Do Powerful CEOs Make Efficient Investment Decisions?

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ABSTRACT

Employing a comprehensive measure of CEO power, we investigate whether powerful CEOs make efficient investment decisions. We find that powerful CEOs reduce investment efficiency, and this investment inefficiency is mainly driven by overinvestment. We further provide evidence that the ownership and expert components of the CEO power measure contribute to the investment inefficiency, suggesting agency problem. In addition, we find that powerful CEOs overinvest more when product market competition is high, when firms have abundant internally generated funds, have access to the credit market, and are less financially constrained. We also investigate the situations that could restrain the inefficient investment of powerful CEOs. We find that powerful CEOs reduce overinvestment and enhance investment efficiency when the operation complexity increases and when CEOs have a low level of power. However, we do not find evidence that corporate governance helps reduce the investment inefficiency of powerful CEOs.

JEL classifications: G31, G32, G34, M12

Keywords: Investment efficiency; Powerful CEOs; Corporate governance.

1. Introduction:

This study empirically examines whether powerful CEOs compared to other CEOs make efficient corporate investment decisions. There are several reasons why this study is important. Firstly, investment is directly related to the firm's profitability and wealth creation. If a firm invests inefficiently, either overinvest or underinvest relative to the optimum or expected level of investment, this inefficient investment is likely to destroy firm value. Secondly, literature related to investment efficiency documents that different aspects of firm activities or characteristics such as financial reporting quality, accounting conservatism, internal controls, earnings management, debt maturity, short-term debt for the firms with financial flexibility, presence of lead independent directors on the board, free cash flow, state and foreign ownership, managerial ability, and product market competition have a significant impact on the firm's investment efficiency.[1] However, almost all of them are indirect sources that affect investment efficiency. Though the literature on corporate finance has documented that the chief executive officer (CEO) plays a central role in a firm's decisions making process (Jensen and Meckling 1976) and in managing a firm's resources, there has not been much research on how powerful CEOs affect firm's investment efficiency directly.

Thirdly, agency conflicts between owners and managers due to incongruities in risk preferences may encourage managers to underinvest while at the same time managerial entrenchment and empire-building tendency may induce managers to overinvest. Both of these

[1] See for example Biddle, Hilary and Verdi (2009); Chen et al. (2011) for financial reporting quality; Chen et al. (2017) for state and foreign ownership; Cheng, Dhaliwal and Zhang (2013) for internal controls; Childs, Mauer and Ott (2005) for short-term debt for the firms with financial flexibility; Gomariz and Ballesta (2014) for debt maturity; Lara, Osma and Penalva (2016) for accounting conservatism; McNichols and Stubben (2008) for earnings management; Rajkovic (2020) for the presence of lead independent directors on the board; Stoughton, Wong and Yi (2017) for product market competitions; Richardson (2006) for free cash flow; and Gan (2019) for managerial ability.

scenarios either protect managers from losing a job or help expropriate assets at the cost of shareholders' wealth. Finally, the existing literature on CEO power provides limited but mixed evidence on how powerful CEOs affect firm investment. For example, Li, Lu and Phillips (2019) show that powerful CEOs in high-demand product markets introduce more new products and enhance investment, advertising, and firm value. On the other hand, Pan, Wang and Weisbach (2016) document that the quality of the acquisitions, measured by the market reaction to the acquisition announcement, decreases as CEO tenure lengthens and CEOs gain control over the board. This finding provides an initial indication of inefficient investment. As the studies that directly investigate the efficiency of investment by powerful CEOs are scarce, we intend to fill this gap exploring the relationship between CEO power and a firm's investment efficiency using a direct measure of efficient investment.

To examine the relationship between CEO power and a firm's investment efficiency, we conduct a panel study of S&P 1500 firms over the period 1993-2016.[2] We closely follow the framework proposed by Biddle, Hilary and Verdi (2009); Chen et al. (2011); Gomariz and Ballesta (2014) and construct the proxy for efficient investment, underinvestment, and overinvestment. We follow Han, Nanda and Silveri (2016) to construct a CEO power index that consists of seven components: CEO duality, CEO pay slice, dependent executives, CEO only insider, stock ownership, founder, and tenure. A CEO is considered as powerful if the composite power index is greater than the sample median.[3] Our empirical results show that firms with powerful CEOs reduce investment efficiency by about 7.8% of the cross-sectional mean of investment efficiency

[2] The sample period ends in 2016 as the complete data on new Tobin's Q measure from Peters et al. (2017) is available only until 2016.

[3] We define power index and each component of the index in section 3.3

measure. We also find that the reduction in efficiency is mainly driven by the increase in overinvestment by about 14.3% of the cross-sectional mean of overinvestment measure. We do not find any significant evidence of underinvestment when CEOs are powerful. Thus, the results indicate that powerful CEOs increase agency problem predominantly by building empires.

Since CEO power is multidimensional, we investigate what type of power is responsible for the inefficient investment. We find that ownership power and expert power affect investment efficiency while structural power does not.[4] This finding shows that when powerful CEOs have a high ownership stake in the firm (agency problem) and when their tenure lengthens, they make more value-destroying investment decisions. Though the latter finding is consistent with Pan, Wang and Weisbach (2016), the former needs more explanation because CEOs with a high ownership stake in the firms are expected to invest efficiently to align with the interest of shareholders. However, CEOs with a high ownership stake, beyond a certain threshold, may deviate from the optimum level of investment for various reasons. For example, when CEOs have a high ownership stake in the firm, their voting rights and wealth preference sensitivity increase due to under diversification, or their pecuniary or non-pecuniary benefits may be far greater than the benefits to the shareholders, or they could be too optimistic about the prospect of the project and think that if they are successful, their benefit will be high as they have a high ownership stake in the firm. In line with these arguments, Kim and Lu (2011) find that large CEO ownership can be harmful to shareholder value. The harmful effects include excessive private benefits, expropriation of minority shareholder wealth, and empire-building. The authors state that high

[4] Founder and stock ownership are components of ownership power; tenure is the component of expert power; and CEO duality, CEO pay slice, dependent executives, CEO only insider are components of structural power.

levels of share ownership entrench the CEOs and discourage them from taking a high risk. Since the outcome from R&D expenditure is more uncertain than capital expenditure, R&D expenditures can be viewed as riskier than capital expenditure (Coles, Daniel and Naveen 2006; Kim and Lu 2011). When entranced managers reduce firm risk, they do so mainly through reducing R&D expenditures and the findings from Kim and Lu (2011) confirm that beyond a certain threshold of CEO ownership, firms reduce R&D expenditure. On the other hand, since the managers want to grow the firm at the same time while reducing investments in risky assets, they tend to increase investment in less risky assets such as capital expenditure.[5] So, when CEOs become more entrenched, they are more likely to overinvest in capital expenditure.

A firm's investment level can vary as the level of CEO power varies. For example, CEOs who have significantly high levels of power may make investment decisions differently than CEOs who have low levels of power. To explore the impact of the different levels of CEO power on a firm's investment efficiency, we group CEOs into low, medium, and high CEO index power.[6] We find that CEOs with lower power increase the firm's investment efficiency and decrease overinvestment. On the other hand, CEOs with a high level of power increase overinvestment and decrease investment efficiency. The findings indicate that possessing certain levels of power is beneficial but excessive power is harmful to the firm.

We next investigate under what circumstances the detrimental effect of powerful CEOs is less pronounced. We find that powerful CEOs in a complex business environment improve

[5] Untabulated results show that powerful CEOs with high ownership stake increase investments in capital expenditure and decrease investments in R&D.

[6] Not all CEOs have power. In our sample, there are 1,196 firm-year observations in which CEO power index is zero. The measure of low level of power does not include zero power in this study.

investment efficiency and reduce overinvestment. This evidence suggests that high power is beneficial to the firms when group decision-making becomes more important and in such a situation even the highly powerful CEOs are less likely to expropriate firm assets for their personal use. However, when powerful CEOs need to act quickly in a competitive market by taking swift, sometimes unilateral, investment decisions, they either overinvest or underinvest and thus make inefficient investment decisions. A strong corporate governance may curb the value-destroying investment activities by powerful CEOs. However, we do not find any significant evidence of a positive impact of corporate governance on the relationship between CEO power and a firm's investment inefficiency. We also find that small and young firms and firms with less leverage and more cash are more likely to overinvest while firms that face difficulty in raising capital or firms with junk bond rating or without bond rating invest more inefficiently. Our main findings are robust to the endogeneity, several alternative measures of CEO power, and investment efficiency.

In a recent study by Pan, Wang and Weisbach (2016), the authors show that CEOs at the beginning of their tenure reduce investment. As their tenure lengthens and as they gain more power over the board through director appointments, they incrementally increase investment. The authors also show that when the CEOs get to the end of their tenure, the quality of their investment reduces as indicated by the reduced acquisition announcement return, suggesting overinvestment by the longer-tenured CEOs. Though the authors provide initial evidence of overinvestment by longer-tenured CEOs, our study differs from theirs in several ways.

