***	0.023***	-0.103***	-0.100***	1	
Founder	0.021***	-0.088***	0.082***	0.079***	-0.067***	1

Table 4: Regressions of Firm Performance on Internal Governance for Whole Sample and Subsamples by Horizon/ Age

This table summarizes the results of regressing firm performance variables (current year's industry-adjusted market-to-book ratios) on the internal governance variable δ and other control variables. See Table 1 for variable definitions. Column (1) presents the results for the entire sample, Column (2) presents the results for CEOs with shorter horizon (9 years or less) and Column (3) presents the results for younger CEOs (defined as those whose age is less than the median CEO age of 56 years). Our sample period is from 1996 to 2017. See Table 1 for variable definitions. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	M/B		
	Whole Sample	Horizon Shorter	Horizon Longer
	(1)	(2)	(3)
δ	1.996*	5.707***	-2.777
	(1.70)	(3.34)	(-1.52)
δ^2	-2.045	-8.012***	4.229
	(-1.06)	(-2.98)	(1.39)
Size	-1.018***	-1.057***	-1.009***
	(-18.00)	(-12.99)	(-10.40)
Leverage	1.168***	1.477***	0.376
	(3.82)	(3.62)	(0.76)
Firmage	-0.053***	-0.029	-0.083***
	(-4.21)	(-1.46)	(-3.76)
Segments	-0.022**	-0.026*	-0.031*
	(-2.18)	(-1.78)	(-1.80)
Director	-0.017	-0.021	-0.014
	(-1.59)	(-1.48)	(-0.80)
Outsider	0.121	0.281	0.159
	(0.93)	(1.51)	(0.83)
Chair	-0.110**	-0.168**	0.058
	(-2.46)	(-2.57)	(0.74)
Founder	0.084	-0.372**	0.400**
	(0.64)	(-2.31)	(1.99)
Payslice	1.518***	1.548***	1.470***
	(5.18)	(4.22)	(3.08)
PPS	0.000***	0.000***	0.001***
	(16.87)	(10.53)	(9.99)
FF10 FE	yes	yes	yes
Year FE	yes	yes	yes
Firm FE	yes	yes	yes
Adj.R^2	0.106	0.097	0.112
N	19,117	10,054	9,063

Table 5: Regression of Firm Performance on Internal Governance Incorporating Horizon or Age
This table summarizes the results of regressing firm performance variables (current year's industry-adjusted market-to-book ratios) on the internal governance variable δ and other control variables. Our sample period is from 1996 to 2017. See Table 1 for variable definitions. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	M/B	
	Horizon	Age
	(1)	(2)
δ	6.908***	-25.545***
	(3.52)	(-2.59)
δ^2	-8.914***	35.582**
	(-2.71)	(2.06)
Horizon	0.097***	
	(3.60)	
Horizon $\times \delta$	-0.524***	
	(-2.76)	
Horizon $\times \delta^2$	0.723**	
	(2.20)	
Age		-0.094***
		(-3.89)
Age $\times \delta$		0.490***
		(2.85)
Age $\times \delta^2$		-0.671**
		(-2.23)
Size	-1.009***	-1.007***
	(-17.82)	(-17.79)
Leverage	1.170***	1.170***
	(3.82)	(3.82)
Firmage	-0.051***	-0.050***
	(-3.99)	(-3.97)
Segments	-0.022**	-0.022**
	(-2.22)	(-2.24)
Director	-0.016	-0.016
	(-1.52)	(-1.51)
Outsider	0.112	0.104
	(0.86)	(0.80)
Chair	-0.061	-0.045
	(-1.31)	(-0.96)
Founder	0.112	0.137
	(0.86)	(1.05)
Payslice	1.588***	1.586***
	(5.38)	(5.38)
PPS	0.000***	0.000***
	(16.97)	(17.09)
FF10 FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*
Adj.R^2	0.107	0.108
N	19,117	19,117

