

CEO fitness and corporate performance

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Abstract

Physical exercise has been associated with improved cognitive functioning and other psychological benefits. Despite these potential benefits, there is very limited research on the association between the physical fitness level of the CEO and corporate performance. We address this gap in the literature. Specifically, we use artificial intelligence to estimate the physical fitness level of two thousand CEOs in non-financial S&P 1500 firms during the period 2007-2022. We find no support for a general positive or negative association between a continuous measure of the physical fitness level of the CEO and corporate performance. However, we find that extremely fit CEOs (i.e., top 5%) are associated with higher valuation. Furthermore, and perhaps surprisingly, we find that extremely fit CEOs perform worse during crises but better under business-as-usual settings than their less fit peers. Our results suggest that the potential benefits of being extremely fit during crises are, in an empirical sense, more than outweighed by hours spent in the gym (and not the office) and a relatively high focus on the “life” in the work/life balance. Our findings are robust, economically significant, and important for understanding the nuanced relationship between the physical fitness level of the CEO and corporate performance.

Keywords: CEO fitness, corporate performance, crisis, uncertainty

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1. Introduction

The importance of physical exercise and mental wellbeing has received increased attention in the literature (Mandolesi et al., 2018). This evolving perspective has also gained relevance among top executives, who often face long working hours and intense schedules (Loehr & Schwartz, 2001; Lovelace et al., 2007; Keloharju et al., 2023). Prior literature finds several benefits associated with being fit, such as enhanced cognitive capacity, greater stress management, and improved planning ability (Colcombe & Kramer, 2003; Lista & Sorrentino, 2010; Hötting & Röder, 2013). These qualities are expected to be particularly relevant in crises and situations under heightened uncertainty, where CEOs are required to make complex decisions under pressure (Mandolesi et al., 2018). Based on the benefits found in the literature, one might intuitively expect that firms would favor physically fit leaders (Keloharju et al., 2023). These leaders may be better equipped to handle firm decisions quickly and more effectively in stressful situations. However, a shift towards very fit CEOs is not reflected in the real world as we do not observe only very fit CEOs. While the focus of physical fitness has increased, there is still very limited evidence of potential implications for corporate performance.

Prior literature within this research area presents a somewhat mixed picture. Limbach and Sonnenburg (2015) find that CEOs who have completed a marathon are associated with better corporate performance and Dong et al. (2019) find similar findings for former athletes who are part of the board of directors. In contrast, Biggerstaff et al. (2017) find that CEOs who play golf during trading hours are associated with reduced corporate performance, suggesting that time spent on fitness-related activities or other non-work activities during work hours may come at a cost. Thus, our aim is to – at least partially – fill this gap in the literature by investigating the association between CEO fitness and corporate performance.

Recent advancements in artificial intelligence (AI) have made it possible to estimate the physical fitness level of CEOs. We exploit this new opportunity and investigate the association between the physical fitness level of the CEO and corporate performance for more than two

thousand CEOs in non-financial S&P 1500 firms during the period 2007-2022. We are especially interested in this association during crises and periods of high uncertainty as the pressure on the CEO is supposed to be high in such situations. Thus, our main research question is: “Does the physical fitness level of the CEO impact corporate performance during crises and periods of high uncertainty?”.

We find no significant support for a general positive or negative association between the physical fitness level of the CEO and corporate performance. However, our results indicate that extremely fit CEOs (i.e., top 5%) are associated with a 7%-9% higher valuation (Tobin’s Q). Furthermore, we find that crises and high uncertainty negatively moderate the relationship between extremely fit CEOs and corporate performance. Thus, extremely fit CEOs perform worse during crises in terms of operational performance (ROA down by 0.5% points) than their less fit peers, but these extremely fit CEOs perform better under business-as-usual settings (ROA up by 1.6% points and Tobin’s Q up by 13%). Thus, extremely fit CEOs seem to be better on average but with an unfortunate risk profile (i.e., worsening the lower tail outcomes). Our findings are important for understanding the nuanced relationship between the physical fitness level of the CEO and corporate performance.

We contribute to the existing literature in three main ways. *First*, we show that there is no significant linear or non-linear association between the physical fitness level of the CEO and corporate performance when we use a continuous variable to measure the fitness level. Prior literature has addressed such association for extreme levels of CEO fitness (i.e., marathon participation in Limbach and Sonnenburg, 2015). More broadly, our findings tie into the literature on CEO health and corporate performance. Keloharju et al. (2023) find a positive association between the mental health of the CEO and corporate performance but only for small firms and not for physical health. *Second*, we show that extremely fit CEOs are associated with higher valuations by investors (Tobin’s Q) but not associated with improved operational performance (ROA) in general. The positive association with valuation is in line with earlier literature (Limbach and

Sonnenburg, 2015). *Third*, and most importantly, we show that extremely fit CEOs are associated with worse operational performance (ROA) during crises (i.e. the financial crisis and the pandemic) but better valuations by investors (Tobin's Q) and better operational performance in business-as-usual settings. To the best of our knowledge, the association between the physical fitness level of the CEO and corporate performance during crises has not been investigated previously. Our novel findings contribute to the existing literature on the potential benefits of physical exercise and performance in a corporate setting (Limbach and Sonnenburg, 2015; Biggerstaff et al., 2017; Dong et al., 2019).

We review the literature and develop our hypotheses in the next section. We describe our sample, variables, and methodology in the third section. We report the empirical results in the fourth section. We discuss the results in the fifth section, and we conclude in the sixth section.

2. Literature review and hypothesis development

CEOs matter (Bertrand & Schoar, 2003; Hambrick, 2007; Hambrick & Mason, 1984), and physical fitness matters (Colcombe & Kramer, 2003; Rhea et al., 2004; Coe et al., 2006; Lista & Sorrentino, 2010; Hötting & Röder, 2013). The role of executives, particularly CEOs, has evolved significantly over time (Lovelace et al., 2007). One of the most important attributes of these executives is to be able to manage stress, which is particularly relevant for CEOs, whose role can often mean long working hours with high pressure, demand, and many responsibilities (Neck et al., 2000; Lovelace et al., 2007). Both academic research and public discourse have started to explore the potential influence of traits such as attractiveness, personality traits, abilities, and physical fitness (Hambrick et al., 2005; Rhodes & Pfaeffli, 2012; Limbach & Sonnenburg, 2015; Halford & Hsu, 2020, Keloharju et al., 2023). Among these, physical fitness remains relatively unexplored, despite its potential implications for a firm's performance.

Psychological and health-related literature supports the idea that physical fitness can be a powerful tool for handling stress and maintaining performance in high-pressure environments.

Thus, research shows that regular physical activity reduces anxiety, lowers risk of disease, and enhances cognitive functioning (Lovelace et al., 2007; Hötting & Röder, 2013; Mandolesi et al., 2018). This positive relationship between physical activity and enhanced cognitive performance is not only limited to corporate settings, as similar findings have been observed among younger people (Coe et al., 2006). In the context of CEO's physical fitness, it has been shown to improve executive-control processes such as planning, coordination, and working memory (Colcombe & Kramer, 2003). Furthermore, Rhea et al. (2004) argue that fitness contributes to better job performance through enhanced cognitive capacity and stress management. These findings imply that CEOs who are physically fit may be more mentally focused and resilient under pressure (Dong et al., 2019).