Firstly, Pan, Wang and Weisbach (2016) mainly looked at the CEO tenure which is one of the components of our CEO power measure. As the tenure lengthens, the CEO becomes more

powerful. However, CEO power is multi-dimensional as described in Finkelstein (1992) and our CEO power measure consist of all seven different aspects of the power. A CEO may hold significant power in a firm even though his tenure is not long. For example, if a CEO is the chairman of the board, has a significant ownership stake in the firm, and gets the highest pay among the top executives (Bebchuk, Cremers and Peyer 2011), the CEO exerts significant power on the board regardless of the length of tenure. The opposite may be true. In our sample, 6.3% (11.8%) of firm-year observations have CEOs whose tenure is less than or equal to sample median (mean) tenure but still considered powerful and 15.6% (9.4%) of firm-year observations have CEOs whose tenure is higher than sample median (mean) but not considered as powerful. The first scenario is common when successors join the firm long before becoming CEO. These inside CEOs know the firm, management, business strategy, etc. very well than the outsiders. It is also possible that some CEOs may hold CFO or COO positions even before taking the role of a CEO. Since they know the management and boards and hold the different powerful positions, they already gain significant power during their early period as CEO.

Secondly, Pan, Wang and Weisbach (2016) focus more on physical investments measured by the sum of capital expenditure and acquisition and less so on intangibles measured by research and development (R&D) expenses. Our study focuses on the total investment of capital expenditure and intangibles where the intangibles are measured using 30% of selling, general and administrative expenses (SG&A) along with R&D expenses as in Peters and Taylor (2017). Peters and Taylor (2017) indicate that firms not only invest in knowledge capital (R&D) but also in organizational capital, which includes human capital, brand, customer relationships, and distribution systems. The inclusion of intangibles is important as intangible capital is shown to

make up 34% of firms' total capital in recent years according to Corrado and Hulten (2010).

Thirdly, though the authors estimated the quality of investment by testing the acquisition announcement return, they have not examined the quality of R&D, capital expenditure, or total investment. We closely follow Biddle, Hilary and Verdi (2009); Chen et al. (2011); Richardson (2006) and analyze the quality of physical and intangible expenditures by examining the deviation of such investment from the optimum level. Fourthly, we have made significant improvements in our sample size. Data on executives collected from the Execucomp database has a lot of missing observations in the title and CEO age. We have hand-collected the missing title and CEO age information from Bloomberg, proxy statements, and searching on the internet. Also, we have addressed some of the issues wherein CEO tenure and CEOs are not correctly identified.[7] All these steps add up to around 5000 more observations in our sample.

Our study also differs from other investment efficiency studies in measuring investment opportunities hence the investment efficiency. Efficient investment is often measured by the residuals obtained from regressing the total investment on the proxy for investment or growth opportunity. In the investment efficiency literature, sales growth rather than Tobin's Q is mostly used as a proxy for growth opportunities because marginal Q is notoriously hard to measure (Biddle, Hilary and Verdi 2009) and does not explain intangible capital very well (Peters and Taylor 2017). In this study, we use a new measure of Tobin's Q developed by Peters and Taylor (2017) as a proxy for investment opportunities where the denominator of the new measure includes the

[7] For example, if Excucomp identifies that an executive became CEO in 2010 and left as CEO in 2015 but does not flag that executive as CEO in 2011 or later period until 2014, we identify this executive as CEO if the fiscal year is greater than "date became CEO" and less than "date left as CEO".

intangibles.[8] The authors show that the new measure is a superior proxy for both physical and intangible investment opportunities. We hence expect this new proxy improves the measure of investment efficiency.

We make several contributions to the literature. First, by providing evidence of the significant relation between CEO power and investment efficiency, we add to the literature that is related to investment efficiency (Biddle, Hilary and Verdi 2009; Chen et al. 2011; Chen et al. 2017; Childs, Mauer and Ott 2005; Gomariz and Ballesta 2014; McNichols and Stubben 2008; Rajkovic 2020; Stoughton, Wong and Yi 2017). We show that CEO power is another key factor that affects investment efficiency. Secondly, we add to the CEO power-related literature that shows both positive and negative impact of CEO power (Adams, Almeida and Ferreira 2005; Bebchuk, Cremers and Peyer 2011; Han, Nanda and Silveri 2016; Li, Lu and Phillips 2019; Morse, Nanda and Seru 2011; Pan, Wang and Weisbach 2016). Consistent with the earlier studies, we also document that CEO power can be beneficial or harmful to the firm. Specially, we show that a low level of power is not harmful to a firm in general, and a high-level of power is not detrimental if the firm's operation is complex. Thirdly, we add to the literature related to agency problem (Jensen 1986; Jensen 1993; Jensen and Meckling 1976; Shleifer and Vishny 1997) by showing that powerful CEOs increase agency problem when their power is originated mainly from holding a high ownership stake in the firm and from staying longer period as a CEO.

The main implication of this study is that though excessive CEO power is mostly harmful, a low level of power is beneficial to the firm. In fact, CEOs need some power to utilize the firm

[8] Data on the new measure of firms' Tobin's Q are available from Wharton Research Data Services (WRDS).

resources to the advantage of shareholder wealth creation. However, some CEOs are never powerful at some point in their career. Since low-level CEO power is beneficial, CEOs should have some power to help improve investment efficiency and reduce overinvestment, as such power tends to mitigate agency problems. Another implication is that the CEOs' high ownership power (beyond a certain threshold) is harmful to the firms. Powerful CEOs with high ownership stakes make the most inefficient investment decisions. They are heavily involved with overinvesting in projects that are less risky but help them build an empire for themselves through large investments in physical assets. Finally, though excessive CEO power is harmful to the firm's overall investment efficiency, this excessive power can be advantageous to the shareholders and can even mitigate agency problems when the firm's business and geographical operations are more complex. Our findings suggest that firms with more operational complexity should grant CEOs more power in order to make good investment decisions.

2. Literature Review and Hypothesis Development

2.1 Why studying CEO power?

Powerful CEO is considered to be someone who has the ability to overcome oppositions from other executives and directors and consistently (often significant) influence and control key strategic decisions within a firm (Baldenius, Melumad and Meng 2014; Haleblian and Finkelstein 1993). Powerful CEOs also possess the capacity to exert his/her will and to cope with internal and external sources of uncertainty (Finkelstein 1992). Prior studies on CEO power show mixed evidence on the impact of having powerful CEOs. Pan, Wang and Weisbach (2016) document that as the CEO's tenure lengthens, agency problems may lead to empire-building and complacency, resulting in overinvestment in low-quality projects and a reduction in shareholder wealth. If the

CEO becomes entrenched due to excessive power, he/she may be less willing to accept the advice of others due to his/her exaggerated opinion of his/her own abilities.

2.2 Powerful CEO and Firm's Investment Efficiency

Corporate investment decision is one of the most important decisions a firm needs to make for its long-term survival and growth. Good and efficient investment decision leads to the wealth creation for the shareholders while distorted investment leads to lower firm value. Despite the significant effort to making prudent investment decisions, the investment can be suboptimal due to information asymmetry between the management and external capital providers (Myers and Majluf 1984) and misalignment of interests between managers and shareholders (Jensen 1986; Jensen and Meckling 1976).

Information asymmetry between managers and suppliers of capital leads to moral hazards and adverse selection problems. Moral hazard models suggest that when managers pursue their own interests, they invest in projects that maximize their own benefit at the cost of shareholders' wealth (Jensen 1986; Jensen and Meckling 1976; Myers 1977; Myers and Majluf 1984; Shleifer and Vishny 1989). On the other hand, lenders might observe this problem and ration capital, resulting in an underinvestment problem (Stiglitz and Weiss 1981). Since managers have inside information about the firm's prospects, they know better than outsiders when the stocks are overvalued. Taking the advantage of this information asymmetry, managers might adversely select some value decreasing projects by raising capital through selling overpriced stocks. However, Myers and Majluf (1984) argue that shareholders may be aware of this type of activities hence ration capital and increase the cost of financing. This again might prevent

managers from taking profitable projects because of financial constraints. So, the evidence from above suggests that information asymmetry leads managers to either overinvest or underinvest. The question now arises whether powerful CEOs increase or decrease information asymmetry.

