Wrinkles of Experience: CEO Age and Abnormal Investment*

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Abstract

Firms led by older CEOs significantly reduce their abnormal investment, defined as the deviation from the expected investment levels derived from a Q-theory model. CEOs in the top age tercile are associated with a 4.4% (or approximately $669 million) decline in abnormal investment, driven primarily by reduced overinvestment. This finding is robust to the inclusion of firm- and CEO-level characteristics and potential endogeneity concerns, and is distinct from CEO compensation-based risk-taking incentives, overconfidence, talent, and managerial abilities. CEO recession experience likely serves as a channel through which older CEOs mitigate overinvestment. Overall, the results show that CEO age and recession experience play a significant role in shaping corporate investment policy.

Keywords: CEO Age, Overinvestment, Underinvestment, Q-Theory, Risk-Taking Incentives, Overconfidence, Recession Experience
JEL: G31, G32, G34

1. Introduction

This paper explores how CEO age influences corporate *abnormal* investment, characterized by the deviation from expected investment levels. We extend existing research linking CEO traits—such as age and life experiences—to investment decisions, by testing these traits more directly. Specifically, we rely on an abnormal investment metric based on a Q-theory model to assess overinvestment and underinvestment patterns associated with CEOs at a particular age and with a certain amount of recession experience. Prior studies, including Serfling (2014), suggest that CEOs take on less risky investments as they age. This is an inter-temporal analysis of changes in investment policy as opposed to examination of an investment policy for CEOs of a certain age. Similarly, Blank and Hadley (2021) show that CEOs with recession experience demonstrate

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improved investment adaptability over the business cycle, again representing an inter-temporal analysis rather than a direct test of recession experience on current investment policy.

We find that older CEOs have less abnormal investment using a Q-theory predictive model. When we decompose abnormal investment, we observe that older CEOs exhibit both lower levels of overinvestment and underinvestment, but only the overinvestment component is robust to CEO/firm level controls and alternative explanations. In terms of components of new investment, we find that overinvestment by older CEOs is associated with lower levels of M&A expenditures. The channel explaining the link between the overinvestment and CEO age result is prior recession experience as CEO. The overinvestment findings are robust to the inclusion of firm- and CEO-level characteristics and potential endogeneity concerns, as well as explanations linked to CEO risk-taking incentives, and CEO traits such as overconfidence, talent, and managerial ability.

The analysis begins with employing an augmented version of the Q-model of investment to assess firms' observed investment levels against the predicted or expected values generated by the model. The absolute disparity between these values is labeled as abnormal investment. This methodology has been utilized in prior research[1] to explore the link between abnormal investment and various firm-, manager-, and investor-level characteristics. To estimate expected investment levels, we use information on S&P 1500 firms in the ExecuComp database from 1950 to 2022. Subsequently, we construct proxies for abnormal investment, overinvestment, and underinvestment measures to scrutinize whether CEO age affects corporate abnormal investment. Findings indicate a significant negative influence of CEO age on abnormal investment, with a substantial economic impact. CEOs in the top age tercile age reduce abnormal investment by about 4.4%, translating to nearly $669 million lower abnormal investment for an average S&P 1500 firm. Further analysis shows that this decrease is primarily driven by a reduction in overinvestment, while no statistically significant difference in underinvestment is observed between older and younger CEOs in specifications with CEO and firm-specific control variables.

[1] See Stoughton, Wong and Yi (2017); Choi, Hann, Subasi and Zheng (2020); Goodman, Neamtiu, Shroff and White (2014); Ward, Yin and Zeng (2020); García-Lara, Osma and Peñalva (2016); Biddle, Hilary and Verdi (2009); Hann, Subasi and Zheng (2019); Benlemlih and Bitar (2018); Shroff (2017); Brogaard, Shi, Wei and You (2022), among others.

One concern surrounding the findings pertains to the endogeneity of CEO selection, arising from the nonrandom assignment of CEOs to firms. Another concern involves endogeneity resulting from omitted variables that are correlated with CEO age, thereby biasing the estimates. Although it is challenging to completely eradicate biases stemming from various sources of endogeneity, we employ diverse tests including an instrumental variable approach to address these concerns. In the initial test, inspired by Serfling (2014), we use the logarithm of the consumer price index (CPI) at the CEO's birth year to instrument CEO age. The CPI exhibits a robust negative correlation (approximately 53% in the sample) with the independent variable, CEO age, as higher CPI values correspond to later years, aligning with the typical earlier birth years of older CEOs. Notably, the CPI demonstrates minimal direct correlation (around 2% in the sample) with the dependent variable, abnormal investment. This lack of direct correlation stems from the notion that the CPI at the CEO's birth year should not directly impact the firm's current abnormal investment, except through its association with the CEO's age. Employing a 2-Stage Least Squares (2SLS) model with the CPI at birth as the instrument, the second-stage estimates persistently reveal a negative and significant relationship between CEO age and abnormal investment.

In an extra step to address endogeneity stemming from the nonrandom assignment of CEOs to firms, we conduct a sensitivity test by excluding observations where the CEO has recently been appointed. This refined subset of firm-years aims to minimize the influence of CEO-firm endogenous matching, allowing us to focus on instances where CEOs are more likely to exert a substantial impact on firm investment behavior. Even with this stringent subset, the analysis consistently reveals a negative and economically significant impact of CEO age on overinvestment. Additionally, we implement propensity score matching (PSM) to alleviate biases related to selection on observables by matching firms with similar characteristics. The PSM analysis corroborates our findings, showing that firms led by older CEOs exhibit, on average, significantly less overinvestment than their matched counterparts with younger CEOs.

To mitigate endogeneity concerns arising from omitted variables, we employ an extensive analysis of CEO-level characteristics using a diverse CEO sample, incorporating them into the

baseline model. This approach not only enhances the robustness of the model but also aids in dispelling alternative interpretations of the key finding. Initially, we explore whether the negative influence of CEO age on overinvestment may be attributed to variations in wealth and shifting risk-taking incentives embedded in compensation packages as CEOs age. Factors such as the CEO's wealth, including their share of firm ownership, the value of stock and option holdings, or the worth of their company-sponsored pension, are likely to change with age, influencing their investment behavior. The results indicate that the inclusion of relevant controls for these factors does not alter the age effect documented in the baseline tests.

We next assess whether CEO age predominantly reflects the impact of changing overconfidence levels, consequently resulting in varied levels of overinvestment between older and younger CEOs. Employing proxies for CEO overconfidence derived from their stocks and options holdings, the results show that accounting for the overconfidence level does not alter the primary conclusions regarding the influence of CEO age on overinvestment. Interestingly, the analyses also reveal that more overconfident CEOs exhibit higher levels of overinvestment which refines results in the previous literature on overconfidence. (e.g., Malmendier and Tate, 2005, 2008; Malmendier, Tate and Yan, 2011; Campbell, Gallmeyer, Johnson, Rutherford and Stanley, 2011; Hirshleifer, Low and Hong Teoh, 2012). This overinvestment translates into a greater deviation from expected investment levels and increased abnormal investment.

We investigate whether the observed link between CEO age and overinvestment might be attributable to CEO talent, which could increase with age and potentially confound our main findings. To explore this, we incorporate controls for CEO talent proxies, including the age at which the CEO first assumed an executive role and the prevailing job market conditions at that time (Custódio, Ferreira and Matos, 2013; Custódio and Metzger, 2014; Falato, Li and Milbourn, 2015). With these controls, the main finding of a negative association between CEO age and overinvestment remains robust. This suggests that talent alone does not drive the age-related variation in investment behavior.

We also consider the potential role of managerial abilities and skills in shaping the inverse

relationship between CEO age and overinvestment. Analogous to discussions on innate talent, if managerial abilities evolve with age, CEO age might encapsulate the impact of these abilities, influencing the results. CEOs endowed with robust managerial capabilities may excel in anticipating industry trends and making astute investments in high-value projects, leading to more optimal decisions. Conversely, highly capable CEOs may overrate their abilities in identifying value-adding investment projects, resulting in suboptimal decisions. After including managerial ability proxies (Custódio et al., 2013; Demerjian, Lev and McVay, 2012), we find that the negative relationship between CEO age and overinvestment remains. Furthermore, a positive and significant correlation between CEO ability and overinvestment is observed, implying that, akin to overconfident CEOs, more able CEOs tend to engage in higher levels of overinvestment.

Finally, we explore a potential pathway through which CEO age influences abnormal investment. Drawing from Blank and Hadley (2021), who demonstrate that CEOs with recession experience adapt strategically and exhibit risk-shifting firm policies in response to the economic environment, we posit that older CEOs may reduce abnormal investment due to their increased exposure to recessions. Both univariate and multivariate analyses support CEO recession experience as a plausible mechanism linking CEO age to overinvestment. This association aligns with the findings reported by Amini, MacKinlay, Rountree and Weston (2024) documenting a decrease in abnormal investment during economic recessions.

This study makes a number of contributions to the literature. First, it extends the existing literature on the impact of CEO personal traits on corporate investment by relying on Q-based estimate of abnormal investment. Previous studies have explored the influence of CEO characteristics such as overconfidence (e.g., Malmendier and Tate, 2005, 2008; Malmendier et al., 2011; Hirshleifer et al., 2012), managerial skills and industry expertise (e.g., Custódio et al., 2013; Custódio and Metzger, 2014), recession experience (Blank and Hadley, 2021), and age (e.g. Yim, 2013; Serfling, 2014; Li, Low and Makhija, 2017) on various forms of corporate investment, including physical capital, research and development (R&D), and acquisitions.

We extend these studies by relying on a measure of deviation of corporate investment from

the expected levels predicted by investment models—referred to as abnormal investment. Unlike existing studies that examine investment levels, the analysis delves into how CEO age contributes to this departure from expected investment levels. This framework offers insights into the efficiency of corporate investment and its relationship with CEO age. It demonstrates that the age of CEOs plays a significant role in influencing abnormal investment, distinct from the impact of overconfidence, managerial abilities, or innate talent, and highlights the nuanced dynamics of CEOs' experience across business cycles and different economic conditions and corporate investment policies.

Second, this paper speaks to the existing literature on abnormal investment, which has predominantly explored its connections with product market competition (Stoughton et al., 2017), analysts' capital expenditure forecasts (Choi et al., 2020), managerial forecast accuracy (Goodman et al., 2014), institutional investors' monitoring (Ward et al., 2020), accounting conservatism (García-Lara et al., 2016), financial reporting quality (Biddle et al., 2009), director connections (Hann et al., 2019), corporate social responsibility (Benlemlih and Bitar, 2018), changes in generally accepted accounting principles (Shroff, 2017), and analysts' coverage (Brogaard et al., 2022). In this context, this study offers a distinctive perspective by highlighting the significant role played by the age of the CEO. It demonstrates that CEO age serves as a significant determinant of abnormal investment, suggesting that older CEOs tend to deviate less from the expected investment levels predicted by models considering factors such as firm investment opportunities, past performance, past investment, and size.

This paper is structured as follows: Section 2 details the methodology for estimating abnormal investment. The construction of the sample, and control variables are outlined in Section 3. Section 4 quantifies abnormal investment, as well as overinvestment, and underinvestment based an augmented Q-theory of investment. Section 5 presents both basic univariate and multivariate results. Sections 6 examines alternative explanations for the documented relation between CEO age and abnormal investment. Section 7 offers a potential mechanism by which CEO age can impact abnormal investment while Section 8 concludes.