Limbach and Sonnenburg (2015) test the relationship between CEO fitness and corporate performance by using marathon completion as a proxy for fitness. They investigate CEOs of S&P 1500 firms from 2001 to 2011 and find that CEOs who completed marathons were associated with higher corporate performance as measured by valuation (Tobin's Q) and operational performance (ROA). Similarly, Dong et al. (2019) use the board members' former Olympic participation as another proxy for fitness. They find that firms with athlete directors outperformed boards without athletes in terms of Tobin's Q and ROA. Notably, these positive effects of athletic experience were found to be stronger during the financial crisis, where they argue that athlete directors have greater mental resilience and better crisis management skills. The conclusions from these two papers support the idea that physical fitness may increase corporate performance, and especially so during times of crisis and uncertainty.

The findings are in line with the conclusions from the health literature and more specifically from Mandolesi et al. (2018), who find that physical exercise promotes cognitive function and physical wellbeing. However, the relationship between CEO physical exercise and corporate performance can be negative. Biggerstaff et al. (2017) find that CEOs with more freedom to play golf during trading hours are associated with poorer corporate performance. These findings raise

an issue of a potential tradeoff for CEOs between time spent on physical activity and time spent in the office which ultimately also is tied to prioritizations regarding work/life balance. This suggests that while fitness offers cognitive and stress-management benefits, it can also have a negative effect on a firm's performance.

Our first hypothesis investigates whether there is a general association between CEO fitness and corporate performance. Thus, this first hypothesis does not address potential moderating effects from crises and/or periods of high uncertainty. We do not expect to find a significant association. Although the fitness level of the average CEO may be higher than the fitness level of the average lay person (Keloharju et al., 2023), empirically CEOs represent such a diversity of fitness levels that it would be counterintuitive to believe that only fit CEOs can serve firms in a satisfactory manner. If only fit CEOs could produce satisfactory results, shareholders would not waste money on less fit CEOs. This underlying reasoning is equivalent to the difficulty of finding robust evidence that a certain CEO personality trait is inherently good or bad for corporate performance (Tett & Burnett, 2003; Judge & Zapata, 2015). Thus, our first hypothesis is the following:

H1: The physical fitness level of the CEO is not associated with corporate performance.

In contrast to the baseline hypothesis, the second hypothesis explores the relationship when incorporating crisis and uncertainty. Based on the literature review, CEOs with a higher fitness level can be expected to perform better in times of uncertainty as they are more efficient and better performing, and able to handle high stress situations (Colcombe & Kramer, 2003; Lovelace et al., 2007; Dong et al., 2019). Dong et al. (2019) find that having a fit director is particularly important in crisis periods, as having a good physical condition leads to more effective decision-making. Furthermore, previous literature has shown that being physically active leads to lower anxiety and better cognitive functioning (Lovelace et al., 2007; Mandolesi et al., 2018). As times of crises and uncertainty are typically characterized by time pressure and important decisions that need to be

made, these potential attributes associated with physical fitness could have a positive impact, which is why fit CEOs are expected to perform better during these challenging times.

However, although there seems to be convincing arguments why crises and periods of high uncertainty should positively moderate the relationship between the physical fitness level of the CEO and corporate performance, Biggerstaff et al. (2017) implicitly point to both a direct and an indirect effect that could work in the opposite direction. The direct effect is that time spent exercising (or playing golf in the case of Biggerstaff et al., 2007) cannot then be spent in the office. The indirect effect is that time spent exercising may be a proxy for a relatively large focus on the life element in the work/life balance. Thus, a fit CEO may not want to compromise health to work the extra hours requested in a crisis. Both the direct effect and the indirect effect may be detrimental for corporate performance during crises or times of high uncertainty when the leadership of the CEO is needed the most. Furthermore, being fit necessitates a certain regimen of planning and regularity which ties into the arguments of Aabo et al. (2024) who find that CEO high in conscientiousness (also related to a high degree of planning and resistance to change) perform worse during periods of increased uncertainty. This leads us to two competing hypotheses:

H2A: Crises and periods of high uncertainty positively moderate the association between the physical fitness level of the CEO and corporate performance.

H2B: Crises and periods of high uncertainty negatively moderate the association between the physical fitness level of the CEO and corporate performance.

The underlying reasoning for our three hypotheses follows the logic from the psychology literature (Tett & Burnett, 2003; Judge & Zapata, 2015) that emphasizes that a personality trait is not inherently good or bad (resembling our H1 hypothesis) but that the superiority or inferiority of a personality trait is context specific (resembling our H2A and H2B hypotheses).

3. Data and methodology

The first section describes our sample (3.1). The second section describes the CEO physical fitness variable (3.2). The third section describes our proxies for uncertainty and crisis (3.3). The fourth section describes the dependent corporate performance variables (3.4). In the fifth section, we describe further independent variables (3.5). The sixth section describes the robustness variables (3.6). The seventh section reports descriptive statistics and correlation coefficients (3.7). Finally, the last section elaborates on the methodology (3.8).

3.1 Sample

We investigate non-financial S&P 1500 firms in the period from 2007 to 2022. Our initial sample consists of all non-financial S&P 1500 firms included in the S&P 1500 per June 2019. We exclude firms classified into the industries of financials, real estate, and utility (GICS) as these industries are highly regulated (and leveraged). Furthermore, we exclude firms/CEOs with missing or incomplete information related to dependent, independent, and/or control variables. Finally, we exclude interim CEOs (i.e., CEOs with a full tenure of 12 months or less). Our final sample consists of 893 non-financial S&P 1500 firms, 2,192 CEOs, and more than thirteen thousand firm-year observations.

3.2 Fitness level

Our main variable is *FIT* which is the CEO's physical fitness level measured by artificial intelligence (ChatGPT) on a continuous scale from 1 (low fitness level) to 10 (high fitness level) with 1 decimal. We follow Pescatello et al. (2014) who 1) define physical activity as movement of the body driven by skeletal muscles leading to an increase in energy and 2) define physical fitness as a combination of characteristics and abilities that enable an individual to perform physical activity. These characteristics are either defined as health or skill components where the former consist of elements such as body composition and muscular strength (Pescatello et al., 2014). We

exploit the visible characteristics of a CEO by asking ChatGPT to assess the physical fitness level of each CEO based on publicly available pictures. We select pictures so 1) that the pictures are “similar” in the sense that they are all from a business setting where the CEO is wearing business attire (as opposed to e.g., leisure clothing) and 2) that the pictures are from the tenure of the CEO in the specific firm. Furthermore, the pictures are cropped from the top of the heads to the lower chest to ensure comparability. One picture of each CEO is used.

We upload the pictures of the CEOs to ChatGPT and ask ChatGPT to assess the physical fitness level of the CEOs.¹ As a rough robustness check, we estimate the correlations between the fitness levels estimated by observers (two of the authors of this study and an independent person) and by ChatGPT for a random sample of 42 CEOs. The correlations range between 0.80 and 0.85 (a specific observer versus ChatGPT). The correlation between the average estimates of observers and the estimates of ChatGPT is 0.87. The high correlation is reassuring.