Table 6: Changes in Investment Rates Around CEO Turnover

This table presents differences in the average investment and divestment rates surrounding CEO turnover. The year the incoming CEO leads the firm is designated as year zero. The time interval (in years) in which the test of difference is performed is indicated in the column headings. *Investments* is defined in Table 1. The table presents the mean of differences in *Investments* 2 years prior to the turnover and year *t*, where *t* = -1, 0, 1 and 2. The table also provides the percentage change of the *Divestments* beginning two years prior to the CEO turnover. The scale of the investment rate (divestment rate) is given by the vertical left (right) side of the figure. *t-statistics* are given in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	(-2,-1)	(-2,0)	(-2,1)	(-2,2)
Investments	0.005*	0.014***	0.011**	0.003
	(0.931)	(2.805)	(2.038)	(0.503)
	(-2,-1)	(-2,0)	(-2,1)	(-2,2)
Disinvestments %	0.033	-0.051	-0.067	0.009
	(0.402)	(-0.571)	(-0.806)	(0.115)

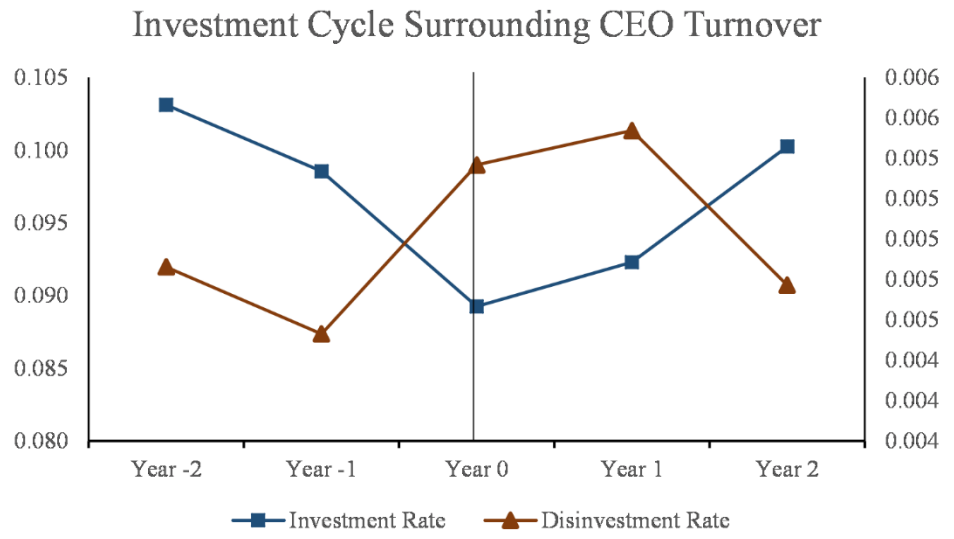

Table 7: Regressions of Changes in Investment Rates Prior to CEO Turnover on Distance from Dynamic Optimal Internal Governance by Horizon or Age