On one hand, CEOs can gain some advantages by concealing information. For example, by withholding or manipulating information, CEOs can mask inefficiencies or make themselves indispensable to the firm to improve job security or make gainful profits from private information or avoid monitoring to escape disciplinary mechanisms imposed by corporate governance (Aboody and Baruch 2000; Bartov and Mohanram 2004; Demsetz and Lehn 1985). If CEOs are powerful, these problems will exacerbate as powerful CEOs have more authority to influence key strategic decisions. On the other hand, powerful CEOs may choose to enjoy a quiet life and avoid making risky decisions. Besides, they may want to build a strong reputation of management in the market to raise capital on attractive terms (La Porta et al. 2000). One way powerful CEOs can establish a reputation of not exploiting shareholders is by making the information environment transparent. The evidence from Jiraporn, Liu and Kim (2014) shows that powerful CEOs reduce information asymmetry measured by the bid-ask spread. So, powerful CEOs may increase or decrease information asymmetry and thus underinvest and overinvest depending on their incentives.

Studies related to agency problems document that managers may deviate from the optimal level of investment by accepting negative, wasteful NPV projects that maximize their own wealth rather than shareholder wealth (Jensen 1986; Jensen 1993; Shleifer and Vishny 1989). This can result in managerial entrenchment and empire-building for themselves and ultimately overinvestment. The firm's investment is also determined by the availability of free

cash flow. Consistent with agency cost explanations, Richardson (2006) shows that firms with the highest level of free cash flow overinvest by 20% of the free cash flow rather than distribute it to external debt holders or shareholders. CEOs with stronger power are expected to deteriorate the situation.

Extant literature on CEO power documents that powerful CEOs are subject to various agency problems. As CEOs gain more power, they become entrenched and their decision-making process becomes suboptimal. Eisenhardt and Bourgeois (1988); Haleblian and Finkelstein (1993) argue that powerful CEOs destroy firm value by taking unilateral decisions and disregarding expert opinion and advice from the board and other members of the team. Bebchuk, Cremers and Peyer (2011) investigated the relationship between the CEO power measured by CEO Pay Slice (CPS) and firm performance. They find that CEO power is negatively associated with firm value, accounting profitability, and acquisition announcement stock returns, suggesting agency problems. Focusing on the formal position and status of the CEO as a founder, Adams, Almeida and Ferreira (2005) also find that firm's performance becomes more volatile when CEOs have power over the board and other top executives. More recently, Pan, Wang and Weisbach (2016) find that CEOs with longer tenure are reluctant to divest assets even doing so would increase shareholder value. All these studies suggest that powerful CEOs make value-destroying sub-optimal investment decisions and exacerbate agency problems. Based on the above argument, we hypothesize that

H1: Powerful CEOs make inefficient investment decisions through either underinvestment or overinvestment.

2.3 Powerful CEO, Operational Complexity, and Firm's Investment Efficiency

The association between CEO power and investment efficiency can be affected by whether CEOs mostly take group or unilateral decisions. In a group decision making, CEOs need to rely on others by building a strong leadership team of executives and boards members. In the team, leaders empower the employees who ultimately make decisions for the leaders without asking permission to make decisions. The importance of empowering employees is greater when the firm's operational complexity increases. In such a business setting, CEOs need to deal with a lot of complex analytical data that is not easy to comprehend or coordinate decisions made by different business segments. Under these circumstances, CEOs require to be participative, take input from multiple parties and adopt an integrated or consultative approach so that they can support the decisions made. A recent study supports this view. By using a unique dataset of more than 1000 CEOs and CFOs, Graham, Harvey, and Puri (2015) find that when firms are large or complex, when CEOs are overloaded and need the most input for investment decisions such as capital allocation and corporate investment, they delegate the decisions most. Hence, in such a business environment even if the CEOs are powerful, they are less likely to make poor business decisions. Taken together, we hypothesize that

H2: Operational complexity mitigates the inefficient investment of powerful CEOs.

2.4 Powerful CEO, Product Market Competition, and Firm's Investment Efficiency

Powerful CEOs' investment decisions can be affected if CEOs do not delegate but rather mostly take unilateral decisions. Delegation of business decisions can vary based on CEOs' experience, knowledge of comprehending complex analytical data and intuitions. For example, Graham, Harvey, and Puri (2015) document that CEOs delegate less when they are

knowledgeable and longer-tenured. In practice, it is rare that all parties come to the same conclusion especially in a business environment where swift decisions are required to be made. As a result, CEOs need to take the best possible decisions based on the likelihood of outcome by balancing all the analysis and advice. One such business environment is the competitive market. Product market competition may play a significant role in how powerful CEOs make their investment decisions. Competition may encourage managers to invest in risky projects. For example, a recent study by Amini and Kumar (2020) shows that firms operating in competitive industries invest significantly more in both physical capital and R&D relative to their peers in concentrated industries. They argue that managers in a competitive market have a greater incentive to invest and innovate than those in a concentrated market.

Though powerful CEOs increase investment in a competitive market, this increased investment may not necessarily be optimum or efficient. They may end up overinvesting in projects that benefit them more than the shareholders. Stoughton, Wong and Yi (2017) provide such theoretical and empirical evidence that firms in general, not necessarily powerful CEOs, in a concentrated industry make more efficient investment decisions whereas firms in a competitive market tend to overinvest and hence invest inefficiently. That is, firms in a competitive market invest inefficiently. However, it is not clear whether powerful CEOs of firms in the competitive market do the same. It is possible that powerful CEOs may increase investment in a competitive market but the increased investment may not be efficient as suggested by Stoughton, Wong, and Yi (2017) and may end up overinvesting in projects that help powerful CEOs to build an empire. On the other hand, since all the parties involved in decision-making may not come to the same conclusion in such an environment and CEOs need to take the best possible calculative risk, they

may end up underinvesting. If CEOs are powerful, the situation may even deteriorate as it is the CEOs who ultimately have to face the consequences of bad decisions. Based on this argument, we hypothesize that

H3: Product market competition worsens the inefficient investment of powerful CEOs.

2.5 Powerful CEO, Governance, and Firm's Investment Efficiency

The main problem of excessive CEO power is that powerful CEOs may get involved in empire building by making value-reducing investment decisions. In their survey, Shleifer and Vishny (1997) show that managers have plentiful opportunities to abscond with financiers' funds or to squander them on pet projects. This activity gets worse when CEOs assume more power. Since powerful CEOs have a strong influence on the board decision making, they could extract private benefit and adversely affect board decisions and firm performance (Adams, Almeida and Ferreira 2005; Bebchuk, Cremers and Peyer 2011; Han, Nanda and Silveri 2016; Khanna, Kim and Lu 2015; Morse, Nanda and Seru 2011). However, strong corporate governance, internal or external, can restrict CEOs from making distorted investment decisions by imposing overall discipline and improving the quality of monitoring (Shleifer and Vishny 1989). For example, Shleifer and Wolfenzon (2002) find that when corporate governance or investor protection is strong, managers are less likely to divert corporate resources from investment projects to personal use. Kim and Lu (2011) find that strong external governance leaves less slack for agency problems by holding CEOs accountable for their performance. Based on the arguments, we hypothesize that

H4: Strong corporate governance mitigates the inefficient investment of powerful CEOs.

3. Research Design

3.1 Proxy for Growth Opportunity

Firms are expected to invest until the marginal benefit of capital investment equals the marginal cost. In other words, firms should invest in all positive NPV projects. To investigate the relationship between CEO power and investment efficiency, we first measure the expected level of investment which is a function of growth opportunities. Deviation from that expected level (underinvestment or overinvestment) is known as inefficient investment. We follow Peters and Taylor (2017) and employ their new Tobin's Q measure to proxy for growth opportunities. The new measure of Tobin's Q is an improvement from the traditional one as it captures investment in both tangible and intangible assets. Capturing intangible assets investment is important as return on such investments takes longer than that on physical assets. Moreover, powerful CEOs may shy away from investing in intangible assets while overinvesting in physical assets because investing in intangible assets is riskier than that in physical assets. Our measure for Tobin's Q is as follows

$$q_{it}^{tot} = \frac{V_{it}}{K_{it}^{phy} + K_{it}^{int}} \quad (1)$$

where, K^{phy} represents the replacement cost of physical capital measured as the book value of property, plant, and equipment, K^{int} represents the replacement cost of intangible capital measured as the sum of the firm's externally purchased and internally created intangible capital and V represents the market value of outstanding equity, plus the book value of debt, minus the firm's current assets.[9]

[9] Please refer to Peters & Taylor, (2017) for detailed measure of intangible capital.

3.2 Proxy for Efficient Investment

In a frictionless perfect financial world, firms can fund and undertake all value-increasing investment projects as long as marginal benefits are equal to marginal costs, independent of the availability of internal capital to finance such projects (Modigliani and Miller 1958). However, the real world does allow firms to pursue all value-increasing investment projects due to capital market frictions that prevent them from raising external capital when the internally generated fund is insufficient to undertake such projects (Myers and Majluf 1984). As a result, despite having attractive investment and growth opportunities, firms deviate from optimal levels of investments, leading to lower future growth and reduced operating performance and firm value. When firms pass up positive NPV projects due to financing frictions, the underinvestment problem is plausible. On the other hand, the agency conflict of free cash flow introduced by Jensen (1986) may lead to an overinvestment problem. Managers may waste these funds instead of distributing them to shareholders as dividends when the pecuniary and non-pecuniary benefits of overinvestments are larger to the managers. The existence of either underinvestment or overinvestment relative to the expected level of investment is considered to be inefficient investment scenarios.