We estimate only one fitness level for each CEO. Thus, we assume that the CEO’s fitness level is constant during the tenure of the CEO. This is not fully accurate as physical fitness decreases with age (Nakamura, et al., 1989). However, we choose this approximation because 1) the median tenure of a CEO in our sample is 6.1 years (i.e., we do not expect a major deterioration

¹ We use the following prompt: “Assume I want to examine whether fitness level has an impact on firm performance. For this I know that I need to use AI to help me come up with fitness level of the CEOs which I can use for the project and the project only. Therefore I’m asking you ChatGPT to help me out for only this project, where I will send pictures of CEOs and you will come up with fitness level estimates of the best of your ability on a continuous scale from 1 to 10 with one decimal point, where 1 is the lowest fitness level you can imagine and 10 is the most fit you can possibly be. Some examples of fitness level ratings could be 3.5, 4.2, 7 or 5.9. Remember to only provide me with one number and to look for anything relevant. The picture will be from the top of their head to the middle of their torso, so you have everything necessary to come up with an estimate. The pictures that you will be given are all in a business setting which means that the CEO will be in a suit or other professional clothing. In your assessment of the CEO’s fitness level, make sure to consider their face, their body composition and muscular strength which includes the CEO’s muscle, bone, fat and size if visible. Lastly, in terms of their faces make sure to consider their facial composition.” The prompt follows the physical fitness definition by Pescatello et al. (2014). ChatGPT responds: “Understood, I will support your project by estimating the fitness level of each CEO based on the images you provide. For each photo, I will:

- Analyze the CEO’s facial features (such as jawline definition, facial tone, and symmetry),
- Evaluate physical body composition (including posture, neck, shoulders, and upper torso within the limits of business attire),
- Consider signs of muscular strength, body fat, bone structure, and overall size,
- Deliver a single fitness score on a 1.0 to 10.0 scale, where 1.0 represents extremely low fitness and 10.0 represents peak physical fitness.

I will provide just one number per image, taking all visible and relevant indicators into account. Please upload the next photo when you’re ready.”

in physical fitness during the typical tenure), 2) we control for CEO age in our regressions, and 3) it is difficult - if not impossible - to specify the exact dates at which photos are taken. When we search for photos, we search for the name of the CEO in combination with the name of the firm. This makes it overwhelmingly likely that the photo is taken during the tenure of the specific CEO for the specific firm.

To investigate the implications of an extreme CEO physical fitness level, we employ two measures, *FIT5* and *FIT10*. *FIT5* is a binary variable equal to 1 if the CEO's fitness level (*FIT*) is among the 5% most fit and 0 otherwise (i.e., *FIT* = 7.4 or above). *FIT10* is a binary variable equal to 1 if the CEO's fitness level (*FIT*) is among the 10% most fit and 0 otherwise (i.e., *FIT* = 7.1 or above).

In the very top of extremely fit CEOs (i.e., *FIT* > 8.2) with a tenure in the sample period of at least 3 years, we find nine CEOs (years in sample period and name of firm in parentheses) : Gary P. Muto (2017-2021, Ascena), Patrick H. Hawkins (2011-2022, Hawkins), Thomas L. Deitrich (2015-2022, Itron), Jeffrey P. Bezos (2007-2021, Amazon), Thomas J. Hook (2007-2016, Integer), Michael Rapino (2007-2022, Live Nation Entertainment), Dennis A. Muilenburg (2015-2019, Boeing), Robert G. Painter (2020-2022, Trimble), and Jason D. Lippert (2013-2022, Lippert Components). The most well-known of these nine CEOs is Jeff Bezos. Jeff Bezos is known for working out (Financial Express, 2017). A further explicit sign of physical fitness activities rests on Dennis A. Muilenburg who is an active endurance cyclist (Bloomberg, 2018). We did not find any explicit references to physical activities for the remaining seven CEOs.

3.3 Uncertainty and crisis

We employ two variables that moderate the relationship between the fitness level of the CEO and corporate performance. *First*, we use the CBOE Volatility Index ("VIX") to proxy for uncertainty. To align with the time dimension of our corporate performance variables (i.e., our dependent variables), we use two measures of VIX, *VIXUlt* and *VIXAvg*. Tobin's Q is calculated at a specific

point in time (i.e., a stock measure). Thus, when Tobin's Q is our dependent variable, we use the VIX value of the last trading day of the year, *VIXUlt*. Return on assets, ROA, is calculated for a specific year (i.e., a flow measure). Thus, when return on assets is our dependent variable, we use the average VIX value during the year, *VIXAvg*. *Second*, our sample period contains two crises, the financial crisis and the Covid-19 pandemic. Thus, *Crisis* is a binary variable equal to 1 for the financial crisis years 2008-2009 and the COVID-19 pandemic years 2020-2022 and 0 otherwise.

3.4 Dependent variables

Our dependent variable is corporate performance. We measure corporate performance both in terms of valuation (Tobin's Q) and operational profitability (ROA). Tobin's Q is the most widely used market performance measure and return on assets (ROA) is the most widely used accounting performance measure (Hoobler et al., 2018).

We measure Tobin's Q as total assets + market value of equity – book value of equity, scaled by total assets. Tobin's Q is skewed to the right. Thus, in regression analysis, we take the log of Tobin's Q plus 1, *logTobinsQ*. For robustness purposes, we use the winsorized version (1% and 99%) of Tobin's Q, *wTobinsQ*.

We measure return on assets, *ROA*, as EBITDA scaled by lagged total assets. *ROA* has extreme outliers. Thus, in regression analysis, we use the winsorized version (1% and 99%) of *ROA*, *wROA*.

3.5 Further independent variables

We include the following CEO control variables in our regression analysis. *Age* is the age of the CEO measured in years. *Founder* is a binary variable equal to 1 if the CEO is the founder of the firm and 0 otherwise. *Duality* is a binary variable equal to 1 if the CEO is the chairman of the board of directors and 0 otherwise. *Gender* is a binary variable equal to 1 if the CEO is a man and 0 otherwise. *LogTenure* is the log-transformed (x+1) tenure of the CEO in years. *logStockownership*

is the log-transformed version ($x+1$) of shares held by the CEO as a fraction of common shares outstanding. *logOptionownership* is the log-transformed version ($x+1$) of vested and unvested options held by the CEO as a fraction of common shares outstanding.

We include the following firm control variables in our regression analysis. *logSize* is the natural log of total assets. We lag *logSize* one year (“Lag”) when the dependent variable is a flow measure (*wROA*). *R&D* is R&D expenditures scaled by total sales. We winsorize at 1% and 99% (*wR&D*). *Leverage* is total liabilities scaled by total assets. We winsorize at 1% and 99% (“*wLeverage*”). We lag *leverage* one year (“Lag”) when the dependent variable is a flow measure (*ROA*).

3.6 Robustness variables

First, we use Tobin’s Q in a winsorized version as opposed to the default log version.

Second, we include the Big Five personality traits (*openness to experience*, *conscientiousness*, *extraversion*, *agreeableness*, and *neuroticism*), *narcissism*, *overconfidence*, and *facial attractiveness* as control variables in a robustness test to mitigate omitted variable bias. The measurements of the Big Five personality traits are based on the Q&A sessions in conference calls following the methodology of Harrison et al. (2019 and 2020). The Big Five personality traits are measured on a continuous scale from 1 (low) to 7 (high). *Narcissism* is measured by the relative first-singular pronouns usage in the Q&A sessions in conference calls (Chatterjee and Hambrick, 2007; Aktas et al. 2016). *Narcissism* is measured on a continuous scale from 0 (low) to 1 (high). For the Big Five personality traits and *narcissism*, we require at least 3 conference calls and at least 1,000 words spoken by the CEO. *Overconfidence* is based on the option-based approach of Malmendier and Tate (2005) and Campbell et al. (2011). *Overconfidence* is a binary variable equal to 1 if the CEO shows overconfidence twice based on the option-based approach (67% in the money) and 0 otherwise. The CEO is categorized as overconfident from the first occurrence of overconfidence. Finally, *facial attractiveness* is measured on a continuous scale from 1 (low) to 10

(high) based on a web-based application from attractivenessstest.com which builds on a deep convolutional neural network developed by He et al. (2016).

Third, for elaboration purposes, we investigate the implications of an extremely unfit CEO. We employ two measures, *UnFIT5* and *UnFIT10*. *UnFIT5* is a binary variable equal to 1 if the CEO's fitness level (*FIT*) is among the 5% least fit and 0 otherwise. *UnFIT10* is a binary variable equal to 1 if the CEO's fitness level (*FIT*) is among the 10% least fit and 0 otherwise.