2. Research Design

2.1. Abnormal Investment Model

The primary measure of abnormal investment used in this study is based on Richardson (2006) and extended by Stoughton et al. (2017). This approach first estimates the expected new investment level using the following regression model:

$$\begin{aligned} I_{i,j,t} = {} & \beta_1 V/P_{i,j,t-1} + \beta_2 Leverage_{i,j,t-1} + \beta_3 Cash_{i,j,t-1} + \beta_4 Firm\ Age_{i,j,t-1} \\ & + \beta_5 Size_{i,j,t-1} + \beta_6 Return_{i,j,t-1} + \beta_7 I_{i,j,t-1} + \theta_j + \lambda_t + \varepsilon_{i,j,t}, \end{aligned} \tag{1}$$

for firm i in industry j in year t. The dependent variable, new investment, consists of capital expenditures plus research and development (R&D) expenses plus acquisitions minus sale of property, plant, and equipment (PP&E) minus amortization and depreciation, all scaled by total assets. The missing values of sale of PP&E, R&D, and acquisitions are set to zero. V/P measures firm growth opportunities, where V represents the value of assets in place divided by the market value of equity, P. The value of assets in place comes from a residual income model of assets described in Ohlson (1995) and Richardson (2006). The results hold if the firm's market-to-book ratio (a common proxy for Tobin's Q) or recent sales growth is used as the measure of growth opportunities (Biddle et al., 2009; García-Lara et al., 2016). *Leverage* is the sum of the book value of short-term and long-term debt divided by the sum of the book value of total debt and the book value of equity. *Cash* is the balance of cash and short-term investments scaled by total assets. *Firm Age* is the natural logarithm of one plus the number of years the firm has been listed in the Compustat database, and *Size* is the natural logarithm of total assets. *Return* is the stock return measured as the change in market capitalization of the firm over the previous year. The model includes industry fixed effects, θ_j, based on the Fama-French 48 industry classification (Fama and French, 1997) to control for unobserved industry differences. It also includes year fixed effects, λ_t, to control for any time trends and to remove common macroeconomic shocks from the estimates. All ratio variables are winsorized at the 1% and 99% tails. Finally, the reported standard errors

are robust to heteroskedasticity and are clustered by firm and year to account for within-firm and within-year serial correlation.

Following prior studies (e.g., Richardson, 2006; Stoughton et al., 2017), we use the estimated residuals from Equation (1) to measure unexpected investment. Because the expected value of residuals is zero i.e., $E(\varepsilon_{i,j,t}) = 0$, the absolute values of the residuals represent a deviation from the expected investment level or abnormal investment. Therefore, we classify firms with positive residuals in a given year as overinvesting firms and firms with negative residuals in a given year as underinvesting firms. Mathematically, the abnormal investment proxy (AI), overinvestment proxy (OI), and underinvestment proxy (UI) for firm i in industry j at time t are defined as:

$$AI_{i,j,t} = |\widehat{\varepsilon}_{i,j,t}| = |I_{i,j,t} - \widehat{I}_{i,j,t}|, \tag{2}$$

$$OI_{i,j,t} = |\widehat{\varepsilon}_{i,j,t}| = |I_{i,j,t} - \widehat{I}_{i,j,t}| \qquad \text{if} \quad I_{i,j,t} > \widehat{I}_{i,j,t} \tag{3}$$

$$UI_{i,j,t} = |\widehat{\varepsilon}_{i,j,t}| = |I_{i,j,t} - \widehat{I}_{i,j,t}| \qquad \text{if} \quad I_{i,j,t} < \widehat{I}_{i,j,t}, \tag{4}$$

where higher values of these proxies, AI, OI, and UI, imply a greater degree of abnormal investment (in either direction). Several recent studies use a similar approach to measure firm-level expected investment and examine its association with product market competition (Stoughton et al., 2017), analysts' capital expenditure forecasts (Choi et al., 2020), managers' forecast accuracy (Goodman et al., 2014), institutional investors' monitoring (Ward et al., 2020), accounting conservatism (García-Lara et al., 2016), financial reporting quality (Biddle et al., 2009), director connections (Hann et al., 2019), corporate social responsibility (Benlemlih and Bitar, 2018), changes in generally accepted accounting principles (Shroff, 2017), and analysts' coverage (Brogaard et al., 2022).

2.2. CEO Age and Abnormal Investment Model

To examine how CEO age affects abnormal investment, we use the following model:

$$y_{i,j,t} = \beta_1 Older\ CEO_{t-1} + \beta_2 Controls_{i,j,t-1} + \lambda_t + \theta_j + \varepsilon_{i,j,t}, \tag{5}$$

where y is the proxy for or abnormal investment (AI), overinvestment (OI), or underinvestment (UI), as defined in Equations (2) to (4). *Older CEO* is a dummy variable that is assigned a value of 1 if the firm's current CEO is in the highest age tercile, and 0 otherwise. $Controls$ is a matrix of firm and CEO characteristics. Following Stoughton et al. (2017), at the firm level, the model controls for *Market-to-Book*, *Leverage*, $Cash$, $Size$, $Tangibility$, and $Firm\ Age$. Older and larger firms, drawing from their wealth of industry experience, are anticipated to exhibit more efficient investment practices. On the other hand, riskier firms characterized by abundant growth opportunities and high leverage are prone to less efficient investments. Similarly, firms with a greater ability to borrow, as indicated by tangibility, and those holding substantial cash reserves are also likely to invest less efficiently, often due to agency problems.

Table A1 in the Appendix lists the variable definitions and data sources used throughout this paper. All the regression models include year fixed effects to control for economy-wide shocks and general time trends affecting corporate investment. To control for unobservable heterogeneity, the regressions also include industry fixed effects (θ_j) using the Fama-French 48 industry classification and cluster standard errors by firm and year. We primarily use industry fixed effects, as they accommodate the possibility that certain firms may consistently overinvestment or underinvest—patterns that firm fixed effects would otherwise remove. However, to demonstrate the robustness of our findings to firm-specific heterogeneity, we also include firm fixed effects in some specifications.

3. Data

The initial sample for estimating the residuals of Equation (1) consists of S&P 1500 firms listed in the ExecuComp database, with coverage in both CRSP and Compustat from 1992 to 2022. Firms with missing or negative total assets or sales are excluded.[2] Within this sample, various CEO level control variables are derived, encompassing CEO age, tenure, talent, overconfidence, gender, duality, ownership, pension, and wealth represented by the CEO's total portfolio delta and vega.

[2]As certain companies alter their fiscal year-end dates midway through the calendar year, multiple annual records for accounting data may arise. In such instances, the last annual record within a specific calendar year is selected for analysis.

The estimation of delta and vega values follows Coles, Daniel and Naveen (2006) and Core and Guay (2002). CEO managerial ability information is sourced from two primary sources: Demerjian et al. (2012), spanning the years 1980 to 2020, and Custódio et al. (2013) covering the years 1992 to 2016. The paper delves further into the discussion of these control variables as it examines the models. Appendix Table A1 provides a comprehensive definition of these variables and the data sources used in their construction.

3.1. Descriptive Statistics

Panel A of Table 1 presents summary statistics for firm characteristics. The average new investment across all firm-years is 6.1% of total assets, with the average firm in the sample having assets valued at approximately $15.09 billion (in 2010 dollars), a market leverage ratio of 36.2%, and an age of around 27 years. The average firm in the sample experiences an annual sales growth of 13.2% and cash makes up around 15% of its total assets. Physical capital expenditure, research & development (R&D) spending, and acquisitions represent 5%, 3%, and 2.4% of total assets, respectively, for an average firm.

Figure 1 depicts the distribution of CEOs' ages, ranging from as young as 26 years old (2 CEOs) to as old as 95 years old (1 CEO). Ages 49 to 61 encompass at least 2000 CEOs for each age value, with the highest concentration found in the 55-year-old bin. Ages 45 to 48 and 62 to 64 include at least 1000 CEOs each. Finally, ages 35 to 75 fall within the 1% to 99% range of the empirical distribution. This age range is used for the remainder of the paper to mitigate the impact of extreme values.

Table 1, Panel B presents summary statistics for characteristics of CEOs who are between 35 and 75 years old. The average CEO in the S&P 1500 firms sample is approximately 55 years old, holds a tenure of 8 years, and possesses a stake of about 2% in the firm. Around 42.6% of the CEOs are classified as overconfident. Notably, about 97% of the CEOs are male, and 49% of them also serve as the chair of the board of directors. In summary, substantial cross-sectional differences are evident in new investment and its components, firm characteristics, and CEO characteristics.

Table 2 shows descriptive statistics for CEOs across age terciles. The average CEO age in

the upper tercile is 62, compared to 47 in the lower tercile. Comparing these two groups reveals that older CEOs tend to have longer tenures. CEOs in the upper tercile also tend to have higher levels of proxy variables for managerial ability, more cumulative recession experience, and more overconfidence. In contrast, CEO age has a negative association with talent proxies. Age also positively aligns with various components of compensation: older CEOs typically have higher stock ownership, larger pension values, and option holdings that are more sensitive to stock price changes and volatility than those held by younger CEOs. Regarding governance, older CEOs are more frequently the Chair of the Board. Firm characteristics also vary with CEO age. Older CEOs tend to lead older firms with higher leverage ratios and tangible assets, while younger CEOs oversee firms with faster annual sales growth, higher returns, and higher market-to-book ratios.

4. Abnormal Investment Estimation

This section provides the numerical estimates from models used to quantify abnormal investment, as well as overinvestment, and underinvestment. Specifically, Table 3 reports the regression estimates for Equation (1). The results are largely consistent with prior studies (Richardson, 2006; Stoughton et al., 2017).[3] Focusing on column (3), which includes both industry and year fixed effects, the negative coefficient for V/P implies that firms with higher growth opportunities have higher investment. The negative coefficient for *Leverage* and the positive coefficients for $Cash$ and $Size$ suggest that larger firms with lower financial constraints also have higher investments. The results also show that firms with good past stock performance and higher prior investment tend to have higher future investment than their industry peers. We use the absolute residual values from the regression in column (3) to determine abnormal investment, overinvestment, and underinvestment.

Table 4 presents summary statistics for these proxies, shown for the full sample in Panel A and by CEO age terciles in Panel B. Abnormal investment, overinvestment, and underinvestment represent 5.1%, 6.6%, and 4.1% of total assets, respectively, for the full sample. Panel A also reveals

[3]Throughout all the analyses, $I_{i,j,t}$ is multiplied by 100 for ease of readability and reducing the number of zeros reported after the decimal point for many of the coefficients.

that while overinvestment occurrences are fewer than two-thirds of underinvestment instances, the average magnitude of overinvestment is greater. More importantly, Panel B indicates that abnormal investment, overinvestment, and underinvestment each decrease with CEO age, showing a consistent and monotonic decline. This suggests a potential connection between CEO age and these investment measures, with older CEOs exhibiting smaller deviations from expected investment levels across all three proxies. This observed contrast in investment behavior between older and younger CEOs forms the primary focus of our study, which we rigorously test and discuss in Section 5. Before delving into the main analysis, the next section presents a supplementary breakdown of new investment components as they relate to CEO age, providing additional context for our findings.

4.1. Investment Constituents

To understand how investment composition evolves, we dissect new investment into its primary components: capital expenditures, R&D, and acquisitions. The average for each component is then computed across CEO age terciles, with the youngest CEOs in the lowest tercile and the oldest CEOs in the highest tercile.

Figure 2 delineates the distribution of average investment across these components. This univariate analysis unveils that older CEOs allocate less to all three components of investment. Firms with younger CEOs allocate approximately 5.38% (as a percentage of total assets) on average to capital expenditures, whereas those under older CEOs allocate around 4.88%, a reduction of 0.50 percent. Acquisitions see a shift as well, with younger CEOs dedicating around 2.66% and older CEOs about 2.26%, representing a decline of roughly 0.40 percent. Innovation activities are also different between younger and older CEOs. Compared to their younger counterparts, older CEOs invest approximately 1.58 percent less in R&D. Overall, these shifts align with prior research indicating that older CEOs engage in fewer M&As (Yim, 2013), curtail R&D spending possibly due to its inherent riskiness and delayed payoff (Barker III and Mueller, 2002; Serfling, 2014), and reduce capital expenditures (Li et al., 2017).

To analyze individual investment components in a multivariate framework, Table 5 presents regressions of capital expenditures, R&D, and acquisitions, respectively, on CEO age. These

regressions use the same set of control variables as specified in the new investment regression in Equation (1) and Table 3. In terms of investment components, CEO age is negatively associated with acquisitions, aligning with Yim (2013) and suggesting that older CEOs are less inclined toward acquisitions—a pattern that may contribute to the observed link between CEO age and lower overinvestment. However, investment in R&D and physical assets does not differ significantly between older and younger CEOs in this multivariate analysis.

5. Main Results

5.1. How does CEO Age Influence Abnormal Investment?

This section presents the main empirical results. First, we conduct a univariate (graphical) analysis to explore the relationship between CEO age and the proxies for abnormal investment. Subsequently, we employ a series of multivariate regressions to control for other potential factors related to abnormal investment. Lastly, we perform supplementary tests to verify the robustness of the impact of CEO age on investment behavior.