We estimate the expected investment as a function of investment opportunity measured by Tobin's Q shown in Eq. (2). We follow Biddle, Hilary and Verdi (2009) for model specification and Peters and Taylor (2017) for key-dependent and independent variables.

$$Invest_{i,t+1} = \beta_0 + \beta_1 Tobin'sQ_{i,t} + \varepsilon_{i,t+1} \quad (2)$$

where $Invest_{i,t+1}$ is the total investment of firm i in year t+1, defined as the sum of capital expenditure and intangible assets, multiplied by 100 and scaled by the lagged value of

replacement cost of physical capital and intangible capital. Intangible assets are the sum of R&D and 30% of selling, general and administrative expenses (SG&A). We follow Peters and Taylor (2017) to construct the measure of SG&A. Tobin's Q is the proxy for growth opportunity.

Following Biddle, Hilary and Verdi (2009), we estimate Eq. (2) for each industry-year with at least 20 observations using the Fama and French (1997) 48-industry classification which we use throughout the study. We define investment inefficiency as the deviation from the expected or optimum level of investment. We further define positive residuals as overinvestment as the firm is investing more than the expected level captured by Tobin's Q and the negative residuals as underinvestment. Following Chen et al. (2011); Gomariz and Ballesta (2014), we multiply the absolute value of the residuals from Eq. (2) by minus one to capture the investment efficiency. Hence a higher value means more efficient investments.

3.3 Measuring CEO Power

In academic literature, power is defined as the ability of individuals to exert their will (Finkelstein 1992). In a firm, a manager needs to cope with different types of uncertainty originating in and outside the firm. The ability to manage uncertainty is the key factor for managerial power. According to Finkelstein (1992), the CEO power can be obtained from four different sources: a formal position in an organizational structure (structural power), the strength of the CEO's ownership position (ownership power), the CEO's expertise in an area (expert power), and the personal status (prestige power). Tang, Crossan and Rowe (2011) point out that prestige is not a proximal measure of executive power due to a significant ambiguity involved in capturing this dimension. We hence exclude the prestige dimension of power from our study. The structural power obtained from the formal position is measured by duality, CEO pay slice,

CEO only insider, and the number of top four dependent executives. The ownership power is measured by CEO equity ownership and founding status, and the expert power is measured by CEO tenure. [10] We briefly discuss each component of the power measure below.

Duality: The concentration of titles has been used in the prior literature to measure CEO power.[11] Holding the position of a chair of the board by the CEO reduces the board's monitoring power while increasing CEO power. We create a duality dummy variable that takes a value of one when the CEO serves as the chair of the board, and zero otherwise.

CEO Pay Slice: CEO power is also defined through the CEO pay slice (CPS). As in Bebchuk, Cremers and Peyer (2011), we measure CPS as the CEO's total compensation over the combined total compensation of the top five executives including the CEO. If the CPS is greater than the yearly industry median CPS, the CPS dummy is equal to one and zero otherwise.

CEO only insider: Another measure of CEO power is a dummy that indicates whether the CEO is the only insider on the board. The idea is that if an inside non-CEO manager sits on the board, he or she is more likely to participate in and influence the top decision-making with the CEO. Thus, if the CEO is the only insider on the board, he/she is considered to be more powerful.

Dependent Executives: The CEO can increase his/her power by building an internal connection with the executives through appointment decisions. Top executives who are hired by the CEO are less likely to oppose the CEO's proposed direction for the firm because CEOs are

[10] We do not use Triality (CEO is also the chairman and president) measure as it is highly correlated with Duality measure. However, when Triality is included in the power index measure we obtain results that are qualitatively similar to our main findings.

[11] See, for example, Adams, Almeida and Ferreira (2005); Han, Nanda and Silveri (2016); Li, Lu and Phillips (2019); Tang, Crossan and Rowe (2011).

heavily involved in recruiting, nominating, and influencing their compensation and relative positions. Following Khanna, Kim and Lu (2015); Li, Lu and Phillips (2019), we create an indicator variable, *Dep. Exec.*, that equals one if the proportion of top 4 non-CEO executives appointed during the current CEO's tenure is above the industry median.

CEO stock ownership: One way to align the interest of shareholders with that of managers is to increase the manager's stock holding in the firm. If managers have a high stake in the firm, they are likely to act in a way that will increase the wealth of the firm. Bebchuk and Fried (2003) document that the optimal contracting approach mitigates the agency problem and improves firm performance by incentivizing the CEO to increase his own wealth. However, managerial power and rent-seeking behavior may induce managers to gain as many shares and options as possible to increase their own wealth. As the managers own more stocks, they obtain more discretionary power to influence the decision-making process in the board (Finkelstein 1992). To construct CEO stock ownership power, we collect all the available stock ownership data from the Execucomp database. We have constructed an ownership dummy variable that takes a value of one if the CEO's percentage of equity ownership is above the yearly industry median.

Founder CEO: Since founder CEOs have a considerably high equity stake in the firm and are less likely to be removed from office than other CEOs, they are more likely to be powerful and have a greater influence on the firm's overall decision-making process (Adams, Almeida and Ferreira 2005; Morse, Nanda and Seru 2011). We construct the founder dummy equal to one if the CEO is also the founder, and zero otherwise. Since Execucomp database provides inconclusive founder data, we follow Bebchuk, Cremers and Peyer (2011) and define a CEO as founder (in addition to the above measure) if the CEO was the CEO five years before the IPO date reported

by Compustat or the first date the firm appears in the Center for Research in Security Prices.

CEO Tenure: CEOs with longer tenure build a good relationship with the other executives and influence them in the decision-making process. Also, prior literature shows that as the tenure lengthens, CEOs are more likely to influence investment decisions (Pan, Wang and Weisbach 2016). From the available CEO tenure data in Execucomp, we construct a tenure dummy equal to one if the CEO tenure is greater than the yearly industry median, and zero otherwise.

Power Index: Finally, we construct the CEO power index by adding the seven indicator variables, ranging from 0 to 7. Our main variable of interest, Power Dummy, is measured using the categorical variable approach. The power dummy is equal to one if the power index is greater than the sample median, and zero otherwise. Therefore, the powerful CEOs are those with the power index above the sample median.

3.4 Regression Model

To test the impact of the presence of a powerful CEO on a firm's investment efficiency, we develop the following model

$$Y_{i,t+1} = \beta_0 + \beta_1 Power\ Dummy_{i,t} + \sum Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

where the dependent variable $Y_{i,t+1}$ represents efficient investment (InvEff), underinvestment (Under), and overinvestment (Over). The key independent variable, Power Dummy, is a dummy variable equal to 1 if the power index is greater than the sample median, and 0 otherwise.

The relationship between CEO power and investment efficiency could be affected by

correlated omitted variables. We hence include several control variables that determine a firm's investment (Biddle, Hilary and Verdi 2009; Chen et al. 2017; Gomariz and Ballesta 2014; Rajkovic 2020; Stoughton, Wong and Yi 2017) . For example, firms with inadequate liquidity or burdened with higher leverage fail to undertake profitable projects while excess liquidity enables the manager to make investment decisions that might be costly from the shareholder perspective (Denis and Sibilkov 2010). To address the liquidity concern, we add slack, cash flow (OCF), and leverage as control variables and expect them to have a negative effect on investment efficiency. We include market to book (MB) ratio as a control to capture investment opportunities for the firm. Higher growth opportunities induce managers to invest aggressively and hence are expected to have a negative association with investment efficiency.

We also include a measure of a firm's financial strength, Altman's Z-score (1968), in order to control for the financial solvency of the firm. The relationship between Z-score and investment efficiency is expected to be positive as a higher Z-score closer to three or more suggests a solid financial position. Research also shows that larger firms are found to invest more judiciously than smaller firms while firms with available resources can choose the subset of investment opportunities that they have the best capacity to exploit and turn them into sustained competitive advantages. To control for firm size and available resources, we employ log of total assets as a proxy for firm size and property, plant and equipment scaled by lagged total assists as a proxy for tangibility. We expect a positive impact of firm size on a firm's investment decision.