This table summarizes the result of the change in the investment rate of the firm prior to the voluntary retirement of the CEO. The main explanatory variable is *Distance1* defined for CEOs younger than 54 as the absolute value difference between the firm's δ and the optimum δ^* given by Equations (2) of the paper as a function of *Horizon* and *Distance2* is the absolute value of the difference between the firm's δ and the optimal δ^* given by Equation (3) as a function of the *Age.* Otherwise, the distance variables are set to zero. See Table 1 for variable definitions. *Young* equals one for the younger CEOs. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	ΔInvestment Rate (-2, 0)		ΔInvestment Rate (-2, -1)	
	Horizon	Age	Horizon	Age
	(1)	(2)	(3)	(4)
Distance1	0.142		0.111***	
	(1.50)		(2.59)	
Distance2		0.157*		0.109**
		(1.70)		(2.56)
M2B	-0.007*	-0.007	0.006*	0.006*
	(-1.65)	(-1.64)	(1.70)	(1.70)
ROA	0.052	0.052	-0.195	-0.194
	(0.43)	(0.43)	(-1.29)	(-1.28)
Size	0.071***	0.072***	0.119***	0.119***
	(2.77)	(2.79)	(4.08)	(4.08)
Leverage	0.452***	0.451***	0.376***	0.376***
	(2.89)	(2.89)	(2.58)	(2.59)
Firmage	0.008	0.008	0.014	0.014
	(0.90)	(0.91)	(1.48)	(1.47)
Segments	-0.005	-0.005	-0.001	-0.001
	(-1.06)	(-1.06)	(-0.38)	(-0.38)
Director	-0.007	-0.007	-0.005	-0.005
	(-0.98)	(-1.02)	(-0.80)	(-0.80)
Outsider	0.143**	0.144**	-0.059	-0.059
	(2.22)	(2.23)	(-1.00)	(-1.00)
Chair	0.040***	0.040***	-0.033*	-0.033*
	(2.84)	(2.83)	(-1.76)	(-1.77)
Founder	-0.180***	-0.181***	0.018	0.019
	(-2.98)	(-3.00)	(0.17)	(0.18)
Payslice	-0.141*	-0.140*	0.095	0.094
	(-1.80)	(-1.78)	(1.17)	(1.16)
PPS	-0.000	-0.000	-0.000	-0.000
	(-0.70)	(-0.72)	(-0.37)	(-0.37)
Young	0.054**	0.056**	0.026	0.025
	(2.01)	(2.13)	(1.19)	(1.14)
FF10 FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Adj.R^2	0.177	0.177	0.183	0.183
N	1,067	1,067	996	996

Table 8: Regressions of SPPE and SPPIV at CEO Turnover on Distance from Dynamic Optimal Internal Governance by Horizon or Age

This table reports the results of the regression whereby the dependent variable is either the ratio of dollar property sales to beginning period assets (*Sppe*) in the year of CEO turnover or the ratio of dollar gains or losses on property sales to beginning period assets (*Sppiv*) in the year of CEO turnover. The main explanatory variables are *Distance1, Distance2* and *Young.* See Table 1 for variable definitions. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	SPPE		SPPIV	
	Horizon	Age	Horizon	Age
	(1)	(2)	(3)	(4)
Distance1	-0.016		0.023**	
	(-0.99)		(2.28)	
Distance2		-0.012		0.017**
		(-0.92)		(2.52)
M2B	-0.000	-0.000	-0.001	-0.001
	(-1.05)	(-1.03)	(-1.10)	(-1.10)
ROA	-0.104*	-0.104*	-0.024	-0.025
	(-1.66)	(-1.66)	(-0.87)	(-0.89)
Size	-0.000	-0.000	0.009**	0.009**
	(-0.01)	(-0.01)	(2.28)	(2.26)
Leverage	0.026**	0.026**	-0.056**	-0.056**
	(2.42)	(2.42)	(-2.33)	(-2.35)
Firmage	0.001	0.001	-0.001***	-0.001***
	(0.93)	(0.93)	(-3.06)	(-3.08)
Segments	-0.000	-0.000	0.001	0.001
	(-0.25)	(-0.27)	(1.47)	(1.45)
Director	0.000	0.000	0.000	0.000
	(0.10)	(0.09)	(0.26)	(0.32)
Outsider	-0.010	-0.010	0.018**	0.018**
	(-0.74)	(-0.73)	(2.19)	(2.15)
Chair	0.002	0.002	-0.004*	-0.004*
	(0.91)	(0.98)	(-1.69)	(-1.77)
Founder	0.027*	0.027*	-0.000	-0.000
	(1.66)	(1.66)	(-0.03)	(-0.01)
Payslice	0.027	0.026	-0.020*	-0.020*
	(1.15)	(1.14)	(-1.72)	(-1.69)
PPS	0.000	0.000	-0.000	-0.000
	(0.74)	(0.76)	(-0.59)	(-0.60)
Young	0.001	0.002	0.001	-0.000
	(0.68)	(1.05)	(0.24)	(-0.06)
FF10 FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Adj.R^2	0.095	0.094	0.143	0.142
N	792	792	1,086	1,086