Figure 3 illustrates the correlation between CEO age and the average abnormal investment for ages within the 1% to 99% range of the empirical distribution (35 to 75 years old). This panel overall shows a declining trend, indicating that older CEOs, on average, are associated with lower abnormal investment. The slope seems to flatten and even slightly rise for CEO ages over 65. This slight increase, though statistically small and insignificant, primarily arises due to the limited number of observations within this age bracket.

The univariate analysis indicates a significant influence of CEO age on abnormal investment. However, this analysis does not account for other non-age factors that can potentially influence managers' investment behavior. Therefore, we next conduct multivariate regressions to account for the effects of these non-age factors on abnormal investment. Specifically, we regress the measures of abnormal investment on a dummy variable indicating whether a CEO falls within the top age tercile, along with the log of CEO tenure and a set of firm characteristics expected to influence abnormal investment. The baseline regression results are presented in Table 6. The first three models include

year fixed effects and Fama-French 48 industry fixed effects to control for unobservable time and industry-level factors affecting corporate investment. The last model replaces industry fixed effects with firm fixed effects to control for unobservable factors at the firm level. Additionally, standard errors are corrected for heteroskedasticity and clustered by firm and year in all specifications to address dependence across firms and time.

The standalone regressions (columns 1 and 2) show a negative and highly statistically significant association between CEO age and abnormal investment. Upon introducing control variables in column (3), the coefficient on the CEO age proxy diminishes in magnitude but remains statistically significant. Column (3) includes industry and year fixed effects to ensure that unobservable factors unique to specific industries and specific years do not drive the results. Importantly, the inferences remain consistent: CEO age plays a role in moderating abnormal investment. Furthermore, the findings indicate that older and larger firms, potentially reflecting industry experience, display lower abnormal investment. Conversely, riskier firms, identified by high leverage ratios, tend to exhibit greater abnormal investment. Likewise, companies holding significant cash reserves show higher abnormal investment, possibly attributable to agency problems associated with excess free cash.

Despite incorporating firm-level controls and industry-year fixed effects in these models, there remains a potential concern regarding unobserved time-invariant firm-level factors that may be correlated with both abnormal investment and CEO age, potentially biasing the coefficient estimate on CEO age. To mitigate this concern, the model in column (4) includes firm fixed effects. By including firm fixed effects, the estimates in this model capture average, within-firm changes in both firm abnormal investment and CEO age. Similar to the previous models, standard errors are clustered by firm and year. The results continue to show a negative relationship between CEO age and abnormal investment, indicating that time-invariant firm-specific characteristics are unlikely to be the driving force behind the observed association between abnormal investment and CEO age. The estimates also hold substantial economic significance. The estimates in this column indicate that CEOs in the top age tercile are associated with an approximately 4.4% reduction in abnormal investment. This translates to a reduction of around $669 million in abnormal investment, based on

2010 dollar values.

Table 7 replicates the baseline analysis with a focus on overinvestment, yielding results that closely mirror those for abnormal investment. CEO age remains both statistically and economically significant across all four specifications, with older CEOs exhibiting 6.5% less overinvestment—equivalent to approximately $981 million less for the average firm in our sample. In contrast, Table 8 shows that underinvestment is not significant when including CEO and firm-level controls. Although underinvesting firms make up nearly two-thirds of the sample, no substantial difference is observed between older and younger CEOs in terms of underinvestment. Thus, as we explore alternative explanations and mechanisms, our analysis will focus on CEO age and overinvestment. Moving forward, we present the remaining results with industry fixed effects to conserve space and align with the methodology in studies on CEO age (Yim, 2013; Serfling, 2014, among others). All results are robust to the inclusion of firm fixed effects.

5.2. Endogeneity Concerns

5.2.1. Instrumental Variable

One important concern with the documented relation between CEO age and abnormal investment is that nonrandom matching between CEOs and firms is driving the results. It could be the case that firms recognized for making more efficient and less abnormal investment decisions tend to appoint older CEOs, whereas younger CEOs may be more commonly associated with firms characterized by a history of higher abnormal investment. To alleviate the concern regarding the endogenous matching between CEOs and firms, we employ an instrumental variable approach. Following Serfling (2014), we use the natural logarithm of the Consumer Price Index (CPI) in the year of the CEO's birth as the instrumental variable. The CPI exhibits a strong negative correlation with CEO age since higher CPI values correspond to later years, and older CEOs typically have earlier birth years. This creates a robust negative relation between the CPI at the CEO's birth year and their current age. Importantly, there is no evident reason to posit that the CPI at the CEO's birth year is correlated with the firm's current abnormal investment, except through its association with the CEO's age.

Table 9 presents the outcomes of a two-stage least squares (2SLS) regression using the instrumental variable approach. The estimates from both the first and second stages are reported in this table. The coefficient for older CEOs dummy in the second stage regression (column 2) is negative and statistically significant at 10% confidence level, implying older CEOs tend to exhibit lower overinvestment. This finding provides additional support to the main finding, supportive of a causal relation between CEO age and overinvestment.

5.2.2. Long Tenure

As a supplementary test, we exclude observations of recently appointed CEOs. Specifically, we examine overinvestment among CEOs with tenures capped at various percentiles: 1 to 3 years (25th percentile), 1 to 6 years (50th percentile), 1 to 8 years (mean tenure), and 1 to 11 years (75th percentile). Imposing an upper bound on CEO tenure in this setup addresses the concern that our main results may be influenced by selection bias. CEOs who remain longer at a firm may be of higher quality, suggesting that the observed negative association between CEO age and overinvestment could stem from those who perform well early in their careers, leading to longer tenures. Overall, this refinement likely provides a subset of firm-years where CEO-firm endogenous matching is less influential, and where CEOs are more likely to exert a substantial impact on firm investment behavior.

The results of this analysis are presented in Table 10. Similar to the baseline results, the negative influence of CEO age on overinvestment persists. The coefficient estimate on CEO age is both statistically and economically significant. While it is difficult to rule out all possible endogeneity explanations, these findings affirm that the results are likely driven by a causal effect of CEO age on corporate investment. Overall, the results in this section demonstrate that older CEOs mitigate abnormal investment within firms, aligning it more closely with expected levels. Importantly, the findings show that despite investing less in various components of new investment, older CEOs' allocations tend to align more closely with expected levels, as evidenced by their lower abnormal investment and overinvestment.

5.2.3. Propensity Score Matching

Another concern regarding our main findings is that, while the results in Tables 6 and 7 suggest a negative relationship between CEO age and both abnormal investment and overinvestment, firms led by older CEOs may differ fundamentally from those led by younger CEOs across various dimensions. Indeed, as shown in Table 2, firms with older CEOs tend to be larger, more established, hold less cash, have lower market-to-book ratios, higher leverage, and slower sales growth compared to firms led by younger CEOs. Consequently, these differences could introduce bias into our estimates of CEO age's impact on investment behavior.

To mitigate selection bias stemming from observable firm characteristics, we apply a propensity score matching (PSM) approach. This method allows us to match firms along specific characteristics while permitting differences in investment, facilitating a clearer interpretation of CEO age's effect. Following the approach proposed by Rosenbaum and Rubin (1983), which does not assume a specific functional form for the outcome variable, we define "treated" firm-years as those in the top tercile of CEO age (older CEOs) and "control" firm-years as those in the bottom tercile (younger CEOs). This strategy enables a more accurate estimation of the CEO age effect by comparing firms that are otherwise similar on key determinants of corporate investment.

To construct the matched sample, we first conduct a logit regression where the dependent variable is a treated indicator equal to one if a firm-year falls into the treated group and zero otherwise. The independent variables include those used in Tables 6 and 7 (excluding the older CEO dummy) as well as industry and year fixed effects. Using the predicted propensity scores, we perform nearest-neighbor matching without replacement, applying a common support condition. This procedure is repeated for abnormal investment, overinvestment, and underinvestment.

The left panel of Figure 4 presents the average abnormal investment for the treated and control groups, alongside the average treatment effect on the treated (ATT) and the corresponding *t*-statistic. The middle panel reports the same estimates for overinvestment, while the right panel reports them for underinvestment. Results in the left panel indicate that firms led by older CEOs exhibit, on average, 0.85% less abnormal investment than their matched counterparts with younger CEOs. The

middle panel, which displays results for overinvestment, shows that firms with older CEOs exhibit 1.27% less overinvestment than those with younger CEOs, a difference that is statistically significant. The right panel reveals that older CEOs are associated with slightly lower underinvestment, although this difference is smaller than that observed for overinvestment. Overall, these findings align with the results in Tables 6,7, and8, providing further evidence that increased CEO age is associated with significant reductions in both abnormal investment and overinvestment.

6. Is CEO Age Capturing Other CEO Traits?

An additional concern that could introduce bias in estimating the effect of CEO age on abnormal investment is the possibility of omitted CEO-level variables that might be correlated with CEO age, thereby influencing the inferences. Furthermore, it might be the case that CEO age is merely capturing the impact of well-documented characteristics, such as risk-taking incentives, overconfidence, talent, or managerial abilities, which have been established in the literature as CEO-related factors affecting firm financial policies. The comprehensive sample in this study allows for the construction and inclusion of additional CEO-level controls in the regression models, helping to mitigate biases arising from unobserved CEO heterogeneity. The results of these tests are presented in the following sections.

6.1. Risk-Taking Incentives and Wealth

CEO incentives can influence the firm's investment policies independently of CEO age. As the first step, we address the potential issue of omitted variable endogeneity by investigating whether CEO age serves as a proxy for incentives to take risks, as dictated by the CEO compensation structure. It is conceivable that compensation contracts tailored for younger CEOs differ from those for older CEOs, creating distinct incentives for risk-taking in investment decisions and resulting in varying levels of abnormal investment between younger and older CEOs. In essence, CEO age might merely be capturing the impact of divergent risk-taking incentives.

Theoretical studies (e.g., Edmans and Gabaix, 2011) suggest that firms can structure CEO contracts with specific incentives to encourage them to undertake risky projects. Empirical studies

(e.g., Coles et al., 2006; Rajgopal and Shevlin, 2002; Gormley, Matsa and Milbourn, 2013) provide supporting evidence for this prediction, demonstrating a positive relationship between option-based incentive contracts and risk-taking behavior. Therefore, it is plausible that the baseline results could be influenced by the risk-taking incentives inherent in the CEO's compensation structure. To mitigate this concern and account for compensation-based CEO risk incentives and wealth effects, we reestimate the models in Table 6 using CEO delta and CEO option holdings vega. These proxies are motivated by the existing literature (e.g., Hirshleifer et al., 2012; Cain and McKeon, 2016; He and Hirshleifer, 2022). Delta, in this context, represents the dollar change in a CEO's total stock and option portfolio (i.e., wealth) for a 1% change in stock price. Including delta in the model allows for controlling the alignment of the CEO's incentives with those of the shareholders, as it measures the CEO's motivation to increase stock price. Additionally, vega, which gauges the risk-taking incentives stemming from the CEO's option holdings, reflects the dollar change in the CEO's option holdings for a 1% change in the annualized standard deviation of stock returns. The calculations for vega and delta follow the 1-year approximation method outlined in Core and Guay (2002) and are based on the Black-Scholes option valuation model modified for dividends (Black and Scholes, 1973; Merton, 1973).

The results of this exercise are detailed in Table 11. In column (1), where the log of CEO delta and vega are included to account for CEO compensation risk-taking effects, CEO age maintains a significantly negative coefficient. This suggests that CEO age leads to reduced overinvestment beyond the impact of CEO risk-taking incentives and wealth on investment decisions. Similar to the baseline results in Table 7, the negative effect of CEO age on overinvestment is both statistically and economically significant.

As another test, we employ alternative proxies for CEO wealth, which can arguably impact their investment behavior. Specifically, we substitute CEO ownership and CEO pension for delta and vega. With respect to CEO ownership, lower levels of ownership may enhance the alignment of managerial incentives with shareholder value. However, beyond a certain threshold, entrenchment effects could outweigh the alignment effect leading to overly conservative risk choices and creating a divergence

in the valuation of cash flows between a CEO and other shareholders. The eventual outcome may involve risk-averse, value-reducing investments, and the rejection of potentially beneficial, risky projects with positive net present value (Kim and Lu, 2011; Morck, Shleifer and Vishny, 1988; McConnell and Servaes, 1990; Himmelberg, Hubbard and Palia, 1999; Amihud and Lev, 1981; Smith and Stulz, 1985; Hirshleifer and Suh, 1992; Low, 2009). These frictions that may result in elevated overinvestment, may be more probable when a CEO has greter control from owning more of the firm's shares.