3.7 Descriptive statistics and correlations

Table 1 reports descriptive statistics of our variables. Our dependent variables (corporate performance) and our main independent variables show the following characteristics. The median (mean) firm has a Tobin's Q of 1.7 (2.172) and a ROA of 14.0% (15.2%). The median (mean) CEO has a physical fitness level (*FIT*) of 5.7 (5.7). *FIT* values range from 2.5 to 8.5. The two volatility measures, *VIXUlt* and *VIXAvg*, have medians (means) of 18.2 and 17.5 (20.0 and 20.0), respectively. They range from 11 to 33 (*VIXAvg*) and 40 (*VIXUlt*). Finally, there is a crisis in 30% of our firm-year observations roughly corresponding to five years (2008, 2009, 2020, 2021, and 2022) out of 16 years (2007-2022).

*** Please insert Table 1 here ***

Our CEO control variables show that the median (mean) CEO is 57 (57) years old, has held the position for 6.1 (6.1) years, has stocks corresponding to 0.3% (0.7%) of common shares outstanding, and has stock options corresponding to 0.0% (0.2%) of common shares outstanding. 8% of the CEOs are founders, 46% hold the position as chairman of the board of directors (i.e., *duality*), and 4% of the CEOs are women. Our firm control variables show that the median firm has total assets of 2.6, a leverage ratio of 53%, and R&D expenditures scaled by total sales of 0.0%. We comment on the robustness variables at a later stage.

Table 2 reports correlation coefficients. *FIT* is positively correlated (0.07) with *logTobinsQ* and negatively correlated (-0.02) with *ROA*. Thus, the correlation between the CEO fitness level and corporate performance is not straightforward in this simple framework. In line with the discussion in relation to our CEO fitness variable, we see a negative correlation (-0.39) between *FIT* and the age of the CEO.

*** Please insert Table 2 here ***

Table 2 also shows that *crisis* is positively correlated (0.48 and 0.79) with *VIXUlt* and *VIXAvg*. These correlations fit the asset pricing literature which finds that aggregate market returns are negatively correlated with aggregate market volatility (French et al., 1987; Duffee, 1995).

3.8 Methodology

We perform an unbalanced panel data analysis with firm fixed and time fixed effects. We include firm fixed effects and further CEO and firm control variables to mitigate omitted variable bias (Petersen, 2009). We cluster standard errors at the firm level (Petersen, 2009). We estimate the following model:

$$\begin{aligned} \text{Corporate performance}_{it} = & \beta_0 + \beta_1 \text{FIT}_{it} + \beta_2 \text{VIX}_{it} \text{ or } \text{Crisis}_{it} + \beta_3 (\text{FIT}_{it} \times \text{VIX}_{it} \text{ or } \text{Crisis}_{it}) + \\ & \Sigma \beta_k \text{CEOControls}_{it} + \Sigma \beta_m \text{FirmControls}_{it} + \Sigma \delta \text{Year}_t + \Sigma \text{Firm}_i + \epsilon_{it} \end{aligned} \quad (1)$$

Our two moderating variables, *VIX* and *crisis*, are exogenous in the sense that it is unlikely that the specific firm/CEO affects neither the implied aggregate market volatility nor the prevalence of an economic crisis. We do not directly prove causality (Wulff et al., 2023) and we abstain from attempting to find a valid instrumental variable as instrumental variables have severe limitations in their empirical application (Jiang, 2017; Kahn & Whited, 2018). E.g., in a fitness setting, the obesity rate of the state in which the firm is headquartered has limited association with the fitness

level of the specific CEO and such obesity rate can also be correlated with firm performance as obesity rate tends to be higher in states dominated by decreased economic activity. Based on previous literature and intuition, it is plausible (Harvey, 2017) that the physical fitness level of the CEO affects corporate performance in times of uncertainty and crisis. Furthermore, by including firm-fixed effects, we mitigate omitted variable bias. Thus, although we do not prove causality, we find it likely that an identified association between the physical fitness level of a CEO and corporate performance has a causal dimension.

4. Empirical results

Initially, we measure the physical fitness level of the CEO on a continuous scale. This allows us to test whether an incremental increase in the physical fitness level of the CEO is associated with an improvement or a deterioration in corporate performance. As argued previously, we do not expect to find significant coefficients for our *FIT* variable. If it were the case that a high (or low) CEO physical fitness level was associated with an improved corporate performance, then such fit (or unfit) CEOs would outcompete less (or more) fit CEOs. Thus, a significant result would only be possible in a transition phase and not in an equilibrium situation. Table 3 reports the results.

*** Please insert Table 3 here ***

As expected, Models 1 and 3 show statistically insignificant coefficients for our *FIT* variable whether we measure corporate performance in terms of Tobin's Q (Model 1) or ROA (Model 3). Models 2 and 4 investigate a non-linear relationship between the physical fitness level of the CEO and corporate performance. The results show – as expected – no support for such a non-linear relationship.

Previous literature focuses on a small subset of very fit CEOs who have finished a marathon (3%, Limbach & Sonnenburg, 2015) or very fit directors who have participated in the Olympics

(6%, Dong et al., 2019). To follow this line of reasoning, we investigate the effects of being in the top 5% (*FIT5*) or top 10% (*FIT10*) of the fittest CEOs. Table 4 reports the results.

*** Please insert Table 4 here ***

Table 4 shows a weak indication that being extremely fit could be associated with improved corporate performance as measured by Tobin's Q (Model 1). In terms of economic significance, an extremely fit CEO (i.e., top 5%) is associated with a 7% higher Tobin's Q in a median firm ($7\% = (\exp(0.044+0.99)-\exp(0.99))/((\exp(0.99)-1))$). This is in line with the findings of Limbach and Sonnenburg (2015) who also use a log version of Tobin's Q as their dependent variable. The coefficient in Model 1 (0.044) is very similar to the coefficient in their study (0.046). However, the coefficient for *FIT5* is only statistically significant at a 10 percent level and once we employ *FIT10* the coefficient turns insignificant (Model 2). Furthermore, the coefficients for *FIT5* and *FIT10* are insignificant when we employ the alternative corporate performance measure in the form of ROA (Models 3 and 4). This signifies that if there is an association between the physical fitness level of the CEO and corporate performance, then such association is more driven by investor perception about the future than present operational profitability. As an alternative measure of corporate performance, we use the alpha from a Fama-French three-factor model (not tabulated) and in line with our results for ROA, we find no significant association between the physical fitness level of the CEO and such an alternative measure of corporate performance. In summary, the weak indication of a positive relationship between the physical fitness level of the CEOs and corporate performance in Model 1 is in line with the findings of Limbach and Sonnenburg (2015) but is not robust to 1) an expansion of the definition of being extremely fit (Model 2) and 2) an operational performance measure (Models 3 and 4).