A firm's performance and dividend policy also affect the investment decision. Profitable and regularly dividend-paying firms have more flexibility to justify their future investment even if these are not possibly the best investment decisions. Besides, regularly dividend-paying firms

are supposed to invest in projects that create shareholder wealth. On the other hand, the loss firms, which are financially constrained and are under pressure internally and externally for improving the performance, are expected to utilize the assets in place efficiently to save themselves from further deterioration. To address these concerns, we include a loss dummy (Loss) equal to one if net income is negative and zero otherwise, and a dividend dummy (Dividend) equal to one if cash or common dividend is positive and zero otherwise. Both dummy variables are expected to affect investment positively. We also control for CEO age as Serfling (2014) shows that CEO age can have a significant impact on risk-taking behavior and firm performance in that older CEOs are less aggressive and reduce firm risk through less risky investment policies. We expect to have a positive association between CEO age and investment efficiency. Following prior studies, we also add the operating cycle (Op Cycle) and expect it to have a similar positive impact on investment efficiency (Gomariz and Ballesta 2014; Rajkovic 2020). Finally, we include dummy variables to control for industry effects and year effects.

3.5. Data and Descriptive Statistics

3.5.1 Sample

Our sample includes all S&P 1500 firms for the period 1993–2016. The sample year starts in 1993 when the Execucomp database provides data with sufficient information for our study. Our final year is 2016 because complete data on Tobin's Q from Peters and Taylor (2017) ends in 2016. We exclude firms in regulated industries such as utilities and financials (SIC codes 4900-4999 and 6000-6999) and firms categorized as public service, international affairs, or non-operating establishments (SIC codes 9000+) as Tobin's Q measure may not be appropriate for these industries. We exclude firms with missing or non-positive book value of assets or sales and

firms with less than $5 million in physical capital. Following extant literature, we replace missing R&D and SG&A values with zero. We collect accounting data from Compustat database; analyst coverage data from IBES; block holders and institutional investors' data from Thomson Reuters Institutional (13f) Holdings; and the component of CEO power data from Standard and Poor's Execucomp database. As Execucomp has many missing CEO titles and CEO age information, we have hand-collected that information from the proxy statement, annual reports, Bloomberg, and through searching on the internet. The combined data from different sources result in a sample of unbalanced panel data of 21,784 firm-year observations for 2,268 unique firms. All the accounting continuous variables are winsorized at the 1% and 99% levels.

3.5.2 Summary Statistics

Panel A in Table 1 reports the summary statistics of the firm characteristics. The mean (median) investment efficiency across all firm-years equals −5.47 (−3.91). The magnitude of average (median) overinvestment is 6.33 (3.96) and that of underinvestment is -4.82 (-3.89). The average growth rates indicated by Tobin's Q and market to book ratio are 1.42 and 2.52 respectively. On average, firms hold leverage of approximately 24% of the previous year's total assets, maintain 30% of the total assets as tangibles, and generate cash flow of around 12% of the sales. The majority of the firm (51%) pay dividends while approximately 19% of firms report losses.

Panel B reports that about 39% of firm-year observations have powerful CEOs and the average power index is 3. The mean (median) tenure of the CEOs is 7(5) years. The CEO holds the position of chairman 54% of the time and is the only insider on the board 47% of the time. On

average, the CEO is the founder almost 10% of the time and owns almost 4% of the firm's share.[12] The median of Dep. Exec. (dependent executives) is 0.5, suggesting that 50% of non-CEO top four executives are appointed during the CEO tenure. The mean and median CEO Pay Slice is almost 38%, which is similar to that reported in Bebchuk, Cremers and Peyer (2011). Overall, descriptive statistics for the sample firms are similar to those reported by prior research (Biddle, Hilary and Verdi 2009; Han, Nanda and Silveri 2016). The univariate results from Panel C in Table 1 show that there is a significant difference in investment inefficiency between powerful and other CEOs. The investment of powerful CEOs is more inefficient than that of other CEOs and the difference is mainly driven by the significantly higher overinvestment of the powerful CEOs.

[Insert Table 1 here]

Panel A of Table 2 presents the correlation matrix. The dependent variable, InvEff, has a negative and significant correlation with the CEO power dummy. Also, the investment opportunity proxy is significantly negatively correlated with InvEff, suggesting that CEO power and high growth opportunity might reduce investment efficiency. None of the correlations between control variables are high enough to impose a multicollinearity problem. Panel B shows the correlation of seven components of the CEO power measure. Tenure dummy and dependent executives dummy are moderately correlated with each other. The correlation between other components of CEO power is not high, suggesting that each component captures different aspects of CEO power.

[Insert Table 2 here]

[12] In the descriptive statistics, we report percentage of share ownership instead of a dummy.

Figure 1 also confirms our univariate results. There is a clear pattern that inefficient investment and overinvestment by powerful CEOs are almost always higher than those by the other CEOs throughout the sample period.[13] However, underinvestment does not show consistent differences between powerful and other CEOs over the sample period. While there is a significant drop in overinvestment and investment inefficiency starting from 2002, the opposite is observed for underinvestment for the same period.[14] A similar pattern and direction in overinvestment and investment inefficiency suggest that investment inefficiency is possibly driven by overinvestment.

[Insert Figure 1 here]

Figure 2 shows the breakdown of different levels (low, medium, and high) of power under each component of the power index measure.[15] To construct the figure, we first determine the number of firm-year observations for each power component. We then determine the number of firm-year observations for the three levels of power under each power component. For example, about 9.88% or 2153 firm-year observations have founder CEOs, out of which only 0.9% or 20 firm-year observations have founder CEOs who hold a low level of power, about 27.03% or 582 firm-year observations have founder CEOs who hold a medium level of power, and about 72.04% or 1,551 firm-year observations have founder CEOs who hold a high level of power. Hence Figure 2 shows that founder CEOs hold a very high level of power. Similarly, CEOs who have a

[13] We use absolute value of residuals to proxy for investment (in)efficiency in displaying graph for the ease of visualization and explanation. In all other places, investment efficiency is measured by multiplying absolute value of residuals by minus one.

[14] In 2002, Sarbanes–Oxley Act was passed and probably this had significant effect on firm's investment decision.

[15] Power index values 1 and 2 represent low level power, index values 3 to 4 represent medium level power and index value above 4 indicates high level power.

high ownership stake in the firm and whose tenure is long hold mostly medium to a high level of power. On the other hand, most of the low level of power is represented by structural power (dependent executives, duality, CPS, and CEO insiders). The figure indicates that the relationship between CEO power and investment efficiency may be affected by the type or level of power CEOs hold.

[Insert Figure 2 here]

4. Empirical Results

4.1 Relation between CEO power and investment efficiency

Table 3 reports the test result of the first hypothesis via estimating eq. (3) by using ordinary least squares (OLS) controlling for the industry and year fixed effects. The main interest is the coefficient of power dummy (β1). Column (1) reports the impact of powerful CEOs on a firm's investment efficiency (InvEff) while columns (2) and (3) underinvestment (Under) and overinvestment (Over), respectively. The p-values of the reported coefficient estimates are adjusted for heteroscedasticity and clustered at the firm level.

Column (1) shows that the coefficient of CEO power dummy is significantly negative, suggesting that powerful CEOs tend to reduce investment efficiency. The result is consistent with our first hypothesis that powerful CEOs compared to other CEOs invest inefficiently. This result is also economically meaningful. If we take the average investment efficiency rate in our sample as the typical rate, then our result shows that powerful CEOs decrease investment efficiency by 7.8% of the cross-sectional mean of the investment efficiency measure.[16] Column (2) indicates

[16] 7.8% is calculated as the ratio of the coefficient of Power Dummy (-0.43) and the mean of investment efficiency measure (-5.47) reported in Table 1. The calculation applies throughout the paper.

that CEO power has an insignificant effect on underinvestment.[17] Column (3) shows that powerful CEOs overinvest by 14.3% of the cross-sectional mean of the overinvestment measure.[18] Overall, the results indicate that powerful CEOs invest inefficiently and this inefficiency is mainly driven by significant overinvestment, suggesting an agency problem.

As predicted, the results on control variables are generally consistent with prior studies. We find some evidence that the availability of funds such as slack and cash flow is negatively associated with investment efficiency. It means that when firms have more funds available, they tend to invest inefficiently. Growth opportunities and leverage also negatively affect investment efficiency. Consistent with Rajkovic (2020), we find that larger firms and regularly dividend-paying firms invest efficiently. However, loss firms though financially constrained tend to improve their investment efficiency probably because they want to avoid further deterioration in their performance. Finally, it seems that older CEOs are more likely to make efficient investment decisions.

[Insert Table 3 here]

4.1.1 Relation between types of CEO power and investment efficiency

The results in Table 3 suggest that powerful CEOs make inefficient investment decisions compared to other CEOs. As CEOs gain power from their formal position, ownership, and expertise, we next investigate what type of power has the most significant impact on investment

[17] The dependent variable, Under, is always negative (i.e., negative residuals). The closer the residuals to zero, the less the underinvestment and vice versa. As a result, the positive coefficient estimate of a power dummy implies a negative association with underinvestment.

[18] 14.3% is the ratio of the coefficient of Power Dummy (0.90) and the mean of overinvestment measure (6.33) reported in Table 1. The calculation applies throughout the paper.

efficiency. To conduct the test, we have divided the power components into three groups: structural power, ownership power, and expert power. We add the components of structural power and that of ownership power and create a dummy variable for each type. Since expert power has only one component, tenure, we keep it as it is.