With respect to CEO pensions, one perspective in the literature posits that pensions offer significantly greater opportunities for managerial rent extraction compared to other compensation mechanisms. CEOs with influence over their boards of directors may exploit pensions for rent extraction, given that pension payments are less observable and less sensitive to performance than other forms of long-term compensation (e.g., Bebchuk, Fried and Walker, 2002). Conversely, an alternative viewpoint, known as optimal contracting view, suggests that boards of directors represent the interests of shareholders. Therefore, they structure contracts to align with the CEO's reservation wage, and minimize agency costs (Core, Guay and Thomas, 2005). As a result, boards may substitute pensions for other forms of compensation and incentives when pensions offer optimal incentives and minimize joint tax burdens (Lazear, 1979; Edmans and Liu, 2011). Collectively, these views suggest that, akin to CEO ownership, CEO pension can also influence CEO risk incentives and, consequently, their investment decisions.

Column (2) reports the estimation coefficients. The results reveal that CEO age remains a significant moderating factor on overinvestment even after accounting for the alignment of CEO incentives with shareholders (proxied by CEO ownership and pension). The estimates also indicate that higher levels of CEO ownership and pension are correlated with lower levels of overinvestment. This finding provides partial support for the optimal contracting view of CEO pension and is in line with prior work showing that pension benefits in the compensation package incentivize CEOs to take fewer risks (Cassell, Huang, Manuel Sanchez and Stuart, 2012).

Moving to column (3), an additional variable, CEO duality, is introduced to further control

for the extent of CEO power over their board of directors. The model includes both CEO delta and vega, along with ownership and pension. Additionally, CEO gender is controlled for in this model to account for any potential role gender may play in the risk-taking characteristics of the CEO (Faccio, Marchica and Mura, 2016). The findings align with the results presented in the previous columns: older CEOs have less overinvestment. Additionally, delta exhibits a positive and statistically significant association with overinvestment. This positive correlation aligns with previous studies that have highlighted a positive effect of delta on the risk-taking behavior of CEOs (e.g., Coles et al., 2006; Gormley et al., 2013). More importantly, the reduced levels of overinvestment associated with CEO age are not solely driven by standard risk-taking incentives within their compensation packages or their ownership and pension benefits.

6.2. CEO Overconfidence

Extensive literature highlights that CEOs often exhibit overconfidence in their ability to create value for the firm, leading to tendencies of overinvestment–deviating from expected investment levels due to an optimistic outlook on investment opportunities (e.g., Malmendier and Tate, 2005, 2008; Malmendier et al., 2011; Hirshleifer et al., 2012, among others). Given that physiological and psychological characteristics evolve with age (Haug and Eggers, 1991; Raz, Gunning-Dixon, Head, Rodrigue, Williamson and Acker, 2004; Resnick, Pham, Kraut, Zonderman and Davatzikos, 2003; Schaie, 1996; Mutter and Poliske, 1994; Verhaeghen and Cerella, 2002), it is plausible that overconfidence also undergoes changes with age. Consequently, CEO age may be capturing the effect of evolving overconfidence. The extent to which CEOs become more or less confident with age, however, remains uncertain. Management and psychology studies (Taylor, 1975; Kovalchik, Camerer, Grether, Plott and Allman, 2005; Forbes, 2005) using small samples of managers and entrepreneurs suggest that younger individuals tend to be more overconfident. Conversely, other studies propose that overconfidence arises from survival and self-attribution biases (Doukas and Petmezas, 2007; Billett and Qian, 2008), suggesting that overconfidence is higher in older individuals. Given these perspectives, it is important to ensure that CEO age is not merely a proxy for overconfidence, as this could be driving the negative association between CEO age and overinvestment.

To rule out this possibility, first we construct a dummy variable for CEO overconfidence, motivated by Malmendier and Tate (2005, 2008). Adopting a widely used approach in the literature (e.g., Campbell et al., 2011; Malmendier et al., 2011; Hirshleifer et al., 2012; Banerjee, Humphery-Jenner and Nanda, 2015; Kenny, Tham Tze-Minn and Wei, 2018), we use the ExecuComp database to extract information on the number and value of vested stock options held by the CEO. The average moneyness of the CEO's options is then computed, representing the ratio of the average value per option to the average strike price. The average value per option is calculated by scaling the total value of the CEO's option holdings by the number of options. The average strike price is determined by subtracting the average value per option from the firm's stock price at the end of the fiscal year. CEOs are classified as overconfident if, during their tenure, they defer the exercise of vested options that are at least 67% in the money on at least two occasions. This analysis assumes that overconfidence is a persistent trait, implying that once a CEO is identified as overconfident, this characterization remains for the rest of the sample period. Alternatively, a more stringent criterion is used by identifying CEOs as overconfident if they postpone the exercise of vested options that are at least 100% in the money, following the methodology of Campbell et al. (2011). The 67% cutoff identifies optimistic managers, while the 100% cutoff aims to capture an even more optimistic subset of CEOs.

Table 12 presents the estimation results of models incorporating CEO overconfidence proxies. Columns (1) and (2) display outcomes when a 67% cutoff is applied to calculate the overconfidence proxy, while columns (3) and (4) showcase results using a 100% cutoff. In all specifications, we observe a consistently negative relationship between CEO age and overinvestment, indicating that CEO age is not merely a proxy for CEO overconfidence. As in the previous tables, the inclusion of industry and year fixed effects ensures that unobserved industry and time heterogeneity are not driving the findings. Notably, in the specifications without additional control variables (columns 1 and 3), the coefficient on CEO overconfidence is positive and statistically significant, indicating that overconfident CEOs tend to overinvest, resulting in a higher deviation from expected investment levels. This finding aligns with prior studies (e.g., Malmendier and Tate, 2005, 2008; Malmendier

et al., 2011; Campbell et al., 2011; Hirshleifer et al., 2012), which suggest that overconfident CEOs are prone to increased overinvestment. However, when additional control variables are included, the coefficients on CEO overconfidence become statistically insignificant, although the direction of the estimates remains consistent with expectations.

6.3. CEO Talent

An alternative perspective on the negative correlation between CEO age and overinvestment is that CEO age might serve as a proxy for CEO talent. If there is an assortative matching of talented CEOs with firms that engage in less overinvestment, the observed relationship may be driven by the inherent talent of the CEO to the extent that talent changes with age. To address this possibility, we conduct additional tests using proxies for CEO talent. Specifically, we construct two talent proxies. Following prior studies (e.g., Custódio et al., 2013; Custódio and Metzger, 2014), the first proxy, CEO in Recession, is a dummy variable with a value of 1 if the individual assumed the role of CEO at their current firm during an NBER recession year. The rationale behind this proxy is that, given their attainment of the CEO position, managers who commenced their careers under challenging labor market conditions are presumed to possess higher levels of talent than their counterparts.[4]

In line with earlier research (e.g., Custódio et al., 2013; Custódio and Metzger, 2014; Falato et al., 2015), the second proxy, Fast-Track Career CEO, represents the age at which a manager becomes a CEO for the first time. This proxy is grounded in the idea that executives appointed as CEOs earlier in their careers are likely to possess greater talent, as suggested by competitive sorting theories of firm hierarchy (Rosen, 1982; Kremer, 1993). According to these theories, more talented individuals are assigned to impactful and highly responsible positions, such as the CEO role, resulting in a shorter ascent up the corporate ladder for these executives. The summary statistics in Table 1 show that about 11.6% of the CEOs in the sample assumed the role of CEO in their current company in a NBER recession year.

[4]Custódio et al. (2013) and Custódio and Metzger (2014) look at the job market conditions when the CEO obtains their first academic degree to construct this proxy. The sample used in this study, however, lacks information on CEOs' educational backgrounds. Consequently, a different approach is adopted by considering the job market conditions at the time the individual assumes the role of CEO in their current firm.

These two talent proxies are added separately to the overinvestment model. The regression estimates are in Table 13. In columns (1) and (2), the 'CEO in Recession' dummy variable serves as a proxy for CEO talent, while columns (3) and (4) utilize the log of the 'Fast-Track Career CEO' variable for the same purpose. The insignificant coefficient estimates on the recessionary dummy variable in the first two columns suggest that whether a CEO commences their job in a recessionary year does not have a meaningful impact on overinvestment. However, the negative and significant coefficient on CEO age persists, with similar magnitudes to those reported in Table 12. In the subsequent two columns, employing an alternative CEO talent proxy (Fast-Track Career CEO) does not alter the conclusions regarding the influence of CEO age on reduced overinvestment. Moreover, since this proxy is an age-based proxy, the positive coefficient on the CEO talent proxy is consistent with the main results reinforcing the key finding that older CEOs tend to exhibit lower overinvestment and CEO age is unlikely to be merely a proxy for CEO talent.

6.4. Managerial Abilities

Finally, we explore whether CEO age primarily reflects the managerial skills and abilities of CEOs. CEOs endowed with superior managerial capabilities may be better equipped to comprehend technological advancements, anticipate industry trends, make judicious investments in high-value projects, and optimize the efficient utilization of the firm's resources (Demerjian et al., 2012). If managerial abilities indeed increase with age, they could be the driving force behind the main finding of reduced abnormal investment for older CEOs. To address this, we aim to control for CEO managerial abilities.

Recent studies have constructed proxies for managerial ability. We employ these proxies to account for managerial ability. The first proxy, introduced by Custódio et al. (2013), leverages information on a CEO's past work experience in S&P 1500 firms, encompassing all positions held in other firms, including those outside the S&P 1500. It is derived from the principal components analysis of five aspects of a CEO's career: the number of (1) positions; (2) firms; (3) industries; (4) instances of holding a CEO position at a different company; and (5) instances of working for a conglomerate. This proxy allows for classifying a CEO as either a generalist or a specialist and is

labeled as 'Generalist CEO.'

The second proxy, developed by Demerjian et al. (2012), gauges the efficiency with which a firm's managers can convert corporate resources into revenues relative to their industry peers. This proxy considers resources such as (1) cost of inventory; (2) general and administrative expenses; (3) fixed assets; (4) operating leases; (5) past research and development (R&D) expenditures; and (6) intangible assets.[5] This proxy is labeled as 'High-Revenue-Generating CEO.'

Column (1) of Table 14 incorporates the first proxy, column (2) integrates the second proxy, and column (3) includes both proxies simultaneously. The models consistently control for other CEO characteristics discussed in the preceding sections, encompassing CEO wealth, talent, and confidence proxies in all specifications. The primary observation from the table is that the negative correlation between CEO age and reduced overinvestment persists across all specifications, regardless of the managerial ability proxy employed. This suggests that the previously observed negative association between CEO age and overinvestment is not simply a reflection of CEO managerial ability, which might be correlated with CEO age. Another notable finding is the lack of a statistically significant difference in overinvestment between CEOs with higher managerial abilities and those with presumably lower managerial abilities. Overall, these analyses above show that the negative impact of CEO age on overinvestment is distinct from CEO compensation-based risk taking incentives, overconfidence, talent, and managerial abilities.

7. CEO and Economic Recession Experience

The preceding sections demonstrated that CEO age does not solely reflect the impact of typical CEO traits explored in existing literature. Given this observation, a pertinent question arises: what potentially does CEO age capture, and what might be the underlying mechanism through which CEO age influences abnormal investment? Amini et al. (2024) provide insight by documenting that firms tend to engage in decreased abnormal investment during economic downturns. They suggest

[5]We express our gratitude to the authors of both studies for their generous provision of managerial ability measurements, which are made available for academic use.

that time-varying monitoring and enhanced governance mechanisms serve as potential channels driving this reduction in abnormal investment during challenging economic periods. Schoar and Zuo (2017) demonstrate that the economic conditions when managers enter the labor market have long-term impacts on their career trajectories and managerial approaches. Those who commence their careers during recessions tend to adopt more conservative styles, characterized by reduced investment in capital expenditures and research and development, along with a propensity for cost-cutting measures.