Table 9: Regressions of Innovation Input and Output Prior to CEO Turnover on Distance from Dynamic Optimal Internal Governance by Horizon or Age

This table reports the results of the regression whereby the dependent variable is either a change in the R&D investment rate or the change in the R&D's *Impact. R&D* is the amount of research and development expenditures/ beginning of period assets. *Impact* is the number of total citations scaled by the number of patents for a firm in the fiscal year. The main explanatory variables are *Distance1*, *Distance2* and *Young*. See Table 1 for variable definitions. Panel A presents the change of our dependent variables between two years prior to the voluntary turnover event and the date of the turnover event. Panel B presents the results between two years prior to the turnover event and one year prior to the voluntary turnover event. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Change in Innovation Input and Output between -2 and 0				
	R&D (-2, 0)		Impact (-2, 0)	
	Horizon	Age	Horizon	Age
	(1)	(2)	(3)	(4)
Distance1	-0.024		63.032*	
	(-1.22)		(1.75)	
Distance2		-0.022*		28.217
		(-1.74)		(0.88)
M2B	-0.000	-0.000	1.679*	1.685*
	(-0.37)	(-0.34)	(1.71)	(1.70)
ROA	0.023	0.024	-107.429***	-99.934***
	(1.10)	(1.17)	(-3.64)	(-3.53)
Size	-0.010***	-0.010***	-20.073**	-21.495**
	(-3.63)	(-3.74)	(-2.16)	(-2.18)
Leverage	-0.007	-0.008	-2.408	-4.810
	(-0.85)	(-0.92)	(-0.09)	(-0.18)
Firmage	-0.001	-0.001	4.503**	4.319**
	(-1.24)	(-1.21)	(2.13)	(2.01)
Segments	-0.000	-0.000	1.470	1.441
	(-0.47)	(-0.48)	(1.32)	(1.32)
Director	0.001	0.001	1.329	1.851*
	(1.50)	(1.60)	(1.44)	(1.92)
Outsider	-0.004	-0.005	-1.713	3.166
	(-0.50)	(-0.53)	(-0.12)	(0.24)
Chair	-0.001	-0.001	-7.334	-7.448
	(-0.62)	(-0.45)	(-1.25)	(-1.23)
Founder	-0.001	-0.000	0.000	0.000
	(-0.10)	(-0.06)	(.)	(.)
Payslice	-0.015	-0.015	4.688	-2.585
	(-1.26)	(-1.33)	(0.35)	(-0.17)
PPS	-0.000	-0.000	-0.002	-0.003
	(-0.36)	(-0.47)	(-1.28)	(-1.36)
Young	-0.005	-0.005*	3.093	-3.589
	(-1.36)	(-1.78)	(0.42)	(-0.47)
FF10 FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Adj.R^2	0.069	0.077	0.504	0.491
N	1,381	1,381	303	303

Panel B: Change in Innovation Input and Output between -2 and -1				
	R&D (-2, -1)		Impact (-2, -1)	
	Horizon	Age	Horizon	Age
	(1)	(2)	(3)	(4)
Distance1	-0.001		27.549***	
	(-0.37)		(3.13)	
Distance2		-0.004		25.921***
		(-1.27)		(2.87)
M2B	-0.000	-0.000	0.598	0.519
	(-0.13)	(-0.18)	(1.18)	(1.00)
ROA	0.031	0.032	-7.367	-5.262
	(1.20)	(1.23)	(-0.27)	(-0.19)
Size	0.003	0.003	23.129***	22.541***
	(0.96)	(0.95)	(5.23)	(5.09)
Leverage	0.012	0.013	26.873**	28.390**
	(0.87)	(0.91)	(2.20)	(2.30)
Firmage	0.001	0.001	-10.392***	-10.311***
	(0.78)	(0.73)	(-9.59)	(-9.40)
Segments	-0.000	-0.000	1.479***	1.423***
	(-0.82)	(-0.81)	(3.33)	(3.10)
Director	0.000	0.000	-5.248***	-5.133***
	(0.42)	(0.52)	(-4.61)	(-4.41)
Outsider	0.015*	0.015**	26.354***	26.645***
	(1.95)	(1.99)	(3.38)	(3.41)
Chair	-0.002	-0.002	-10.012***	-10.416***
	(-0.88)	(-1.00)	(-3.47)	(-3.55)
Founder	0.009	0.009	0.000	0.000
	(0.90)	(0.89)	(.)	(.)
Payslice	0.034**	0.034**	-123.730***	-123.053***
	(2.27)	(2.29)	(-11.37)	(-11.14)
PPS	-0.000	-0.000	-0.003***	-0.003***
	(-0.09)	(-0.02)	(-4.83)	(-4.86)
Young	-0.006**	-0.007**	-28.883***	-29.231***
	(-2.31)	(-2.47)	(-9.36)	(-9.17)
FF10 FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Adj.R^2	0.081	0.083	0.946	0.944
N	1,125	1,125	284	284