Results reported in Table 4 show that ownership and expert power affect investment efficiency significantly negatively, with structural power being statistically insignificant.[19] The independent variable coefficients in columns (1) and (3) range from -0.35 and 0.74 in ownership power to -0.41 and 0.67 in expert power. These results indicate that powerful CEOs who have a high ownership stake in the firm invest more inefficiently and their inefficient investment is mainly driven by 11.7% of the cross-sectional mean of overinvestment measure. This finding is consistent with Kim and Lu (2011) who find that high levels of share ownership can reduce firm value by entrenching the CEOs and discouraging them from taking a high risk. When CEOs take less risk but are entrenched, they tend to either reduce investment in highly risky assets such as in R&D or increase investment in low-risk assets such as in capital expenditure. Our findings suggest the latter is more likely.[20] In addition, we find that the expert power is statistically significant for both inefficiency and overinvestment columns. This finding is consistent with Pan, Wang and Weisbach (2016) who show that overinvestment increases as the tenure lengthens. As in our main findings in Table 3, we do not find any significant results for the underinvestment case. The joint significance test for three types of power is statistically significant for columns (1)

[19] We have tested the relationship for each type of power in a separate regression and obtain qualitatively similar results.

[20] Our untabulated result shows that CEOs with high ownership stakes reduce investments in R&D and increase investment in capital expenditure.

and (3). Overall, the results show that CEO power is negatively associated with investment efficiency when ownership stake is high and CEO tenure lengthens, providing evidence for agency problems.

[Insert Table 4 here]

4.1.2 Relation between levels of CEO power and investment efficiency

So far we have used a composite power index dummy for measuring CEO power. We define that CEOs are not powerful if the power index value is lower than the sample median (3). However, some of these CEOs may still have some sort of power.[21] We next investigate what level of power is beneficial or harmful for the firms and report the results in Table 5. We create three levels of power based on the power index: low, medium, and high. If the power index value is less than the median (i.e. index values of 1 and 2), we create a low power dummy variable that equals one and zero otherwise. For the index value of 3 (median) and 4 (75^{th} percentile), we create a medium power dummy variable that takes a value of one and zero otherwise. Finally, for the power index greater than 4, we create a high power dummy that takes a value of one and zero otherwise.

Column (1) in Table 5 shows that the low power dummy is statistically and positively significant for the dependent variable, InvEff. Economically this result indicates that CEOs with a low level of power increase investment efficiency by 5.5% of the cross-sectional mean of investment efficiency measure. The coefficient of medium power dummy in column (2) is negative but insignificant whereas the coefficient of high power dummy in column (3) is negative

[21] About 5.5% or 1196 firm-year observations in our sample have CEOs who possess no power (i.e. power index is zero).

and significant. Consistent with our main findings, these results show that CEOs with a high level of power increase investment inefficiency. The results in columns (2) and (3) suggest that as the level of power increases, the magnitude of the inefficiency also increases. Similar to our findings in prior tables, the underinvestment is not significant at any level of power. However, columns (7) and (9) show that the coefficient for the low power dummy is significantly negative for the overinvestment and significantly positive for the high power dummy. These results indicate that CEOs with low power make efficient investment decisions by reducing overinvestment by almost 12% of the cross-sectional mean of overinvestment measure, while CEOs with high power reduce investment efficiency by increasing overinvestment. Overall, our findings suggest that a low level of power is beneficial to the firms.

[Insert Table 5 here]

4.2 Factors Affecting the CEO Power and Investment Efficiency Relation

Our findings so far indicate that CEO power is negatively associated with investment efficiency unless CEOs possess a low level of power. This negative relationship can be affected by various factors such as firm's operational complexity, product-market competitions, and corporate governance practice in the firm. While operational complexity and corporate governance may curtail CEO power and improve investment efficiency, product market competition may decorate the situation due to the need for swift decisions making by powerful CEOs. In the next few tables, we analyze whether these factors affect the relationship.

4.2.1 Impact of Firm Complexity

A firm's operational complexity may affect powerful CEOs' decision-making activities as CEOs are expected to take more group decisions than unilateral decisions when the operation is

more complex. For example, Graham, Harvey, and Puri (2015) find that the CEOs delegate financial decisions for which they need the most input, when they are overloaded, and when they are distracted by other major activities such as acquisitions. Their findings suggest that complex firms are more difficult to manage and require the collective effort of all executives in making decisions. Hence it is difficult to expropriate firm assets for private benefits in a complex firm even though the CEO is powerful. In line with this argument, we predict that firm operational complexity will improve the relationship between CEO power and investment efficiency. We combine firm's geographical and business complexity to proxy for firm's operational complexity (Firm_Comp). Variable Firm_Comp is an indicator dummy equal to one if the firm's number of geographical and business segments is above the yearly sample median number of geographical and business segments and zero otherwise.

To test our prediction, we interact firm's complexity measure with the power dummy in Eq. (3) and we expect the coefficient of interaction to be positive for the dependent variable investment efficiency (InvEff) and underinvestment (Under) and negative for the dependent variable overinvestment (Over). Table 6 reports the regression results. Consistent with our second hypothesis, we find that the association between CEO power and investment efficiency (overinvestment) is positive (negative) and the coefficient of the interaction term is significantly positive for InvEff and significantly negative for overinvestment measure. These results show that when businesses become more complex, powerful CEOs increase investment efficiency by reducing overinvestment. Column (3) shows that powerful CEOs reduce overinvestment by 12.8% of the cross-sectional mean of the overinvestment measure. As in the previous findings, the interaction term for underinvestment is insignificant. Overall, the results show that firms with

powerful CEOs in more complex operating envirnments improve investment efficiency by significantly reducing overinvestment, suggesting the importance of group decision-making in mitigating agency problems.

[Insert Table 6 here]

4.2.2 Impact of Product Market Competition

Our findings so far show that powerful CEOs invest inefficiently mainly by overinvesting, suggesting an agency problem. Further, the negative relation of CEO power and investment efficiency improves when collective decision-making becomes more important for the firm. The question then arises of what happens if the powerful CEOs need to make a swift decision without getting advice or formal approval from other top executives or the board. Do they invest efficiently? In this section, we test our third hypothesis in business settings wherein CEOs need to act faster. We believe that CEOs are required to be more aggressive and act faster in decision-making when market competition is high. If CEOs do not make the swift decision, they may miss out vital opportunities to their rivals.

We have two measures for market competition. The first one is the product similarity index (TNIC3SIMM) developed by Hoberg and Phillips (2016). The index is a sum of firm-by-firm pairwise cosine similarity scores calculated by parsing the product descriptions from the firm 10Ks and forming word vectors for each firm to compute continuous measures of product similarity for every pair of firms in each year. The use of TNIC product market industry peers instead of SIC or NAICS generates economically large improvements in explaining competitions

and cross-sectional firm characteristics.[22] The higher value of TNIC3TSIMM indicates a large number of firms selling products with similar descriptions and thus higher competition. We use an indicator variable (TNIC3TSIMM dummy) equal to one if TNIC3TSIMM is greater than the yearly sample median and zero otherwise. The second measure of product market competition is Herfindahl-Hirschman Index (HHI) which is measured as the sum of the squares of percentage market share of all firms in Compustat in each SIC 2 digit industry. By excluding negative, zero, and missing sales observations, we calculate market share for each year as the ratio of firm sales to total industry sales. HHI is inversely related to market competition. That is, the higher the value of HHI, the lower the competition, and the higher the concentration. In this study, HHI is an indicator variable equal to one if the HHI is less than the yearly sample median and zero otherwise. The main coefficient of interest is the interaction term between the power dummy and the market competition dummy.

Table 7 reports the results of the impact of product market competition on the relation between CEO power and investment efficiency. Columns (1) and (3) show that the coefficient of the interaction term is significantly negative for investment efficiency (InvEff) and significantly positive for overinvestment (Over), suggesting that powerful CEOs invest more inefficiently in a competitive market by increasing overinvestments, supporting our second hypothesis. We also get a similar result for investment efficiency measure in column (4) using the usual HHI measure of competition. However, the negatively significant coefficient of underinvestment measure in column (5) suggests that the inefficiency is mainly driven by the increase in underinvestment.

[22] Please refer to Hoberg and Phillips (2016) for detailed measure.

Overall, the evidence from Table 7 suggests that by increasing overinvestment or underinvestment, powerful CEOs increase investment inefficiency in a competitive market where they need to take swift decisions, supporting our third hypothesis and suggesting that unilateral decision making is not good for the firm.