Relatedly, Blank and Hadley (2021) demonstrates that CEOs with recession experience exhibit expertise in risk-shifting strategies. They allocate conservatively during expansions, allowing for excess capacity and financial slack to accumulate additional cash reserves during economic contractions. This, in turn, leads to higher asset growth driven by investments in acquisitions and capital expenditures. From a different perspective, Malmendier and Nagel (2016) and Malmendier, Nagel and Yan (2021) illustrate that experiencing a recession early in one's career can profoundly and enduringly shape individuals' awareness of macroeconomic changes and their investment decisions. Building on the aforementioned studies, we propose that older CEOs are likely to exhibit lower overinvestment tendencies, primarily due to their broader experience with recessions. This association stems from their accumulated experience with economic downturns, which has instilled in them a discipline to allocate corporate resources more efficiently, thereby minimizing abnormal investment.

To test this hypothesis, we first construct two proxy variables capturing CEO recession experience. The first proxy measures the number of NBER recession years a CEO has experienced after assuming the CEO position for the first time or after turning 22. The second measures the amount of recession experience a CEO has after assuming the CEO position. Figure 5 displays the average abnormal investment across different levels of recession experience. Panel A of shows the average abnormal investment for CEOs with different levels of recession experience after turning 22, while Panel B illustrates the average abnormal investment for CEOs with varying levels of recession experience after assuming the CEO position for the first time. Both panels show that CEOs with

more recession experience tend to have lower levels of abnormal investment. In Panel B, the trend is strongly downward, with a steepening of the slope for CEOs with three or more years of recession experience as CEO. Together, Panels A and B suggest a negative relation between CEO recession experience and abnormal investment. This declining trend suggests that recession experience could serve as a conduit through which CEO age impacts abnormal investment, given that older CEOs typically have encountered more recessions. In fact, our analysis reveals a correlation of over 80% between CEO age and our CEO recession proxies.

Table 15 provides the statistical evidence. Due to the substantial correlation between CEO age and these recession proxies, it becomes challenging from an econometric standpoint to include both variables simultaneously in a regression or interact them. Consequently, CEO age is substituted with proxies for CEO recession experience. The univariate and multivariate estimates presented in this table consistently demonstrate a negative and statistically significant relationship between overinvestment and CEO recession experience, particularly when considering the experience gained after the CEO assumes their position (columns 3 and 4). Given that firms tend to exhibit lower overinvestment during recessions and older CEOs possess more recession experience, these findings lend support to recession experience as a plausible mechanism through which CEO age influences overinvestment.

These results highlight how using an abnormal measure of investment at a certain level of CEO recession experience provides a more direct test of that trait than comparing raw measures of investment across time periods. The economically significant relation between recession experience and reduced overinvestment is also intuitive. These multivariate results are consistent with Panel B of Figure 5, which illustrates a clear downward trend in overinvestment as a univariate function of CEO recession experience. Older CEOs tend to have lower levels of overinvestment and recession experience as a CEO is a channel that explains this outcome.

8. Conclusions

Using data from S&P 1500 firms spanning the years 1992 to 2022, this study documents that CEO age has a significant negative effect on abnormal investment, defined as the deviation from expected investment levels. Building on prior literature regarding CEO traits and investment policy, we employ a Q-theory model to establish a benchmark for expected investment, allowing for a comparative analysis of actual investment relative to this expected value at different CEO ages. Our findings indicate that older CEOs exhibit lower levels of both underinvestment and overinvestment; however, only the latter shows significance after controlling for CEO and firm characteristics, fixed effects, and alternative explanations.

The economic implications are noteworthy: CEOs in the top age tercile reduce abnormal investment by approximately 4.4%, equating to roughly $669 million in 2010 dollars for an average S&P 1500 firm. Importantly, our results suggest that CEO age is not simply a proxy for risk-taking incentives embedded in compensation contracts, nor for factors such as overconfidence, talent, or managerial abilities. Our analyses indicate that CEO recession experience serves as a credible mechanism linking CEO age to overinvestment. In conclusion, these findings underscore the importance of CEO age and their recession experience across business cycles in significantly shaping corporate investment policies.

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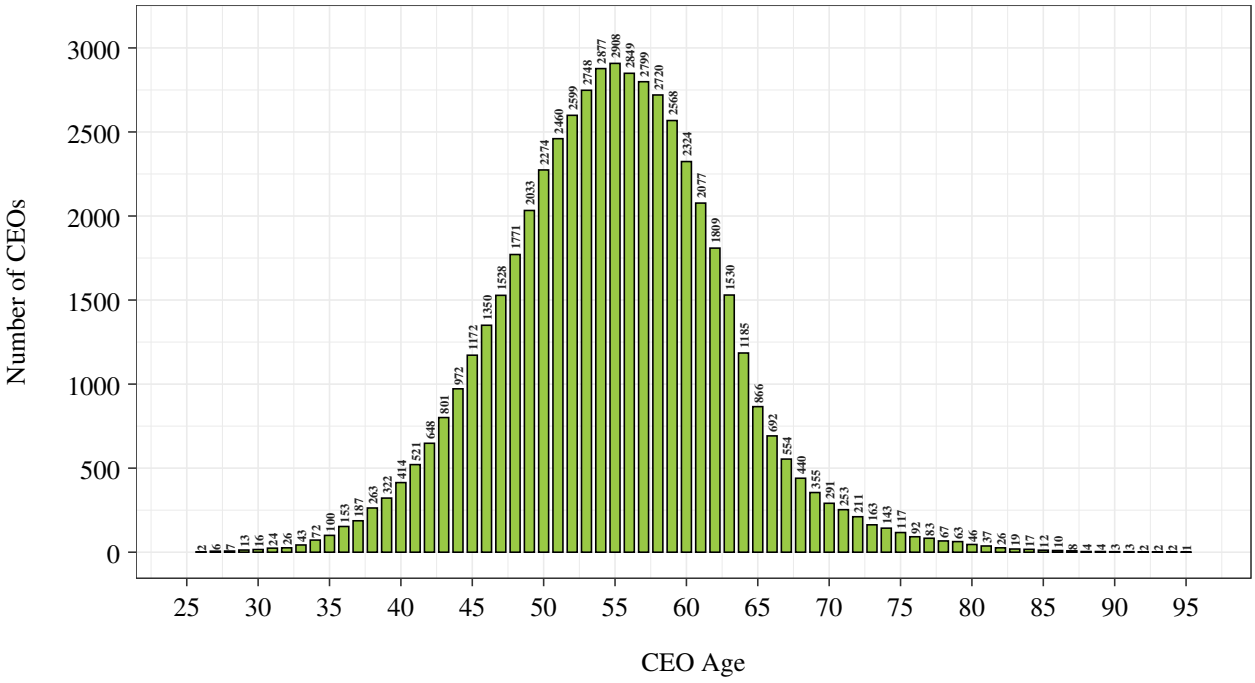

Figure 1: CEO Age Distribution

This figure shows the distribution of CEO age. The count of CEOs for each age is displayed at the top of each bar. The age values range from a minimum of 26 to a maximum of 95. Notably, ages 35 to 75 cover 99% of the entire age distribution. The sample period is 1992–2022.

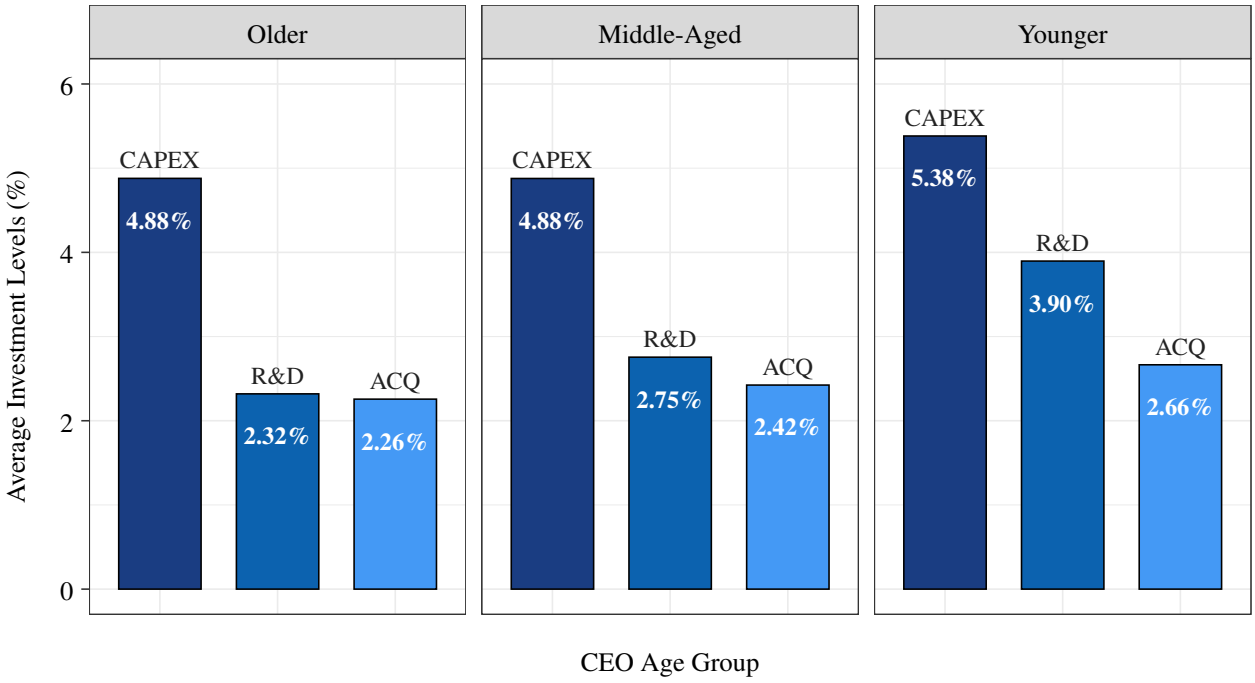

Figure 2: Investment Constituents by CEO Age

This figure decomposes firms' average investment into three categories: capital expenditures (CAPEX), research and development expenses (R&D), and acquisitions (ACQ). The left panel displays the investment values for older CEOs (third tercile of CEO age), the middle panel shows the values for middle-aged CEOs (second tercile of CEO age), while the right panel illustrates the values for younger CEOs (first tercile of CEO age).

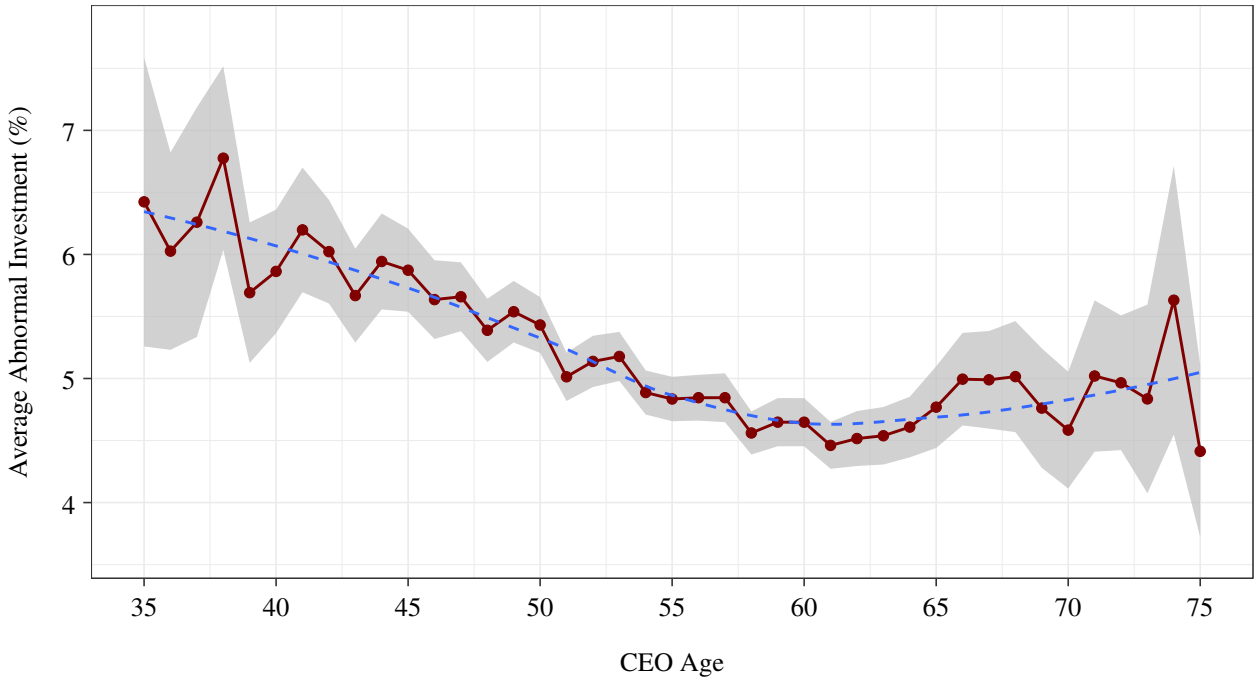

Figure 3: Abnormal Investment by CEO Age

This figure shows the average abnormal investment for different CEOs' ages. The CEO age, which has been winsorized to include values within the 1st and 99th percentiles of their empirical distribution, spans from 35 to 75 years old. The sample period is 1992–2022. *Abnormal Investment* is the absolute value of the firm's deviation from its predicted investment for all firms. The predicted investment model is based on Richardson (2006) and Stoughton et al. (2017) and is given in Equation (1).