Table 10: Balance Given the Generalized Propensity Score (GPS)

This table presents the results of checking imbalances among major covariates of firm and CEO characteristics before and after GPS adjustment. It reports the unadjusted and GPS-adjusted t-statistics of the test of difference for the equality of means. See Table 1 for variable definitions. Independent t-tests are conducted for each covariate to investigate whether the mean in one of the three δ groups is different from those in the other two groups. Specifically, δ is divided into three groups: low, intermediate and high. GPS in each group is approximated by evaluating at the group median δ. Discretizing both the level of δ and the GPS, adjusted t-statistics are calculated by combining the five differences in means from GPS quintile groups, weighted by the number of observations in each group.

	Unadjusted			Adjusted for the GPS		
	Low	Middle	High	Low	Middle	High
Size	-4.100***	-4.845***	8.287***	-2.645***	-0.397	3.087
Leverage	3.670***	0.244	-3.554***	0.379	0.450	-0.972
Firmage	-10.936***	0.873	8.413***	-4.629***	1.112	3.011***
Segments	-5.157***	0.704	3.609***	-1.224	0.575	0.716
Director	-1.700	-2.664***	4.120	-0.778	-0.251	1.065
Outsider	-10.159***	-3.319***	12.112***	-5.651***	-0.005	5.746***
Payslice	-10.918***	4.576***	5.701***	-2.808***	0.602	1.387
PPS	3.003***	-1.169	-1.552	1.551	-0.558	-0.591
Chair	-20.672***	1.329	17.279***	-5.137***	0.447	4.501***
Founder	-0.469	-0.718	1.117	0.553	-0.267	-0.146

Table 11: Regression of Firm Performance on Internal Governance Controlling for GPS

This table summarizes the empirical results of regressing the internal governance variable δ and its squared term against firm performance variables (current year's industry-adjusted market-to-book ratios), controlling for GPS. See Table 1 for variable definitions. Our sample period is from 1996 to 2017. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t-statistics* are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denotes statistical significance at the 1%, 5% and 10% levels, respectively.