Table 5 replicates Table 4 but includes additional CEO variables to mitigate potential omitted variable bias. *First*, the beauty premium is well established in the existing literature

(Hamermesh & Biddle, 1994 and 1998; Hosoda et al., 2003; Webster & Driskell, 1978). The correlation between CEO *facial attractiveness* and *FIT* is 0.43 in our sample (not tabulated). Thus, it might be that the positive association between *FIT* and Tobin's Q in Model 1 in Table 4 is in fact driven by CEO beauty rather than CEO fitness. We include *facial attractiveness* as an independent variable in Table 5. *Second*, CEO overconfidence has been associated with better corporate performance in earlier literature (Bharati et al. 2016; Deshmukh & Goel, 2025, Hilary et al. 2016). If fit CEOs are more overconfident, then it might be that the positive association between *FIT* and Tobin's Q in Model 1 in Table 4 is driven by CEO overconfidence rather than CEO fitness. Surprisingly, we find a negative correlation between CEO *overconfidence* and *FIT* in our sample (-0.06, not tabulated). We include *overconfidence* as an independent variable in Table 5. *Third*, to further mitigate potential omitted variable bias, we include CEO *narcissism* and the Big Five personality traits (*openness to experience*, *conscientiousness*, *extraversion*, *agreeableness*, and *neuroticism*) in Table 5. Rhodes and Smith (2006) find physical activity to be positively correlated with extroversion and conscientiousness and negatively correlated with neuroticism. The correlations (not tabulated) in our sample between 1) *FIT* and 2) *narcissism* and the Big Five personality traits range from a negative correlation with *FIT* (-0.11 to -0.16) for *narcissism* and *neuroticism* to a positive correlation with *FIT* (0.11 to 0.18) for *openness to experience*, *conscientiousness*, *extraversion*, and *agreeableness*. We include *narcissism* and the Big Five personality traits as independent variables in Table 5.

*** Please insert Table 5 here ***

Table 5 shows 1) no significant association between *facial attractiveness* and the Big Five personality traits and corporate performance and 2) a significant and robust association between *overconfidence* and corporate performance. The latter is - as noted previously - in line with existing literature. Most importantly, Table 5 shows that the indication of a positive association between

extreme CEO fitness levels and Tobin's Q in Table 4, Model 1, is not due to an omitted variable bias. Rather, and on the contrary, the inclusion of additional independent variables in Table 5 increases the statistical significance of the coefficients for *FIT5* in Model 1 and *FIT10* in Model 2. In terms of economic significance, an extremely fit CEO (i.e., top 5%) is associated with a 10% higher Tobin's Q in a median firm ($10\% = (\exp(0.058+0.99)-\exp(0.99))/((\exp(0.99)-1))$). However, the results regarding operational performance (ROA) remain insignificant.

We now address the potentially moderating effects of uncertainty and crisis on the association between the physical fitness level of the CEO and corporate performance. Uncertainty and crisis are highly correlated. The correlation coefficient between *VIXUlt* and *crisis* is 0.48 and the correlation coefficient between *VIXAvg* and *crisis* is 0.79 (Table 2). Table 6 shows *VIXUlt*, *VIXAvg*, US GDP growth, and the crisis dummy during our sample period. The three years with the lowest GDP growth rates - the financial crisis (2008 and 2009) and the start of the pandemic (2020) – coincide with the three years with the highest average VIX values (i.e., average VIX values around 30).

*** Please insert Table 6 here ***

Table 7 replicates Table 4 but includes the moderating effects of uncertainty (Panel A) and crisis (Panel B). In Panel A, there is only a very weak indication that uncertainty moderates the association between the physical fitness level of the CEO (*FIT5* and *FIT10*) and corporate performance in the form of Tobin's Q (Models 1 and 2). However, in Models 3 and 4, when corporate performance is measured in terms of ROA, the moderation is significant both in statistical and economic terms. The turning point is close to the 75th percentile of *VIXAvg* for both models (24.5 and 24.9, respectively). Thus, for the majority of years with relatively low uncertainty, being extremely fit is performance enhancing while being extremely fit is associated with a deterioration in ROA in the minority of years where uncertainty is high (2008, 2009, 2020, and 2022). The year

with the lowest uncertainty (11.09 in 2017) is associated with an increase in ROA of 2.36 percentage points ($+4.307 - 0.176 \times 11.09$) if the CEO belongs to the 5% most fit CEOs (Model 3) and an increase of 1.45 percentage points ($+2.614 - 0.105 \times 11.09$) if the CEO belongs to the 10% most fit CEOs (Model 4). Correspondingly, the year with the highest uncertainty (32.70 in 2008) is associated with a decrease in ROA of 1.45 percentage points ($+4.307 - 0.176 \times 32.70$) if the CEO belongs to the 5% most fit CEOs (Model 3) and a decrease of 0.82 percentage points ($+2.614 - 0.105 \times 32.70$) if the CEO belongs to the 10% most fit CEOs (Model 4). These values are economically significant and not counterintuitive in terms of magnitude.

*** Please insert Table 7 here ***

Panel B investigates the moderating effect of crisis (i.e., 2008-2009 and 2020-2022) for the association between the physical fitness level of the CEO (*FIT5* and *FIT10*) and corporate performance. As opposed to Panel A, Panel B shows statistically significant interaction terms both in Models 1 and 2 (Tobin's Q as the dependent variable) and in Models 3 and 4 (ROA as the dependent variable).

In Model 1, being extremely fit (i.e., top 5%) is associated with an increase in Tobin's Q for a median firm of 13.6% ($=(\exp(0.082+0.99)-\exp(0.99))/((\exp(0.99)-1)))$ in non-crisis years. In crisis years, being extremely fit is associated with an increase in Tobin's Q of 0% ($0\%=(\exp(0.082-0.081+0.99)-\exp(0.99))/((\exp(0.99)-1)))$. Thus, Models 1-2 in Panel B suggest that being an extremely fit CEO is associated with no or minimal penalty in crisis years but a reward in non-crisis years. However, this is only the case when corporate performance is measured in terms of Tobin's Q (i.e., investor perceptions of long-term performance).

Models 3 and 4, Panel B, address the situation when ROA (i.e., here and now operational performance) is the dependent variable. In non-crisis years, being extremely fit is associated with increases in ROA of 1.65 percentage points (*FIT5* in Model 3) and 1.18 percentage points (*FIT10*

in Model 4). In crisis years, being extremely fit is associated with decreases in ROA of 0.48 percentage points (*FIT5* and *FIT5 x Crisis* in Model 3) and 0.53 percentage points (*FIT10* and *FIT10 x Crisis* in Model 4). With a mean ROA of 15.18% (Table 1), such magnitudes are economically significant.

In summary, Table 7 shows that from a valuation perspective (i.e., Tobin's Q) being an extremely fit CEO is associated with negligible penalties in years dominated by crisis but rewards in business-as-usual years. However, from an operational profitability perspective (i.e., ROA), Table 7 shows that being an extremely fit CEO is associated with penalties in years dominated by high uncertainty and/or crisis but with even higher rewards in business-as-usual years. Thus, while the average picture is one being favorable to the extremely fit CEO, the extreme fitness of the CEO comes with the downside of deteriorating operational profitability in years where such down-side may hurt the most (i.e., in years of crisis and uncertainty where the firm may be closer to a financial distress situation).

So far, we have used a log-version of Tobin's Q plus 1 to mitigate a distribution skewed to the right. Table 8 shows that our previous conclusions are robust to a winsorized version of Tobin's Q. Models 1 and 2 replicate Table 3 and show no statistical significance. Models 3 and 4 replicate Table 4 and show a weak indication that being extremely fit is associated with improved valuation. Models 5 and 6 replicate Table 7, Panel A, and show a weak indication that uncertainty moderates the association between the physical fitness level of the CEO and valuation. Finally, Models 7 and 8 replicate Table 7, Panel B, and show statistically significant interaction terms. In conclusion, the findings in relation to the valuation perspective (i.e., Tobin's Q) are robust to alternative ways of calculating the variable.

*** Please insert Table 8 here ***

5 Discussion

We argue that a negative association between an extremely fit CEO and corporate performance in crisis years or in years with high uncertainty could be due to the CEO's devotion to fitness in both a direct and indirect way – the *direct* way being hours spent in the gym or on other physical activities that cannot be used at the office and the *indirect* way being relatively more focus on life in the work/life balance. In years where the CEO's presence is especially needed (e.g., in crisis years) such higher focus on other aspects of life than work may be detrimental to corporate performance.