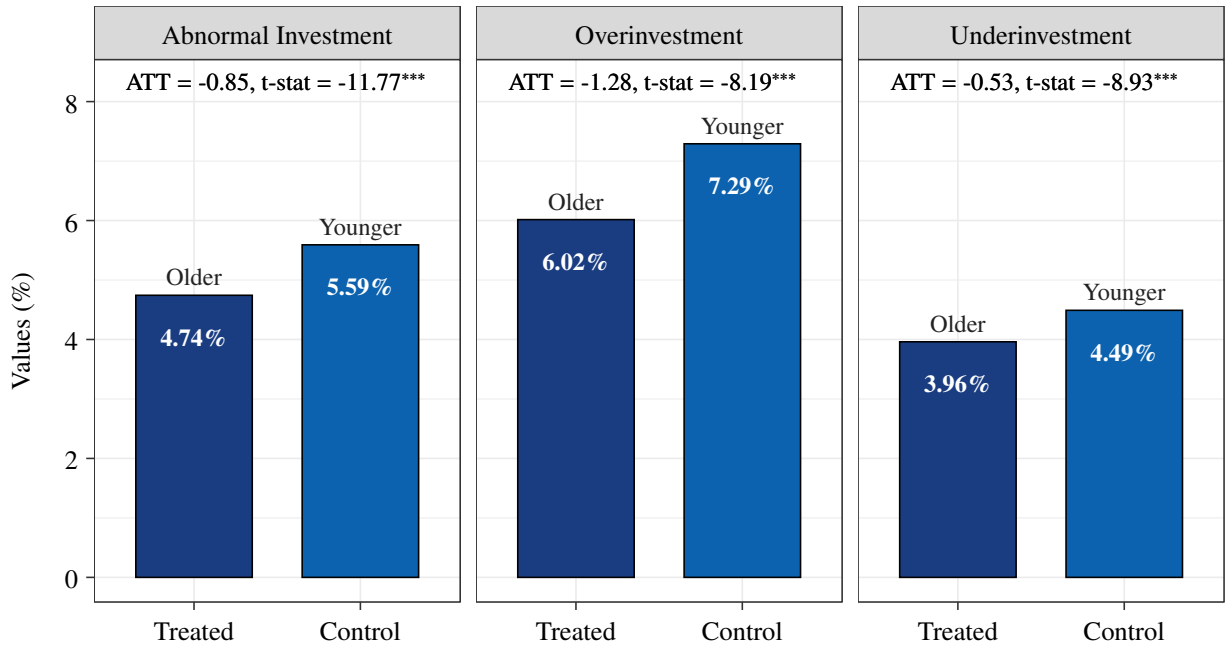

Figure 4: Average Treatment Effects using Propensity Score Matching

This figure presents the average abnormal investment (left panel), overinvestment (middle panel), and underinvestment (right panel) along with the average treatment effect on the treated (ATT) and the corresponding *t*-Statistic. The treated firm-years are defined as those in the top tercile of the CEO age, representing old CEOs, and control firm-years are defined as those in the bottom two terciles, representing young CEOs. The sample period is 1992–2022. *Abnormal Investment* is the absolute value of the firm's deviation from its predicted investment for all firms. The predicted investment model is based on Richardson (2006) and Stoughton et al. (2017) and is given in Equation (1).

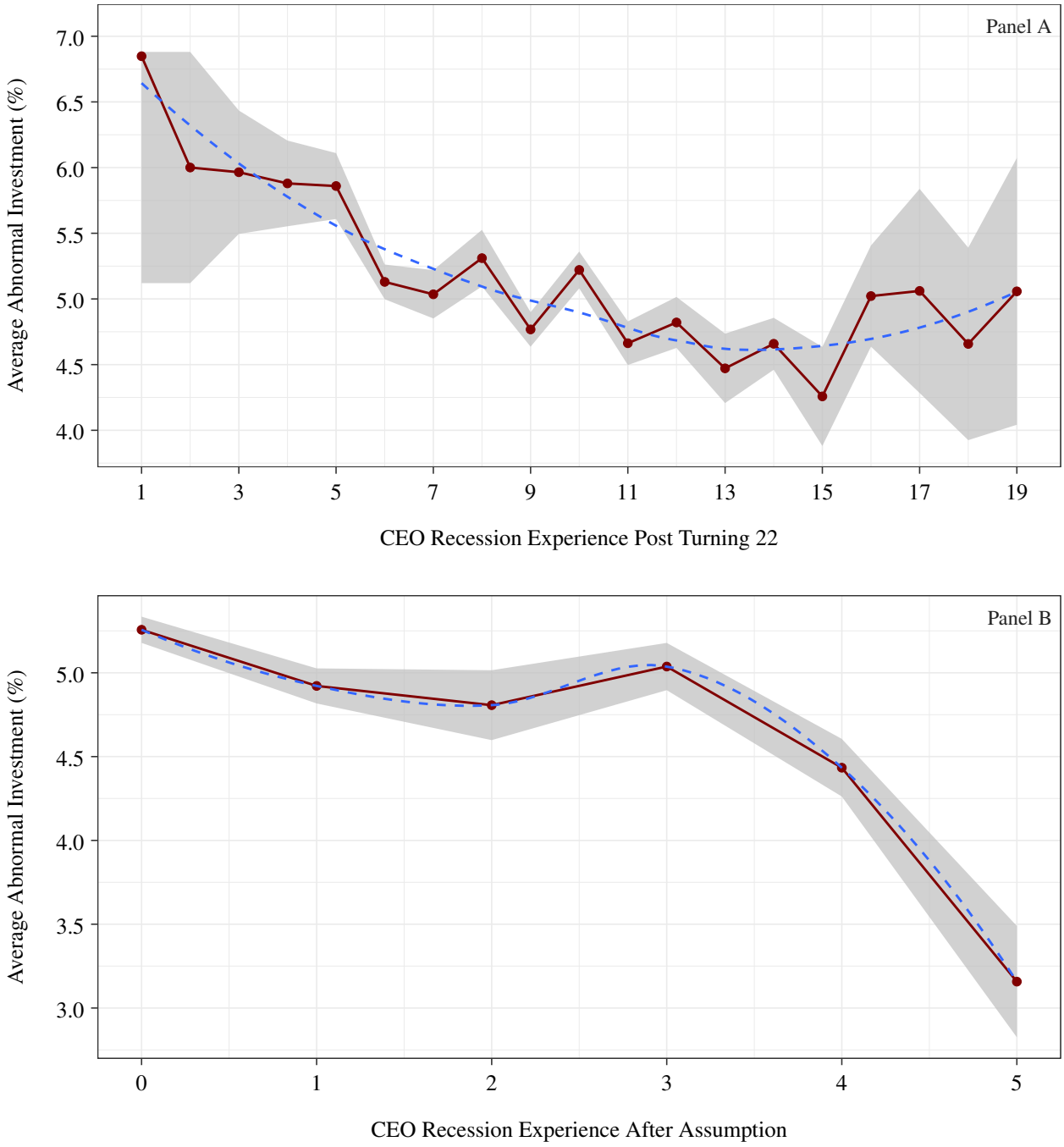

Figure 5: Abnormal Investment by CEO Recession Experience

Panel A of this figure displays the average abnormal investment for CEOs with different levels of recession experience after the age of 21. Panel B illustrates the average abnormal investment for CEOs with varying levels of recession experience after assuming a CEO position for the first time. The sample period is 1992–2022. *Abnormal Investment* is the absolute value of the firm's deviation from its predicted investment for all firms. The predicted investment model is based on Richardson (2006) and Stoughton et al. (2017) and is given in Equation (1).

Table 1: Summary Statistics for the Full Sample

Panel A of this table presents summary statistics for firm-level characteristics while Panel B provides summary statistics for CEO-level characteristics. The sample cover S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022, excluding those with missing or negative total assets and sales. Number of observations, mean, standard deviations (SD), first quartile (P25), median, and third quartile (P75) are reported. All the ratios have been winsorized at the 1% and 99% of their empirical distribution. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Obs.	Mean	SD	P25	Median	P75
Panel A: Firm Characteristics:						
V/P	45,251	0.537	0.546	0.293	0.477	0.721
Market-to-Book	45,251	3.196	5.867	1.291	2.085	3.576
Sales Growth	45,251	0.132	0.388	−0.005	0.075	0.186
Tangibility	45,251	0.263	0.239	0.072	0.186	0.397
Cash	45,251	0.149	0.173	0.026	0.081	0.211
Market Leverage	45,251	0.362	0.324	0.121	0.342	0.529
Return	45,251	0.218	0.686	−0.131	0.102	0.380
New Investment	45,251	0.061	0.099	0.000	0.032	0.093
Capex	45,251	0.050	0.056	0.016	0.035	0.065
R&D	45,251	0.030	0.065	0.000	0.000	0.030
Acquisitions	45,251	0.024	0.057	0.000	0.000	0.016
Firm Age	45,251	26.745	17.247	12.000	23.000	39.000
Total Assets ($ Millions)	45,251	15090.769	88499.138	599.881	1832.953	6462.803
Market Value of Equity ($ Millions)	45,251	9237.240	37580.627	634.918	1717.979	5379.708
Panel B: CEO Characteristics:						
CEO Age	45,251	54.667	7.186	50.000	55.000	59.000
CEO Tenure	45,251	8.116	6.994	3.000	6.000	11.000
CEO in Recessions	45,251	0.116	0.320	0.000	0.000	0.000
Fast-Track Career CEO	45,251	49.942	7.073	45.000	50.000	55.000
CEO Ownership	45,251	0.020	0.052	0.000	0.002	0.011
Overconfident CEO (67% ITM)	34,871	0.426	0.495	0.000	0.000	1.000
Overconfident CEO (100% ITM)	34,871	0.325	0.469	0.000	0.000	1.000
High-Revenue-Generating CEO	35,359	0.566	0.295	0.300	0.600	0.800
Generalist CEO	28,737	−0.172	0.920	−0.860	−0.334	0.335
CEO Recession Exp. Post Turning 22	45,251	8.930	3.063	6.000	9.000	11.000
CEO Recession Exp. Post Assumption	45,251	1.094	1.323	0.000	1.000	2.000
CEO Gender (Male = 1)	45,251	0.969	0.173	1.000	1.000	1.000
CEO Duality	45,165	0.491	0.500	0.000	0.000	1.000
CEO Delta ($ Thousands)	43,771	572.124	1317.485	54.496	161.488	476.629
CEO Vega ($ Thousands)	43,679	96.524	176.851	3.279	28.871	100.278
CEO Pension ($ Thousands)	45,251	1154.360	3942.601	0.000	0.000	0.000