[Insert Table 7 here]

4.2.3 Impact of Corporate Governance

To test our fourth hypothesis that strong governance has a positive impact on the association between CEO power and firm investment efficiency, we use the number of analysts following as the external governance mechanism, and the institutional block holders, and total institutional investors as a proxy for internal governance mechanism. We create an analyst dummy equal to one if the number of analysts following a firm is greater than the yearly sample median and zero otherwise. Block holders are defined as shareholders who own at least 5% of the firm's outstanding shares. We employ an indicator variable block dummy equal to one if the number of institutional block holders is greater than the yearly sample median and zero otherwise. We also construct a categorical variable equal to one if the total institutional investors are greater than the yearly sample median and zero otherwise.

Table 8 presents the results. Our key interest is in the interaction term. We find that the interaction term between CEO power and governance proxy for all the columns is insignificant and almost all the coefficients of interaction terms are in the same directions as our main findings in Table 3 except in columns (1) and (8). Our overall results suggest that the presence of internal and external governance does not alleviate the negative relationship between CEO power and investment efficiency.

[Insert Table 8 here]

4.2.4 Additional Analysis: CEO Power, Investment Efficiency, and Financial Constraints

The firm's investment decision is responsive to internal funds under different degrees of financial constraints. If firms with powerful CEOs have plenty of internal resources such as available cash, they are more likely to overinvest. We conjecture that the association between the presence of CEO power and investment inefficiency will be more pronounced for firms with more cash and less leverage, for small and young firms as these firms will have more tendency towards growing faster, for firms that have access to the bond market for raising capital and for firms that are financially constrained as powerful CEOs in such firms have the internal resources available for capitalizing their own benefits. To test this conjecture, we follow the literature and construct four financial constraint measures: Overinvestment index, Hadlock and Pierce (2010) index (HP Index), Kaplan and Zingales (1997) index (KZ Index), and bond rating.[23] To construct the overinvestment index (OverFirm), we follow Biddle, Hilary and Verdi (2009) and rank firms into deciles based on their cash balance and their leverage. Leverage is multiplied by minus one before ranking so that, as for cash, it is increasing with the likelihood of overinvestment. By re-scaling them to a range between zero and one, we then create a composite score measure, OverFirm, which is computed as the average of ranked values of the two partitions variables. The higher the score, the more likely a firm tends to overinvest. To test the potential impact of financial constraints, we partition the sample into low and high sub-groups, using the lowest (1st, least constrained) and the highest (4th, most constrained) quartile breakpoints and estimate Eq. (3) for each subgroup of all four constraint measures. We also group constraints measures into

[23] The construction of bond rating constraint and KZ index and HP index is discussed in the appendix.

two panels. In Panel A, the higher value of constraints measures leads to more inefficient investments while in Panel B, lower value of constraints measure or un-constraints measures lead to inefficient investments.

Panel A in Table 9 shows the result for subgroups. From the table, we can see that when the likelihood of overinvestment is high, powerful CEOs tend to make more inefficient investment decisions (coefficient = -0.93, column (1)) than when such opportunity is low (coefficient = -0.33, column (2)). We get a similar result to our main findings for *Over* measure in columns (3) and (4) and all the results are highly statistically significant. From columns (5) to (8), we find that when firms are highly constrained (high HP index represents younger and smaller firms), the coefficients are statistically significant -0.59 (0.67) for power dummy in InvEff (Over) model. However, the coefficients, though in a similar direction, are statistically insignificant for less constrained firms. Overall, the results prove that powerful CEOs in small and young firms make more inefficient investment decisions by overinvesting in projects that might be value-destroying. The results also suggest that powerful CEOs tend to build an empire in firms where the growth opportunity is comparatively higher (small and young firms) and there is more room for overinvestment.

Panel B of Table 9 shows the results for two popular indexes for financial constraints. The higher value of the index represents the more difficulty (cost) a firm needs to encounter (incur) to obtain external financing. This type of constraint restricts the firms from wasting the available resources. For the KZ index in columns (1) to (4), we see that powerful CEOs in less financially constrained firms reduce (increase) efficiency (overinvestment) more than powerful CEOs in constrained firms. This result demonstrates that financial constraint forces powerful CEOs to

reduce inefficiency and overinvestment. We obtain similar findings in panel B when the firm's constraint is measured using the bond rating. The findings indicate that there is a significant negative (positive) relationship between efficient investment (overinvestment) and CEO power when firms are less constrained in obtaining external financing. Consistent with our main findings, these results suggest that powerful CEOs increase agency problems when they have easy access to external financing.

[Insert Table 9 here]

5. Robustness checks

5.1 Endogeneity: Instrumental variable regressions

We so far treat CEO power as an exogenous variable and test the relationship between powerful CEOs and their future investment efficiency. However, omitted variables may affect both the CEO power and the firms' investment efficiency. Moreover, the reverse causality may be a concern i.e. firms efficient or inefficient investment may change CEO power in the firm. One way to address these issues is to use the instrumental variables (IVs). We use a three-stage least square (3SLS) method with IVs to address the potential endogeneity problem. The instrument we have used in the first stage is industry average CEO power (Sheikh 2019). We use industry average power because different industries may have different norms in granting power. In some industries, CEOs may need more power for swift decision making while in some other industries CEOs may involve group decision making wherein investment decisions are more technical. So, because of this norm CEOs might have a different level of power which might increase or decrease CEO power but will not affect the firm's investment directly.

Since our key independent variable is a binary variable we employ a three-stage

procedure by Adams, Almeida, and Ferreira (2009). In the first stage, we estimate a probit of the determinants of CEO power. In the second stage, we regress the CEO power dummy on the fitted value from the first and the set of control variables. In the third stage, we regress the dependent variable on controls and the fitted values of the second stage. The key advantages of this procedure are that the binary nature of the endogenous variable is taken into account while the correct specification of the binary response model in the first stage is not required and the standard IV standard errors are still asymptotically valid (Wooldridge 2002).

Table 10 presents the regression result from the first and third stage regressions. Results from the first stage regression model in column (1) show that the coefficient of industry average power (IndPower) is positively significant at the 1% level, suggesting that as the industry average CEO power increases, CEOs gain more power in the firms. When we use the instrumented CEO power in the third stage, we find a more pronounced negative (positive) relationship between CEO power and firm investment efficiency (overinvestment). As our findings in other tables, CEO power has an insignificant effect on the underinvestment model. Overall, our results based on the three-stage least squares (3SLS) with instrumental variables approach are qualitatively similar to our main findings. While we try to address the potential endogeneity problem with 3SLS in this study, we do not disagree that there are still some issues like unobserved heterogeneity or correlated omitted variables that might affect our findings.

[Insert Table 10 here]

5.2 Alternative Measure of CEO power

The key independent variable, CEO power, is measured using the dummy variable approach. One might have a concern that each component of the CEO power variable may be correlated or may not equally affect the CEO's overall influence in the firm. Under such a scenario, our findings could be sensitive to an alternative construction of the power index. To address this concern, we follow Li, Lu and Phillips (2019) and use principal component analysis (PCA) to develop an alternative measure of CEO power. We also construct the absolute power index by taking the log of (1 + power index) rather than a categorical variable based on the median value of power.

Pan, Wang and Weisbach (2016) argue that as tenure lengthens, the CEO gains more power over the board by influencing the appointment of dependent directors who are less likely to oppose the powerful COE's decisions. They find that CEOs with longer tenure tend to overinvest at the end of their tenure and new CEOs almost always disinvest, sell old assets, or discontinue the previous CEO's projects at the beginning of their tenure. Additionally, Graham, Harvey and Puri (2015) show that CEOs with longer tenure tend to hold more power and delegate fewer financial decisions to others. These findings suggest that CEO power is correlated with CEO tenure. In order to partial out CEO tenure effects, we follow Li, Lu and Phillips (2019) and regress the overall CEO power index excluding tenure on CEO tenure and use the residuals as a measure of CEO power. Table 11 shows that our results are robust to these three alternative measures of CEO power and are qualitatively similar to the findings of our main analysis in Table 3.

[Insert Table 11 here]

5.3 Alternative Measures of Investment Efficiency

In our analysis, we have used Tobin's Q as a proxy for growth opportunities and regress our investment measure on Tobin's Q to calculate the residuals. We then multiply the absolute value of residuals by minus one to proxy for investment efficiency. For a robustness check on our results, we provide four alternative measures of investment efficiency in this section. The first alternative measure employs sales growth as a proxy for growth opportunities. We follow Chen et al. (2011) and use a piecewise linear regression model in Eq. (4) to allow for differential predictability for revenue increases and decreases.

$$Invest_{i,t+1} = \beta_0 + \beta_1 NEG_{i,t} + \beta_2 \% \, RevGrowth_{i,t} + \beta_3 NEG * \% \, RevGrowth_{i,t} + \varepsilon_{i,t+1} \quad (4)$$

where $Invest_{i,t+1}$ is the total investment of firm i in year t+1, defined as the sum of capital expenditure and intangible assets, multiplied by 100, and scaled by the lagged value of replacement cost of physical capital and intangible capital. Variable $\% \, RevGrowth_{i,t}$ is the annual revenue growth rate for firm i in year t. The indicator variable $NEG_{i,t}$ takes the value of 1 for negative revenue growth, and 0 otherwise.