	Horizon		Age	
	(1)	(2)	(3)	(4)
δ	7.317***	7.750***	-25.324**	-25.330**
	(3.56)	(3.50)	(-2.57)	(-2.55)
δ^2	-9.642***	-10.337***	35.125**	35.151**
	(-2.77)	(-2.86)	(2.03)	(2.03)
Horizon	0.097***	0.099***		
	(3.61)	(3.66)		
Horizon × δ	-0.527***	-0.535***		
	(-2.78)	(-2.82)		
Horizon × δ^2	0.726**	0.739**		
	(2.21)	(2.25)		
Age			-0.095***	-0.096***
			(-3.91)	(-3.95)
Age × δ			0.492***	0.499***
			(2.87)	(2.91)
Age × δ^2			-0.675**	-0.686**
			(-2.24)	(-2.28)
GPS	-0.006	-0.028	-0.006	-0.028
	(-0.76)	(-0.67)	(-0.74)	(-0.65)
GPS^2		0.003		0.003
		(0.97)		(0.97)
*GPS** δ		-0.020		-0.022
		(-0.20)		(-0.22)
Size	-1.009***	-1.008***	-1.006***	-1.005***
	(-17.81)	(-17.80)	(-17.79)	(-17.77)
Leverage	1.170***	1.169***	1.169***	1.168***
	(3.82)	(3.82)	(3.82)	(3.82)
Firmage	-0.051***	-0.051***	-0.051***	-0.051***
	(-4.01)	(-4.01)	(-3.98)	(-3.98)
Segments	-0.022**	-0.022**	-0.022**	-0.022**
	(-2.21)	(-2.22)	(-2.23)	(-2.24)
Director	-0.016	-0.016	-0.016	-0.016
	(-1.52)	(-1.51)	(-1.51)	(-1.50)
Outsider	0.110	0.113	0.103	0.105
	(0.85)	(0.87)	(0.79)	(0.81)
Chair	-0.063	-0.061	-0.047	-0.045
	(-1.34)	(-1.29)	(-0.99)	(-0.94)
Founder	0.115	0.112	0.141	0.138
	(0.88)	(0.86)	(1.08)	(1.06)
Payslice	1.590***	1.598***	1.589***	1.597***
	(5.39)	(5.43)	(5.39)	(5.43)

PPS	0.000***	0.000***	0.000***	0.000***
	(16.97)	(16.97)	(17.08)	(17.08)
FF10 FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Adj.R^2	0.107	0.107	0.108	0.108
N	19,117	19,117	19,117	19,117

Table 12: Regression of Firm Performance on Internal Governance Controlling for Succession Plan
This table summarizes the results of regressing firm performance variables (current year's market-to-book ratio) on the internal governance variable δ and other control variables. See Table 1 for variable definitions. This table differs from Table 5 since we also include as a control variable, *Succession,* which equals one if the firm's proxy statement indicates the firm has a succession plan. Our sample period is from 1996 to 2017. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	M/B	
	Horizon	Age
	(1)	(2)
δ	6.916***	-25.520***
	(3.52)	(-2.59)
δ^2	-8.933***	35.577**
	(-2.71)	(2.06)
Horizon	0.097***	
	(3.60)	
Horizon $\times \delta$	-0.524***	
	(-2.77)	
Horizon $\times \delta^2$	0.723**	
	(2.21)	
Age		-0.094***
		(-3.88)
Age $\times \delta$		0.489***
		(2.85)
Age $\times \delta^2$		-0.671**
		(-2.23)
Size	-1.010***	-1.007***
	(-17.82)	(-17.79)
Leverage	1.170***	1.169***
	(3.82)	(3.82)
Firmage	-0.050***	-0.050***
	(-3.97)	(-3.95)
Segments	-0.022**	-0.022**
	(-2.21)	(-2.23)
Director	-0.016	-0.016
	(-1.53)	(-1.51)
Outsider	0.111	0.104
	(0.86)	(0.80)
Chair	-0.061	-0.045
	(-1.30)	(-0.95)
Founder	0.115	0.141
	(0.89)	(1.08)
Payslice	1.592***	1.591***
	(5.40)	(5.40)
PPS	0.000***	0.000***
	(16.98)	(17.09)
Succession	0.048	0.048
	(1.09)	(1.09)
FF10 FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*
Adj.R^2	0.107	0.108
N	19,117	19,117

Table 13: Regression of Firm Performance on Internal Governance Controlling for Duration of Pay