The above explanation has the potential to reconcile the findings of this study and the findings of Dong et al. (2019). For the period 1999-2015, Dong et al. find that athletes' attributes (physical fitness among others) enhance their monitoring capabilities as members of the board of directors and improve corporate performance (Tobin's Q and ROA) especially during the financial crisis. It is reasonable to assume that directors are not as pressured on time during crises as CEOs because the former are not operating the business on a day-to-day basis. Thus, in the case of directors during crises, it is likely that the benefits of physical fitness (e.g., ability to handle high stress situations; lower anxiety; better cognitive functioning) outweigh the drawbacks of physical fitness (e.g., time spent keeping fit; relatively high focus on the life element of work/life balance) while the opposite is the case for CEOs.

In relation to the work-life balance considerations, one might speculate that the somewhat surprising, negative correlation between CEO overconfidence and CEO fitness that we noted earlier could be a result of a relative lack of focus on the work side of the work/life balance. Thus, the tendency to exercise deep-in-the-money options can be seen as an indication of a lesser commitment to and/or belief in the glorious future of the firm that the CEO is heading. This speculation is tied to the empirical measurement of overconfidence based on the option approach (Malmendier & Tate, 2005; Campbell et al., 2011) rather than the "true" CEO overconfidence.

To advance a further understanding of the elements contributing to the negative relationship between extreme CEO fitness and corporate performance during crises, we delve into the lower end of the CEO fitness scale. Thus, we create two new measures, *UnFIT5* and *UnFIT10*. *UnFIT5* (*UnFIT10*) is a binary variable equal to 1 if the CEO's fitness level (*FIT*) is among the 5% (10%) least fit and 0 otherwise. We expect an extremely unfit CEO to be associated with less deterioration in corporate performance in crisis years compared to an extremely fit CEO because an unfit CEO will not spend hours exercising and will not necessarily have a “skewed” focus on life in the life/work balance. This would be especially true for corporate performance in the form of ROA because we are here focusing on here and now operational profitability as opposed to investor perception of long-term performance (Tobin's Q). Table 9, Panels A-C, replicates 1) Table 4, 2) Table 7, Panel A, and 3) Table 7, Panel B, respectively.

*** Please insert Table 9 here ***

Table 9 shows no significant results in relation to corporate performance in the form of ROA (Models 3 and 4) as opposed to the highly significant interaction terms in Table 7. This supports the intuition that unfit CEOs may have a lower ability to handle high stress situations, have higher anxiety, and worse cognitive functioning but they do not spend a lot of time keeping fit and they do not have a skewed focus on the life in the work/life balance. Thus, in terms of ROA, there is no penalty of being extremely unfit – neither in business-as-usual times, nor in crisis periods. However, Table 9 shows that in terms of investor perception of long-term performance (Tobin's) there is an indication of a general penalty for being extremely unfit (Panel A) and an indication of a penalty for being unfit during crises (Panel C) but the results are not robust across the two measures of extreme fitness (i.e., across the top 5% and the top 10%). These indications are – as outlined above - *not* supported by a deterioration in here and now operational performance (i.e., ROA).

We would generally expect a close alignment between the results related to Tobin's Q and ROA unless special circumstances are present (e.g., an increase in R&D expenses is likely to improve Tobin's Q because of an increase in growth options but is likely to affect ROA negatively because of increased here and now operational costs). Such expectation is supported by a positive correlation between Tobin's Q and ROA (0.46, Table 2). This raises an interesting question. Could it be that some of the Tobin's Q related indications in Table 9 are due to investor irrationality? Such irrationality would be analogous to earlier findings on the beauty premium where results are difficult to reconcile unless investor irrationality is considered (Ahmed et al., 2023; Hamermesh & Biddle, 1994, 1998; Hosoda et al., 2003)? We leave this interesting question open for future research.

6 Conclusion

We use artificial intelligence to estimate the physical fitness level of more than two thousand CEOs in non-financial S&P 1500 firms during the period 2007-2022. We find no support for a general association between the physical fitness level of the CEO and corporate performance. We do find that extremely fit CEOs are vaguely associated with a higher corporate valuation (Tobin's Q). In terms of our main focus, we show that crises and high uncertainty negatively moderate the relationship between extremely fit CEOs and corporate performance. Most notably, we find that extremely fit CEOs are associated with worse corporate performance during crises both in terms of valuation (Tobin's Q) and in terms of operational performance (ROA) but associated with better corporate performance in a business-as-usual setting. Our findings are important for understanding the nuanced relationship between the physical fitness level of the CEO and corporate performance.

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Appendix: Variable definitions

Dependent variables

logTobinsQ	Total assets + market value of equity – book value of equity, scaled by total assets. Log transformation (x+1).
ROA	EBITDA scaled by lagged total assets. Winsorized at 1% and 99% (“wROA”). Multiplied by 100.

Independent variables

FIT	AI estimated CEO fitness level based on pictures of CEOs in a corporate setting. Continuous scale from 1 to 10 (1 decimal).
FIT5	Binary variable equal to 1 if the CEO’s fitness level (FIT) is among the 5% most fit and 0 otherwise.
FIT10	Binary variable equal to 1 if the CEO’s fitness level (FIT) is among the 10% most fit and 0 otherwise.
VIXUlt	Closing value of the CBOE Volatility Index (VIX) on the last trading day of each year.
VIXAvg	Average closing value of the VIX across all trading days within each year.
Crisis	Binary variable equal to 1 for the financial crisis years 2008-2009 and the COVID-19 pandemic years 2020-2022 and 0 otherwise.

CEO control variables

Age	Age of the CEO – measured in years.
Founder	Binary variable equal to 1 if the CEO is the founder of the firm and 0 otherwise.
Duality	Binary variable equal to 1 if the CEO is the chairman of the board of directors and 0 otherwise.
Gender	Binary variable equal to 1 if the CEO is a man and 0 otherwise.
LogTenure	Tenure of the CEO. Log-transformation (x+1).
logStockownership	Shares held by the CEO as a fraction of common shares outstanding. Log-transformation (x+1).
logOptionownership	Vested and unvested options held by the CEO as a fraction of common shares outstanding. Log transformation (x+1).

Firm control variables

logSize	Natural log of total assets. Lagged one year (“Lag”) when the dependent variable is a flow measure (ROA), but not when it is a stock measure (logTobinsQ).
R&D	R&D expenditures scaled by total sales. Winsorized at 1% and 99% (“wR&D”).
Leverage	Total liabilities scaled by total assets. Winsorized at 1% and 99% (“wLeverage”). Lagged one year (“Lag”) when the dependent variable is a flow measure (ROA), but not when it is a stock measure (logTobinsQ).

Robustness variables

TobinsQ	Total assets + market value of equity – book value of equity, scaled by total assets. Winsorized at 1% and 99% (“wTobinsQ”).
Openness to experience	Big Five personality trait score based on the Q&A sessions in conference calls (Harrison et al., 2019 and 2020). 1-7 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.
Conscientiousness	Big Five personality trait score based on the Q&A sessions in conference calls (Harrison et al., 2019 and 2020). 1-7 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.