Table 2: Summary Statistics by CEO Age

Classified by CEO age, Panel A of this table presents summary statistics for firm-level characteristics while Panel B provides summary statistics for CEO-level characteristics. The sample cover S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022, excluding those with missing or negative total assets and sales. Number of observations, mean, standard deviations (SD), first quartile (P25), median, and third quartile (P75) are reported. All the ratios have been winsorized at the 1% and 99% of their empirical distribution. See Section 3 and Appendix Table A1 for descriptions of the variables. The mean of each variable is reported. All the ratios have been winsorized at the 1% and 99% of their empirical distribution. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Older	Middle-Aged	Younger
	Mean	Mean	Mean
Panel A: Firm Characteristics:			
V/P	0.559	0.540	0.510
Market-to-Book	3.081	3.104	3.410
Sales Growth	0.110	0.111	0.176
Tangibility	0.274	0.268	0.247
Cash	0.132	0.138	0.179
Market Leverage	0.373	0.383	0.331
Return	0.186	0.203	0.268
New Investment	0.052	0.057	0.073
Capex	0.049	0.049	0.054
R&D	0.023	0.028	0.039
Acquisitions	0.023	0.024	0.027
Firm Age	29.437	28.411	22.189
Total Assets ($ Millions)	17323.776	17366.553	10424.748
Market Value of Equity ($ Millions)	10134.811	10104.199	7409.114
Panel B: CEO Characteristics:			
CEO Age	62.208	54.543	46.653
CEO Tenure	11.099	7.259	5.747
CEO in Recessions	0.098	0.122	0.128
Fast-Track Career CEO	55.611	50.141	43.629
CEO Ownership	0.026	0.016	0.018
Overconfident CEO (67% ITM)	0.504	0.404	0.368
Overconfident CEO (100% ITM)	0.388	0.303	0.283
High-Revenue-Generating CEO	0.566	0.561	0.571
Generalist CEO	−0.069	−0.110	−0.336
CEO Recession Exp. Post Turning 22	11.672	8.669	6.231
CEO Recession Exp. Post Assumption	1.426	1.037	0.792
CEO Gender (Male = 1)	0.980	0.963	0.962
CEO Duality	0.614	0.482	0.368
CEO Delta ($ Thousands)	733.707	502.224	470.228
CEO Vega ($ Thousands)	105.812	103.601	79.697
CEO Pension ($ Thousands)	1925.531	1209.230	267.966

Table 3: Expected Investment Regression

This table presents estimates of fixed-effects panel regressions of corporate new investment on a set of firm-level control variables. *New Investment* is defined as capital expenditures plus research and development (R&D) expenses plus acquisitions minus sale of property, plant, and equipment (PP&E) minus amortization and depreciation, divided by total assets. The sample cover S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. *New Investment* is scaled by 100. All control variables are lagged and all the ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	New Investment		
	(1)	(2)	(3)
V/P	−1.224***	−1.154***	−0.963***
	(0.158)	(0.166)	(0.166)
Market Leverage	−1.862***	−1.756***	−1.805***
	(0.251)	(0.245)	(0.256)
Cash	11.050***	11.671***	10.778***
	(0.771)	(0.771)	(0.736)
Log(Firm Age)	0.101	0.152	−0.302***
	(0.102)	(0.096)	(0.102)
Log(Total Assets)	−0.337***	−0.280***	−0.139***
	(0.044)	(0.042)	(0.047)
Return	0.778***	0.696***	0.682***
	(0.170)	(0.130)	(0.128)
Prior New Investment	0.431***	0.429***	0.376***
	(0.017)	(0.017)	(0.016)
Industry Fixed Effects	No	No	Yes
Year Fixed Effects	No	Yes	Yes
Adjusted R^2	0.341	0.348	0.369
Observations	45,251	45,251	45,251

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 4: Summary Statistics for Unexpected Investment

This table present summary statistics for abnormal investment, overinvestment, and underinvestment encompassing S&P 1500 firms included in the ExecuComp database between 1992 and 2022. Number of observations, mean, standard deviations (SD), first quartile (P25), median, and third quartile (P75) are reported. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Obs.	Mean	SD	P25	Median	P75
Panel A: Full Sample:						
Abnormal Investment	45,251	0.051	0.061	0.015	0.031	0.061
Overinvestment	17,373	0.066	0.084	0.014	0.035	0.083
Underinvestment	27,878	0.041	0.039	0.016	0.030	0.053
Panel B: By CEO Age:						
	Older		Middle-Aged		Younger	
	Mean		Mean		Mean	
Abnormal Investment	0.046		0.050		0.056	
Overinvestment	0.060		0.065		0.073	
Underinvestment	0.039		0.040		0.045	

Table 5: CEO Age and New Investment Components

This table presents estimates of fixed-effects panel regressions of corporate new investment constituents on the log of CEO age and a set of control variables. In column (1), the dependent variable is capital expenditure (*Capex*); in column (2), it is research and development spending (*R&D*); and in column (3), it is the capital allocated to acquiring other firms (*Acquisitions*). *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Dependent Variable:		
	Capex	R&D	Acquisitions
	(1)	(2)	(3)
Older CEO	0.016	−0.039	−0.181***
	(0.029)	(0.027)	(0.049)
Log(CEO Tenure)	0.011	0.018	−0.073*
	(0.015)	(0.018)	(0.039)
V/P	−0.086	0.049	−0.265***
	(0.066)	(0.034)	(0.054)
Market Leverage	−0.314***	0.076	−0.803***
	(0.076)	(0.068)	(0.107)
Cash	0.319***	2.533***	−0.069
	(0.102)	(0.371)	(0.320)
Log(Firm Age)	−0.008	−0.038	−0.151**
	(0.027)	(0.027)	(0.060)
Log(Total Assets)	−0.016	0.002	−0.097***
	(0.013)	(0.011)	(0.023)
Return	0.587***	−0.148***	0.258***
	(0.062)	(0.037)	(0.088)
Prior New Investment			
Prior Capex	0.716***		
	(0.019)		
Prior R&D		0.841***	
		(0.016)	
Prior Acquisitions			0.132***
			(0.015)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Adjusted R^2	0.726	0.844	0.072
Observations	45,251	45,251	45,251

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 6: CEO Age and Abnormal Investment: Baseline Results

This table presents estimates of fixed-effects panel regressions of abnormal investment on CEO age and a set of control variables. The dependent variable, *Abnormal Investment*, refers to the absolute value of the firm's deviation from its predicted investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Abnormal Investment			
	(1)	(2)	(3)	(4)
Older CEO	−0.625***	−0.469***	−0.236***	−0.226***
	(0.087)	(0.079)	(0.083)	(0.073)
Log(CEO Tenure)			−0.074	−0.041
			(0.049)	(0.048)
Market-to-Book			0.016**	0.012*
			(0.007)	(0.006)
Market Leverage			0.143	−0.666***
			(0.151)	(0.202)
Cash			4.532***	6.195***
			(0.395)	(0.717)
Log(Total Assets)			−0.553***	−0.541***
			(0.035)	(0.094)
Tangibility			0.138	−0.082
			(0.356)	(0.598)
Log(Firm Age)			−0.316***	−0.152
			(0.069)	(0.209)
Year Fixed Effects	No	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	Yes	No
Firm Fixed Effects	No	No	No	Yes
Adjusted R^2	0.002	0.064	0.108	0.209
Observations	45,251	45,251	45,251	45,251

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 7: CEO Age and Overinvestment: Baseline Results

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The overinvestment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment			
	(1)	(2)	(3)	(4)
Older CEO	−0.945***	−0.772***	−0.372**	−0.430***
	(0.164)	(0.151)	(0.158)	(0.135)
Log(CEO Tenure)			−0.117	−0.051
			(0.095)	(0.092)
Market-to-Book			0.017	0.009
			(0.012)	(0.010)
Market Leverage			−0.051	−1.821***
			(0.241)	(0.458)
Cash			6.637***	12.150***
			(0.834)	(1.494)
Log(Total Assets)			−0.790***	−1.365***
			(0.073)	(0.186)
Tangibility			−1.053	−0.054
			(0.656)	(1.110)
Log(Firm Age)			−0.229*	0.487
			(0.133)	(0.421)
Year Fixed Effects	No	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	Yes	No
Firm Fixed Effects	No	No	No	Yes
Adjusted R^2	0.003	0.068	0.117	0.212
Observations	17,373	17,373	17,373	16,889

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 8: CEO Age and Underinvestment: Baseline Results

This table presents estimates of fixed-effects panel regressions of underinvestment on CEO age and a set of control variables. The dependent variable, *Underinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with lower than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The underinvestment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Underinvestment			
	(1)	(2)	(3)	(4)
Older CEO	−0.361***	−0.212***	−0.050	−0.042
	(0.063)	(0.053)	(0.049)	(0.053)
Log(CEO Tenure)			−0.061*	−0.035
			(0.035)	(0.035)
Market-to-Book			0.002	0.004
			(0.007)	(0.006)
Market Leverage			0.215	0.682***
			(0.198)	(0.225)
Cash			3.297***	1.761***
			(0.304)	(0.424)
Log(Total Assets)			−0.432***	0.184*
			(0.028)	(0.100)
Tangibility			0.373	0.227
			(0.417)	(0.595)
Log(Firm Age)			−0.328***	−0.804***
			(0.059)	(0.181)
Year Fixed Effects	No	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	Yes	No
Firm Fixed Effects	No	No	No	Yes
Adjusted R^2	0.002	0.072	0.136	0.297
Observations	27,878	27,878	27,878	27,651

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 9: CEO Age and Overinvestment: Instrumental Variable

This table presents estimates of 2-Stage Least Squares (2SLS) regressions of overinvestment on CEO age and a set of control variables employing an instrumental variable approach. *CEO Age*, which denotes the age of the current CEO of the firm, is instrumented by the log of *CPI at Birth*; the Consumer Price Index in the year the CEO was born. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. Column (1) shows the 2SLS first-stage estimates obtained from regressing *Older CEO* indicator on the log of *CPI at Birth* and other control variables. Column (2) reports presents the 2SLS second-stage results where the dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The overinvestment variable is scaled by 100. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	2SLS	
	First Stage	Second Stage
	(1)	(2)
Log(CPI at Birth)	−1.423***	
	(0.063)	
Older CEO		−0.464*
		(0.249)
Log(CEO Tenure)	0.051***	−0.116
	(0.008)	(0.097)
Market-to-Book	0.001	0.017
	(0.001)	(0.012)
Market Leverage	−0.014	−0.062
	(0.012)	(0.242)
Cash	0.005	6.636***
	(0.025)	(0.835)
Log(Total Assets)	0.003	−0.787***
	(0.003)	(0.073)
Tangibility	0.037	−1.052
	(0.030)	(0.660)
Log(Firm Age)	0.001	−0.228
	(0.006)	(0.137)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Adjusted R^2	0.408	0.051
Observations	17,330	17,330

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 10: CEO Age and Overinvestment: Long-Tenure

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables for firms with higher than expected investment. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment			
	1 <= Tenure <= 3	1 <= Tenure <= 6	1 <= Tenure <= 8	1 <= Tenure <= 11
	(1)	(2)	(3)	(4)
Older CEO	−0.658**	−0.661***	−0.542***	−0.358**
	(0.254)	(0.180)	(0.181)	(0.174)
Log(CEO Tenure)	0.458	0.156	0.057	0.071
	(0.298)	(0.181)	(0.128)	(0.131)
Market-to-Book	0.004	0.006	0.019	0.018
	(0.019)	(0.016)	(0.014)	(0.013)
Market Leverage	−0.091	0.018	0.093	−0.064
	(0.412)	(0.357)	(0.289)	(0.272)
Cash	8.475***	8.184***	8.154***	7.723***
	(1.562)	(1.090)	(1.061)	(0.911)
Log(Total Assets)	−0.795***	−0.765***	−0.776***	−0.789***
	(0.113)	(0.080)	(0.082)	(0.078)
Tangibility	−0.575	−1.517*	−1.390**	−1.110
	(0.965)	(0.751)	(0.672)	(0.657)
Log(Firm Age)	−0.386*	−0.338**	−0.283**	−0.289**
	(0.207)	(0.140)	(0.133)	(0.139)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.131	0.125	0.125	0.125
Observations	4,903	9,369	11,512	13,635

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 11: CEO Age and Overinvestment: Risk-Taking Incentives and Wealth?