This table summarizes the results of regressing firm performance variables (current year's market-to-book ratio) on the internal governance variable δ and other control variables. See Table 1 for variable definitions. This table differs from Table 5 since we also include it as a control variable, as defined by Gopalan et al. (2013). The duration compensation is a proxy for contract horizon indicating the weighted average percent of total pay that is long-term. Our sample period is from 1996 to 2017. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	M/B	
	Horizon	Age
	(1)	(2)
δ	12.518***	-48.514**
	(3.95)	(-2.53)
δ^2	-18.456***	81.681**
	(-3.65)	(2.52)
Horizon	0.147***	
	(2.80)	
Horizon $\times \delta$	-0.973***	
	(-2.77)	
Horizon $\times \delta^2$	1.597***	
	(2.73)	
Age		-0.141***
		(-2.89)
Age $\times \delta$		0.930***
		(2.84)
Age $\times \delta^2$		-1.527***
		(-2.77)
Size	-1.246***	-1.246***
	(-11.46)	(-11.46)
Leverage	1.449***	1.449***
	(2.82)	(2.82)
Firmage	-0.047*	-0.047**
	(-1.96)	(-1.97)
Segments	-0.045***	-0.045***
	(-2.64)	(-2.63)
Director	0.017	0.017
	(1.00)	(1.00)
Outsider	0.174	0.175
	(0.84)	(0.84)
Chair	-0.021	-0.019
	(-0.23)	(-0.21)
Founder	0.094	0.105
	(0.39)	(0.44)
Payslice	0.734*	0.725*
	(1.78)	(1.76)
PPS	0.000***	0.000***
	(11.10)	(11.11)
Duration	0.106**	0.106**
	(2.48)	(2.48)
FF10 FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*
Adj.R^2	0.107	0.108
N	19,117	19,117

Table 14: Regression of Firm Performance on Internal Governance by COO or CFO

This table summarizes the results of regressing firm performance variables (current year's industry-adjusted market-to-book ratios) on the internal governance variable δ and other control variables. See Table 1 for variable definitions. In this table δ is alternatively the number of titles (tasks) of the CEO divided by the number of titles for the COO and CFO, respectively. Our sample period is from 1996 to 2017. All regressions include industry dummies at the Fama-French 10-industry level, firm-level fixed effects and year dummy variables. *t*-statistics are given in parentheses and all standard errors are two-way clustered by firm and year. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	COO		CFO	
	Horizon	Age	Horizon	Age
	(1)	(2)	(3)	(4)
δ	0.365	-1.623	0.174	-1.085
	(1.47)	(-1.04)	(1.45)	(-1.47)
δ^2	-0.048	0.134	-0.025	0.161
	(-1.44)	(0.47)	(-1.12)	(1.19)
Horizon	0.053*		0.040***	
	(1.84)		(2.86)	
Horizon × δ	-0.030		-0.020	
	(-0.99)		(-1.41)	
Horizon × δ^2	0.002		0.003	
	(0.38)		(1.12)	
Age		-0.052**		-0.040***
		(-2.21)		(-3.27)
Age × δ		0.030		0.019
		(1.17)		(1.55)
Age × δ^2		-0.003		-0.003
		(-0.61)		(-1.24)
Size	-0.954***	-0.951***	-0.694***	-0.695***
	(-5.54)	(-5.52)	(-6.45)	(-6.47)
Leverage	-0.020	-0.027	2.048***	2.044***
	(-0.02)	(-0.03)	(5.40)	(5.39)
Firmage	0.034	0.033	-0.065***	-0.065***
	(0.70)	(0.68)	(-3.20)	(-3.18)
Segments	-0.066**	-0.067***	-0.026*	-0.026*
	(-2.55)	(-2.61)	(-1.92)	(-1.91)
Director	-0.025	-0.025	-0.034**	-0.034**
	(-0.72)	(-0.70)	(-1.97)	(-2.00)
Outsider	-0.014	-0.030	0.448*	0.437*
	(-0.05)	(-0.09)	(1.82)	(1.77)
Chair	0.016	0.022	0.024	0.033
	(0.13)	(0.18)	(0.34)	(0.46)
Founder	0.443	0.476	0.295*	0.323*
	(1.11)	(1.18)	(1.73)	(1.89)
Payslice	1.577**	1.563**	0.294	0.285
	(2.09)	(2.06)	(0.60)	(0.59)
PPS	0.000***	0.000***	0.000***	0.000***
	(7.15)	(7.15)	(8.33)	(8.35)
FF10 FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Adj.R^2	0.135	0.135	0.064	0.064
N	2,943	2,943	8,770	8,770