Extraversion	Big Five personality trait score based on the Q&A sessions in conference calls (Harrison et al., 2019 and 2020). 1-7 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.
Agreeableness	Big Five personality trait score based on the Q&A sessions in conference calls (Harrison et al., 2019 and 2020). 1-7 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.
Neuroticism	Big Five personality trait score based on the Q&A sessions in conference calls (Harrison et al., 2019 and 2020). 1-7 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.
Narcissism	Narcissism score based on relative first-singular pronouns usage in the Q&A sessions in conference calls. 0-1 scale. Requirement: At least 3 conference calls and at least 1,000 words spoken by the CEO.
Overconfidence	Binary variable equal to 1 if the CEO shows overconfidence twice based on the option-based approach (67% in the money) by Malmendier and Tate (2005) and Campbell et al. (2011) and 0 otherwise. If a CEO shows overconfidence, the CEO is categorized as overconfident from the first occurrence of overconfidence.
Facial attractiveness	Facial attractiveness measured on a continuous scale from 1 (low) to 10 (high) based on a web-based application from attractiveness-test.com which builds on a deep convolutional neural network developed by He et al. (2016).
UnFIT5	Binary variable equal to 1 if the CEOs fitness level (FIT) is among the 5% least fit and 0 otherwise. Note that the cut-off fitness level is 4.2, which makes 5.8% of CEOs belong to UnFIT5.
UnFIT10	Binary variable equal to 1 if the CEOs fitness level (FIT) is among the 10% least fit and 0 otherwise. Note that the cut-off fitness level is 4.5, which makes 11.8% of CEOs belong to UnFIT10.

Table 1: Descriptive statistics

	N	Mean	SD	Min	P1	P25	Median	P75	P99	Max
<u>Dependent variables</u>										
logTobinsQ	13911	1.077	0.36	0.30	0.56	0.82	0.99	1.25	2.28	3.20
ROA	13984	15.180	12.58	-219.2	-20.5	9.7	14.3	20.1	50.5	165.3
<u>Independent variables</u>										
FIT	13984	5.711	0.98	2.5	3.6	5.0	5.7	6.4	8.0	8.5
FIT5	13984	0.050	0.22	0	0	0	0	0	1	1
FIT10	13984	0.100	0.30	0	0	0	0	0	1	1
VIXUlt	13984	20.024	6.54	11.04	11.04	14.04	18.21	22.75	40.00	40.00
VIXAvg	13984	20.235	6.40	11.09	11.09	15.39	17.54	24.20	32.70	32.70
Crisis	13984	0.301	0.460	0	0	0	0	1	1	1
<u>CEO control variables</u>										
Age	13984	56.767	7.22	29	41	52	57	61	77	96
Founder	13984	0.081	0.27	0	0	0	0	0	1	1
Duality	13984	0.464	0.50	0	0	0	0	1	1	1
Gender	13984	0.961	0.20	0	0	1	1	1	1	1
logTenure	13984	1.963	0.78	0.00	0.41	1.40	1.97	2.51	3.65	4.16
logStockownership	13984	0.555	0.77	0.00	0.00	0.07	0.25	0.68	3.38	4.48
logOptionownership	13984	0.198	0.36	0.00	0.00	0.00	0.00	0.27	1.54	3.28
<u>Firm control variables</u>										
logSize	13984	7.996	1.65	2.04	4.62	6.82	7.85	9.05	12.23	13.77
R&D	13984	0.169	5.66	0.00	0.00	0.00	0.00	0.05	0.67	496.62
Leverage	13984	0.543	0.27	0.00	0.09	0.38	0.53	0.67	1.31	4.35
<u>Robustness variables</u>										
TobinsQ	13911	2.172	1.57	.35	.75	1.27	1.70	2.49	8.76	23.56
Openness to experience	13170	4.665	0.56	1.75	3.21	4.26	4.74	5.08	5.78	6.09
Conscientiousness	13170	5.093	0.50	2.21	3.95	4.75	5.06	5.43	6.28	6.86
Extraversion	13170	4.756	0.83	1.00	2.12	4.36	4.9	5.3	6.24	7.00
Agreeableness	13170	4.087	0.80	1.00	2.28	3.54	4.12	4.65	6.03	7.00
Neuroticism	13170	3.259	0.63	1.00	1.71	2.9	3.23	3.6	5.07	6.35
Narcissism	13168	0.235	0.08	0.00	0.07	0.18	0.23	0.28	0.45	0.56
Overconfidence	13336	0.441	0.50	0	0	0	0	1	1	1
Facial attractiveness	13979	6.023	0.55	3.90	4.71	5.69	6.01	6.35	7.38	8.57
UnFIT10	13984	0.115	0.32	0	0	0	0	0	1	1
UnFIT5	13984	0.058	0.23	0	0	0	0	0	1	1

The table presents descriptive statistics for all variables. Variables are defined in the Appendix.
ROA, R&D, and Leverage are used in their winsorized format in subsequent tables.

Table 2: Correlation matrix of variables used in the main regression models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) logTobinsQ	1.000							
(2) wROA	0.460***	1.000						
(3) FIT	0.071***	-0.020**	1.000					
(4) VIXUlt	-0.126***	-0.004	-0.063***	1.000				
(5) VIXAvg	-0.114***	-0.045***	-0.038***	0.720***	1.000			
(6) CRISIS	-0.037***	-0.069***	0.051***	0.482***	0.786***	1.000		
(7) Age	-0.048***	0.003	-0.394***	-0.067***	-0.048***	0.011	1.000	
(8) Founder	0.112***	-0.026***	0.014*	0.030***	0.021**	-0.016*	0.077***	1.000
(9) Duality	-0.021**	0.022***	-0.114***	0.026***	0.018**	-0.058***	0.265***	0.157***
(10) Gender	0.010	-0.011	-0.119***	0.026***	0.016*	-0.022***	0.025***	0.042***
(11) logTenure	0.069***	0.003	-0.159***	-0.028***	-0.023***	-0.041***	0.427***	0.333***
(12) logStockownership	0.009	-0.003	-0.058***	0.024***	0.016*	-0.029***	0.247***	0.452***
(13) logOptionownership	-0.034***	-0.088***	-0.009	0.108***	0.077***	-0.010	0.005	0.089***
(14) logSIZE	-0.112***	0.030***	-0.027***	-0.078***	-0.055***	0.040***	0.107***	-0.157***
(15) wR&D	0.284***	-0.278***	0.068***	0.009	0.003	0.002	-0.084***	0.144***
(16) wLeverage	-0.066***	-0.054***	0.042***	-0.017**	-0.005	0.059***	0.004	-0.159***
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(9) Duality	1.000							
(10) Gender	0.026***	1.000						
(11) logTenure	0.362***	0.076***	1.000					
(12) logStockownership	0.249***	0.035***	0.511***	1.000				
(13) logOptionownership	0.066***	0.027***	0.177***	0.140***	1.000			
(14) logSIZE	0.139***	-0.027***	-0.112***	-0.336***	-0.237***	1.000		
(15) wR&D	-0.118***	0.044***	0.050***	-0.020**	0.119***	-0.175***	1.000	
(16) wLeverage	0.020**	-0.041***	-0.154***	-0.217***	-0.082***	0.399***	-0.185***	1.000

The table presents the pairwise correlations for the main variables. Variables are defined in the Appendix.