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables including proxies for CEO risk-taking incentives and wealth. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment		
	(1)	(2)	(3)
Older CEO	−0.373**	−0.341**	−0.371**
	(0.152)	(0.155)	(0.155)
Log(CEO Tenure)	−0.182*	−0.032	−0.174*
	(0.104)	(0.102)	(0.102)
Log(CEO Delta)	0.086		0.243***
	(0.056)		(0.059)
Log(CEO Vega)	0.081		−0.007
	(0.049)		(0.049)
CEO Ownership		−5.179***	−9.305***
		(1.670)	(1.881)
Log(CEO Pension)		−0.062**	−0.073**
		(0.027)	(0.027)
CEO Duality			0.215
			(0.148)
CEO Gender (Male = 1)			0.197
			(0.491)
Market-to-Book	0.014	0.018	0.012
	(0.012)	(0.012)	(0.012)
Market Leverage	−0.056	−0.072	−0.042
	(0.245)	(0.241)	(0.246)
Cash	6.382***	6.609***	6.348***
	(0.856)	(0.825)	(0.855)
Log(Total Assets)	−0.871***	−0.785***	−0.918***
	(0.080)	(0.073)	(0.081)
Tangibility	−0.942	−0.976	−0.845
	(0.672)	(0.654)	(0.646)
Log(Firm Age)	−0.225	−0.245*	−0.238*
	(0.134)	(0.139)	(0.139)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Adjusted R^2	0.117	0.118	0.119
Observations	16,885	17,373	16,863

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 12: CEO Age and Overinvestment: Overconfidence?

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables including proxies for CEO overconfidence. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment			
	(1)	(2)	(3)	(4)
Older CEO	−0.854***	−0.329*	−0.843***	−0.327*
	(0.176)	(0.180)	(0.173)	(0.179)
Overconfident CEO (67% ITM)	0.411**	0.129		
	(0.181)	(0.175)		
Overconfident CEO (100% ITM)			0.407*	0.025
			(0.200)	(0.201)
Log(CEO Tenure)		−0.261**		−0.242*
		(0.124)		(0.123)
Log(CEO Delta)		0.431***		0.449***
		(0.089)		(0.092)
Log(CEO Vega)		−0.062		−0.069
		(0.095)		(0.094)
CEO Ownership		−10.239***		−10.552***
		(2.204)		(2.213)
Log(CEO Pension)		−0.067**		−0.068**
		(0.032)		(0.032)
CEO Duality		0.182		0.183
		(0.180)		(0.181)
CEO Gender (Male = 1)		0.320		0.315
		(0.616)		(0.615)
Market-to-Book		0.003		0.003
		(0.013)		(0.013)
Market Leverage		0.018		0.015
		(0.292)		(0.292)
Cash		6.122***		6.117***
		(0.893)		(0.892)
Log(Total Assets)		−1.062***		−1.067***
		(0.105)		(0.105)
Tangibility		−0.614		−0.616
		(0.716)		(0.717)
Log(Firm Age)		−0.172		−0.175
		(0.145)		(0.146)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.066	0.119	0.066	0.119
Observations	13,661	13,589	13,661	13,589

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 13: CEO Age and Overinvestment: Talent?

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables including proxies for CEO talent. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinnvestment			
	(1)	(2)	(3)	(4)
Older CEO	−0.771***	−0.331*	−0.871***	−0.668***
	(0.152)	(0.179)	(0.152)	(0.194)
CEO in Recessions	0.026	−0.123		
	(0.208)	(0.245)		
Fast-Track Career CEO			0.583	1.846**
			(0.648)	(0.801)
Overconfident CEO (67% ITM)		0.126		0.187
		(0.177)		(0.181)
Log(CEO Tenure)		−0.265**		−0.210*
		(0.124)		(0.118)
Log(CEO Delta)		0.433***		0.437***
		(0.089)		(0.089)
Log(CEO Vega)		−0.063		−0.056
		(0.095)		(0.094)
CEO Ownership		−10.273***		−10.311***
		(2.212)		(2.205)
Log(CEO Pension)		−0.067**		−0.068**
		(0.032)		(0.032)
CEO Duality		0.180		0.148
		(0.181)		(0.185)
CEO Gender (Male = 1)		0.326		0.350
		(0.616)		(0.614)
Market-to-Book		0.004		0.004
		(0.013)		(0.013)
Market Leverage		0.015		−0.000
		(0.292)		(0.292)
Cash		6.117***		6.165***
		(0.892)		(0.887)
Log(Total Assets)		−1.063***		−1.064***
		(0.105)		(0.105)
Tangibility		−0.619		−0.625
		(0.718)		(0.716)
Log(Firm Age)		−0.171		−0.182
		(0.145)		(0.145)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.068	0.119	0.068	0.120
Observations	17,373	13,589	17,373	13,589

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 14: CEO Age and Overinvestment: Managerial Ability?

This table presents estimates of fixed-effects panel regressions of overinvestment on CEO age and a set of control variables including proxies for managerial abilities. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. *Older CEO* is a dummy variable that is assigned a value of 1 if the CEO is in the highest age tercile, and 0 otherwise. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment		
	(1)	(2)	(3)
Older CEO	−0.650***	−0.591***	−0.651**
	(0.206)	(0.209)	(0.239)
Generalist CEO	0.148		0.124
	(0.104)		(0.116)
High-Revenue-Generating CEO		−0.312	0.259
		(0.390)	(0.505)
CEO in Recessions	0.151	−0.129	0.079
	(0.310)	(0.286)	(0.366)
Fast-Track Career CEO	2.009**	1.849**	2.109**
	(0.838)	(0.868)	(0.944)
Overconfident CEO (67% ITM)	0.396*	0.156	0.349
	(0.200)	(0.198)	(0.222)
Log(CEO Tenure)	−0.250*	−0.113	−0.104
	(0.144)	(0.125)	(0.154)
Log(CEO Delta)	0.353***	0.408***	0.300**
	(0.105)	(0.106)	(0.126)
Log(CEO Vega)	0.008	−0.059	−0.003
	(0.112)	(0.115)	(0.141)
CEO Ownership	−7.743***	−10.152***	−7.924***
	(2.571)	(2.341)	(2.626)
Log(CEO Pension)	−0.064	−0.086**	−0.086*
	(0.044)	(0.037)	(0.046)
CEO Duality	0.051	−0.004	−0.056
	(0.226)	(0.194)	(0.238)
CEO Gender (Male = 1)	0.692	0.389	0.682
	(0.728)	(0.738)	(0.865)
Firm Level Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Adjusted R^2	0.112	0.093	0.087
Observations	9,409	11,741	8,227

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 15: CEO Age and Overinvestment: Recession Experience

This table presents estimates of fixed-effects panel regressions of overinvestment on proxies for CEO recession experience and a set of control variables. The dependent variable, *Overinvestment*, refers to the absolute value of the firm's deviation from its predicted investment for firms with higher than expected investment. The predicted investment model follows the formulations of Richardson (2006) and Stoughton et al. (2017), as detailed in Equation (1). The abnormal investment variable is scaled by 100. The sample consists of S&P 1500 firms listed in the ExecuComp database spanning from 1992 to 2022. All control variables are lagged and all ratios have been winsorized at the 1% and 99% of their empirical distribution. Standard errors are corrected for heteroskedasticity and clustered by firm and year. See Section 3 and Appendix Table A1 for descriptions of the variables.

	Overinvestment			
	(1)	(2)	(3)	(4)
Log(CEO Recession Exp. Post Turning 22)	−1.188***	−0.055		
	(0.265)	(0.328)		
Log(CEO Recession Exp. Post Assumption)			−0.673***	−0.735***
			(0.181)	(0.254)
Log(CEO Tenure)		−0.193		−0.042
		(0.128)		(0.138)
Log(CEO Delta)		0.404***		0.411***
		(0.107)		(0.105)
Log(CEO Vega)		−0.059		−0.057
		(0.115)		(0.115)
CEO Ownership		−10.141***		−10.303***
		(2.332)		(2.340)
Log(CEO Pension)		−0.087**		−0.089**
		(0.037)		(0.037)
CEO Duality		0.009		0.014
		(0.192)		(0.183)
CEO Gender (Male = 1)		0.340		0.427
		(0.744)		(0.741)
Overconfident CEO (67% ITM)		0.095		0.160
		(0.190)		(0.197)
CEO in Recessions		−0.114		−0.009
		(0.286)		(0.294)
High-Revenue-Generating CEO		−0.304		−0.318
		(0.388)		(0.387)
Firm Level Controls	No	Yes	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.068	0.092	0.067	0.093
Observations	17,373	11,741	17,373	11,741

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Appendix

A. Variable Definitions, and Additional Robustness Tests

Table A1: Variable Definitions and Sources

This table presents the data sources and the definitions of the variables used in the analysis.

Variable	Definition	Data Source
Panel A: Firm Characteristics		
Total Assets	The book value of total assets, converted to 2010 dollars.	Compustat
Market Value of Equity	The calendar year closing price times the total number of shares outstanding, converted to 2010 dollars.	Compustat
Cash	The book value of cash and short-term investments scaled by book value of total assets.	Compustat
New Investment	Capital expenditures plus research and development (R&D) expenses plus acquisitions minus sale of property, plant, and equipment (PP&E) minus amortization and depreciation, all scaled by book value of total assets.	Compustat
Tangibility	The net of property, plant, and equipment scaled by book value of total assets.	Compustat
V/P	The value of assets in place divided by market value of equity. The value of assets in place comes from a residual income model of assets described in Ohlson (1995).	Richardson (2006)
Market-to-Book	The market value of equity divided by book value of equity.	Compustat
Sales Growth	The percent change in sales from year $t-1$ to year t.	Compustat
Return	The percent change in market value of equity from year $t-1$ to year t.	Compustat
Market Leverage	The sum of the book value of short-term and long-term debt divided by the sum of the book value of total debt and the book value of equity.	Compustat
Firm Age	The number of years for which the firm has been included in the Compustat database.	Compustat
Panel B: CEO Characteristics:		
CEO Age	The age of the current CEO of the firm in years.	ExecuComp
CEO Tenure	The number of years as CEO in the current firm.	ExecuComp
CEO in Recessions	Dummy variable that equals one if the CEO assumed the role at their current firm during an NBER recession year.	ExecuComp
Fast-Track Career CEO	The age at which a CEO takes charge for the first time.	ExecuComp
CEO Ownership	The number of shares owned by the CEO as the percentage of total shares outstanding.	ExecuComp

(*Continued*)

Table A1: Variable Definitions and Sources—*Continued*

This table presents the data sources and the definitions of the variables used in the analysis.

Variable	Definition	Data Source
Overconfident CEO (67% ITM)	Dummy variable that equals one if the CEO, during their tenure, defers the exercise of vested options that are at least 67% in the money on at least two occasions. The average moneyness of the CEO's options is the ratio of the average value per option to the average strike price. The average value per option is calculated by scaling the total value of the CEO's option holdings by the number of options. The average strike price is determined by subtracting the average value per option from the firm's stock price at the end of the fiscal year.	ExecuComp
Overconfident CEO (100% ITM)	Dummy variable that equals one if the CEO, during their tenure, defers the exercise of vested options that are at least 100% in the money on at least two occasions.	ExecuComp
Generalist CEO	First factor obtained by applying principal components analysis to five proxies of general managerial ability: past number of positions, number of firms; number of industries; CEO experience dummy; and conglomerate experience dummy.	Custódio et al. (2013)
High-Revenue-Generating CEO	The residuals from a firm efficiency model determining how efficiently a CEO can convert corporate resources to revenue relative to industry peers. The resources considered are: cost of inventory; general and administrative expenses; fixed assets; operating leases; past research and development (R&D) expenditures; and intangible assets.	Demerjian et al. (2012)
CEO Rec. Exp. Post Turning 22	The number of NBER recession years a CEO has experienced after turning 22.	ExecuComp
CEO Rec. Exp. Post Assumption	The number of NBER recession years a CEO has experienced after assuming the CEO position.	ExecuComp
CEO Gender (Male = 1)	Dummy variable that equals one if the current CEO of the firm is male.	ExecuComp
CEO Duality	Dummy variable that equals one if the current CEO of the firm also serves concurrently as the chairman of the board of directors.	ExecuComp
CEO Delta ($ Thousands)	The dollar change in CEO wealth associated with a 1% change in the firm's stock price.	ExecuComp
CEO Vega ($ Thousands)	The dollar change in CEO wealth associated with a 1% change in the annualized standard deviation of the firm's stock returns.	ExecuComp
CEO Pension ($ Thousands)	The CEO's present value of accumulated pension benefits from all pension plans.	ExecuComp