Table 3: CEO fitness level and corporate performance

	logTobinsQ (1)	logTobinsQ (2)	wROA (3)	wROA (4)
FIT	-.004 (-.558)	-.009 (-.191)	-.022 (-.116)	-.308 (-.206)
FIT ²		.001 (.117)		.000 (.190)
Age	.001 (1.018)	.038 (1.006)	.025 (1.345)	.037 (1.334)
Founder	-.009 (-.225)	-.009 (-.227)	-.296 (-.322)	-.301 (-.327)
Duality	.017 (1.646)	.017* (1.650)	.446 (1.342)	.448 (1.350)
Gender	.007 (.243)	.006 (.240)	.912 (1.364)	.908 (1.355)
logTenure	.027*** (4.078)	.027*** (4.078)	.665*** (3.083)	.665*** (3.084)
logStockownership	-.030*** (-2.766)	-.030*** (-2.770)	-.554* (-1.800)	-.555* (-1.802)
logOptionownership	-.060*** (-5.743)	-.060*** (-5.749)	-1.634*** (-4.546)	-1.633*** (-4.544)
logSize	-.100*** (-9.212)	-.100*** (-9.203)		
logSizeLag			-4.032*** (-9.630)	-4.032*** (-9.627)
wR&D	-.188 (-.991)	-.188 (-.991)	-76.723*** (-10.647)	-76.725*** (-10.646)
wLeverage	.028 (.753)	.028 (.748)		
wLeverageLag			-2.978** (-2.407)	-2.985** (-2.414)
Constant	1.796*** (15.532)	1.812*** (10.380)	48.528*** (12.632)	49.352*** (8.857)
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1339	.1339	.1888	.1888
Observations	13911	13911	13984	13984

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between CEO fitness level and corporate performance while controlling for firm and CEO specific variables. T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Table 4: Extreme CEO fitness level and corporate performance

	logTobinsQ (1)	logTobinsQ (2)	wROA (3)	wROA (4)
FIT5	.044* (1.838)		.666 (.895)	
FIT10		.017 (.983)		.430 (.797)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1346	.1340	.1889	.1889
Observations	13911	13911	13984	13984

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between extreme CEO fitness level and corporate performance while controlling for firm and CEO specific variables. T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Table 5: CEO personality traits and facial attractiveness

	logTobinsQ (1)	logTobinsQ (2)	wROA (3)	wROA (4)
FIT5	.058** (2.408)		.870 (1.166)	
FIT10		.032* (1.741)		.785 (1.434)
Openness to experience	-.002 (-.057)	.000 (-.014)	-.304 (-.293)	-.298 (-.288)
Conscientiousness	.019 (.723)	.021 (.788)	.538 (.593)	.578 (.634)
Extraversion	-.0230* (-1.809)	-.0230* (-1.827)	-.333 (-.778)	-.332 (-.775)
Agreeableness	.016 (.873)	.014 (.783)	.227 (.373)	.204 (.336)
Neuroticism	.006 (.308)	.006 (.269)	-.347 (-.497)	-.345 (-.492)
Narcissism	-.031 (-.420)	-.031 (-.418)	-2.041 (-.873)	-1.988 (-.845)
Overconfidence	.124*** (11.81)	.124*** (11.747)	2.949*** (9.396)	2.961*** (9.435)
Facial attractiveness	-.019 (-1.609)	-.019 (-1.580)	-.433 (-1.236)	-.457 (-1.318)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1785	.1779	.1976	.1978
Observations	13105	13105	13162	13162

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between extreme CEO fitness level and corporate performance while controlling for firm and CEO specific variables as well as CEO personality traits, overconfidence, and facial attractiveness. T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Table 6: Uncertainty, economic growth, and crisis

Year	VIXUlt	VIXAvg	GDP growth	Crisis dummy
2007	22.5	17.5	2.0%	0
2008	40.0	32.7	0.1%	1
2009	21.7	31.5	-2.6%	1
2010	17.8	22.6	2.7%	0
2011	23.4	24.2	1.6%	0
2012	18.8	17.8	2.3%	0
2013	13.7	14.2	2.1%	0
2014	19.2	14.2	2.5%	0
2015	18.2	16.7	2.9%	0
2016	14.0	15.8	1.8%	0
2017	11.0	11.1	2.5%	0
2018	25.4	16.6	3.0%	0
2019	13.8	15.4	2.6%	0
2020	22.8	29.3	-2.2%	1
2021	17.2	19.7	6.1%	1
2022	21.7	25.6	2.5%	1

This table shows our uncertainty measures, the macroeconomic growth (GDP growth), and the crisis dummy during the sample period.

Table 7: Uncertainty and crisis as moderators

	logTobinsQ (1)	logTobinsQ (2)	wROA (3)	wROA (4)
Panel A: Moderated by uncertainty				
FIT5	.099** (2.179)		4.307*** (3.057)	
FIT5*VIXUlt	-.003 (-1.453)			
FIT10		.062** (2.084)		2.614*** (2.788)
FIT10*VIXUlt		-.002* (-1.818)		
FIT5*VIXAvg			-.176*** (-2.691)	
FIT10*VIXAvg				-.105** (-2.503)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1349	.1344	.1898	.1895
Observations	13911	13911	13984	13984
Panel B: Moderated by crisis				
FIT5	.082*** (3.180)		1.649** (2.169)	
FIT5*Crisis	-.081*** (-4.265)		-2.127** (-2.561)	
FIT10		.040** (2.091)		1.177** (2.125)
FIT10*Crisis		-.051*** (-3.262)		-1.708*** (-2.984)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1362	.1352	.1897	.1899
Observations	13911	13911	13984	13984

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between extreme CEO fitness level and corporate performance while controlling for firm and CEO specific variables and moderated by uncertainty (Panel A) and crisis (Panel B). T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Table 8: Alternative measure of Tobin's Q

	wTobinsQ (1)	wTobinsQ (2)	wTobinsQ (3)	wTobinsQ (4)	wTobinsQ (5)	wTobinsQ (6)	wTobinsQ (7)	wTobinsQ (8)
FIT	-0.019 (-0.741)	-0.005 (-0.027)						
FIT^2		-0.001 (-0.082)						
FIT5			0.175 * (1.787)		0.350 ** (1.973)		0.334 *** (3.174)	
FIT10				0.058 (0.777)		0.251 ** (2.109)		0.142 * (1.791)
FIT5*VIXUlt					-0.009 (-1.229)			
FIT10*VIXUlt						-0.010 ** (-1.975)		
FIT5*Crisis							-0.344 *** (-4.482)	
FIT10*Crisis								-0.192 *** (-2.969)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.1032	0.1032	0.1039	0.1032	0.1040	0.1036	0.1056	0.1042
Observations	13911	13911	13911	13911	13911	13911	13911	13911

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between extreme CEO fitness level and winsorized Tobin's Q (1% and 99%). T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Table 9: Extremely unfit CEOs

	logTobinsQ (1)	logTobinsQ (2)	wROA (3)	wROA (4)
Panel A: Extremely unfit CEOs and corporate performance				
UnFIT5	-.026 (-1.119)		-.536 (-.864)	
UnFIT10		-.033** (-2.022)		-.704 (-1.425)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1341	.1348	.1889	.1891
Observations	13911	13911	13984	13984
Panel B: Uncertainty as moderator				
UnFIT5	-.017 (-.535)		-.641 (-.606)	
UnFIT5*VIXUlt	.000 (-.347)			
UnFIT10		-.0290 (-1.306)		-1.033 (-1.337)
UnFIT10*VIXUlt		.000 (-.233)		
UnFIT5*VIXAvg			.005 (.104)	
UnFIT10*VIXAvg				.016 (.458)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1341	.1348	.1889	.1891
Observations	13911	13911	13984	13984
Panel C: Crisis as moderator				
UnFIT5	-.012 (-.508)		-.323 (-.528)	
UnFIT5*Crisis	-.047** (-2.485)		-.718 (-1.017)	
UnFIT10		-.031* (-1.954)		-.682 (-1.447)
UnFIT10*Crisis		-.009 (-.573)		-.080 (-.147)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared (within)	.1346	.1348	.1890	.1891
Observations	13911	13911	13984	13984

The table reports the results for the firm-fixed effects (FE) panel data regression of the relationship between extremely unfit CEOs and corporate performance while controlling for firm and CEO specific variables (Panel A) and moderated by uncertainty (Panel B) and crisis (Panel C). T-statistics are shown below the coefficients. Standard errors are clustered at the firm level. Variables are defined in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.