The second alternative measure addresses the model misspecification concern by augmenting our model in Eq. (2) with additional control variables and industry and year fixed effects. To control the well-documented cash flow-investment sensitivity in the finance literature, we add cash flow and CEO power interaction terms with cash flow and Tobin's Q to Eq. (2). We mainly follow McLean, Zhang and Zhao (2012) to construct our model:

$$Invest_{i,t+1} = \beta_0 + \beta_1 Tobin'sQ_{i,t} + \beta_2 Tobin'sQ * CEO\_Power_{i,t} + \beta_3 OCF_{i,t} + \beta_4 OCF * CEO\_Power_{i,t} + IndFE + YearFE + \varepsilon_{i,t+1} \quad (5)$$

where $OCF_{i,t}$ is the annual cash flow for firm i in year t. By adopting additional controls, we try to capture the expected level of firm investment that is sensitive to growth opportunity, cash flow, and CEO power.

The third alternative measure employs the model suggested by Richardson (2006) to estimate the expected investment:

$$Invest_{i,t+1} = \beta_0 + \beta_1 Tobin'sQ_{i,t} + \beta_2 Firm\ Size_{i,t} + \beta_3 Firm\ Age_{i,t} + \beta_4 Stock\ Return_{i,t} + \beta_5 Invest_{i,t} + \beta_6 Cash_{i,t} + \beta_7 Leverage_{i,t} + IndFE + YearFE + \varepsilon_{i,t+1} \quad (6)$$

where $Stock\ Return_{i,t}$ is the change in the market value of equity from year t-1 to t, $Cash_{i,t}$ is the firm's available cash and $Firm\ Age_{i,t}$ is the difference between the first year when the firm appears in CRSP and the current year.

Lastly, we follow Chen et al. (2011) and remove the bottom decile of positive residuals from eq. (2) because these firms, whose unexpected investments are closest to 0 among all overinvesting firms, are more likely to be affected by measurement error in the investment model (i.e., misclassified as overinvesting firms). Similarly, we remove the top decile from the negative-residual group. We then repeat all the tests using the remaining observations. The results of these four additional tests are presented in columns (1) through (12) of Table 12. Even with the alternative proxy for growth opportunity, augmented investment efficiency model, and removal of top (bottom) negative (positive) residuals, results are qualitatively similar to our main

findings.

[Insert Table 12 here]

6. Conclusion

In this study, we take a direct approach to measuring investment efficiency with a superior proxy for growth opportunity suggested by Peters and Taylor (2017) and investigate the relationship between CEO power and a firm's investment efficiency. Our analysis reveals that powerful CEOs make inefficient investment decisions by overinvesting in projects that are value-destroying for the firms, suggesting agency problems. We further show that CEO power is negatively associated with investment efficiency and positively associated with overinvestment when CEOs have a high ownership stake in the firm or are longer tenured. We also find that CEO power is not always bad for the firms. We show that CEOs with a low level of power increase investment efficiency by 5.5% and they do so by reducing overinvestment by almost 12%. We do not find any evidence that governance mechanisms mitigate the overinvestment problem or improve the powerful CEO's investment inefficiency.

Furthermore, powerful CEOs are also most likely to overinvest or reduce investment efficiency when market competition is high, firms' likelihood of overinvestment increases, when firms are financially less constrained, or when firms are younger and small in size. However, we find that even the most powerful CEOs can create value for the firm by reducing overinvestment and increasing investment efficiency when a firm's operational complexity increases. We employ various alternative approaches to measure CEO power and to measure investment efficiency. In all these situations, our main results remain and are robust to the endogeneity problem.

Though we have tried to construct a comprehensive measure of CEO power, there are some limitations. For example, CEOs can gain power through internal and external connections with the key stakeholders. Further, the CEO's industry-related experience or financial experience, or overall experience may affect both investment decisions and CEO power. Due to data limitations, we cannot address those issues and have to save them for future studies. In this study, we show that a high level of ownership makes investment inefficient and overinvestment more likely, which is consistent with Kim and Lu (2011). However, the authors state that the harmful effects of large ownership may not lead necessarily to a negative slope in the relation between Tobin's Q and CEO ownership. Future studies can analyze whether inefficient investment by powerful CEOs explains the relationship. Also, our key dependent variable is constructed based on the deviations from the expected or optimum level of investment opportunity. However, it is always hard to completely capture the optimum or expected level of growth opportunity. In addition, some correlated omitted variables might still have a significant impact on the relationship between CEO power and corporate investment efficiency even though we control for endogeneity in our analysis.

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Figure 1 Investment inefficiency by powerful and other CEOs

The figure below presents the mean investment efficiency, underinvestment, and overinvestment by powerful and other CEOs from 1993 to 2016. Inefficient investment is measured by the absolute value of the residuals from Eq. 2.

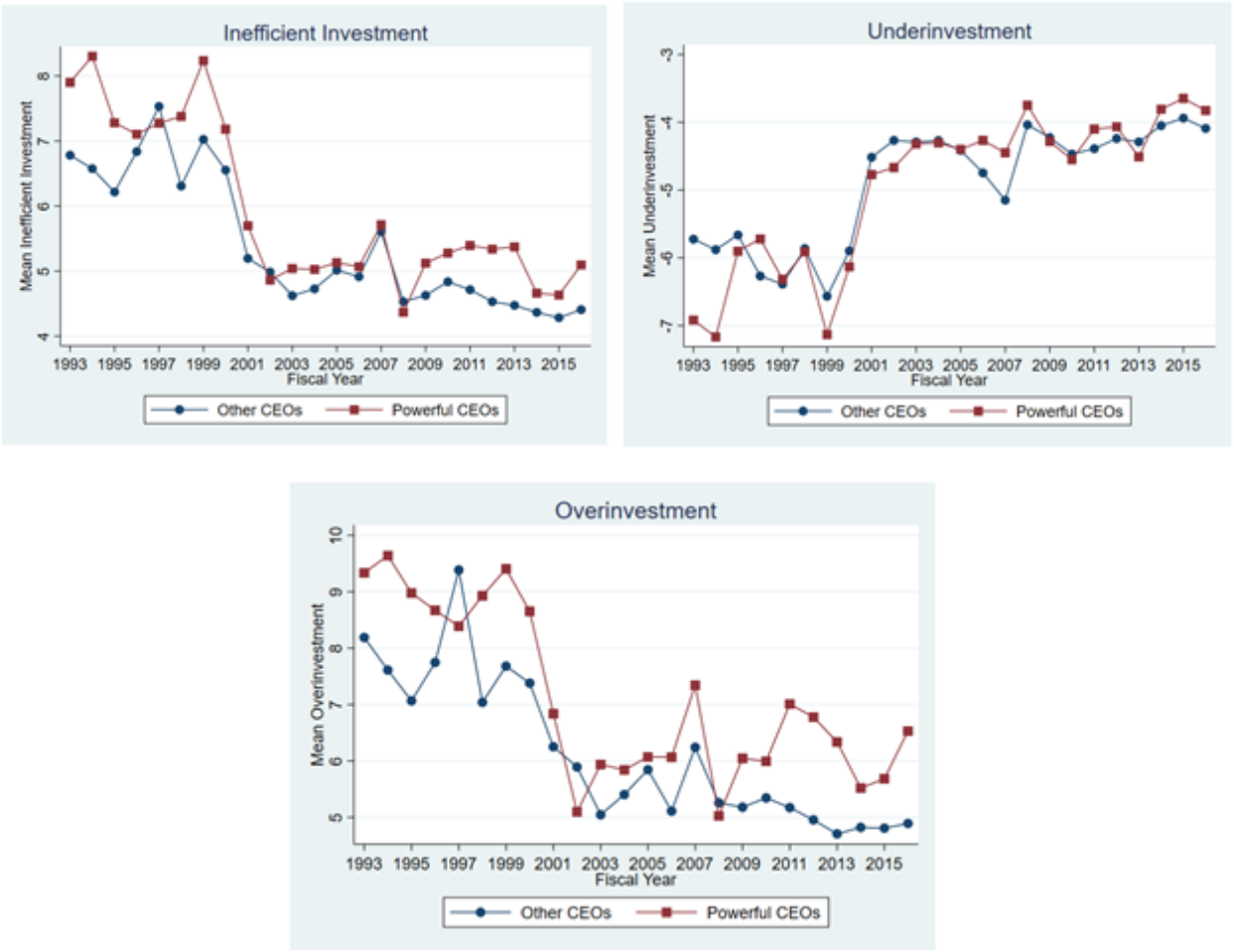
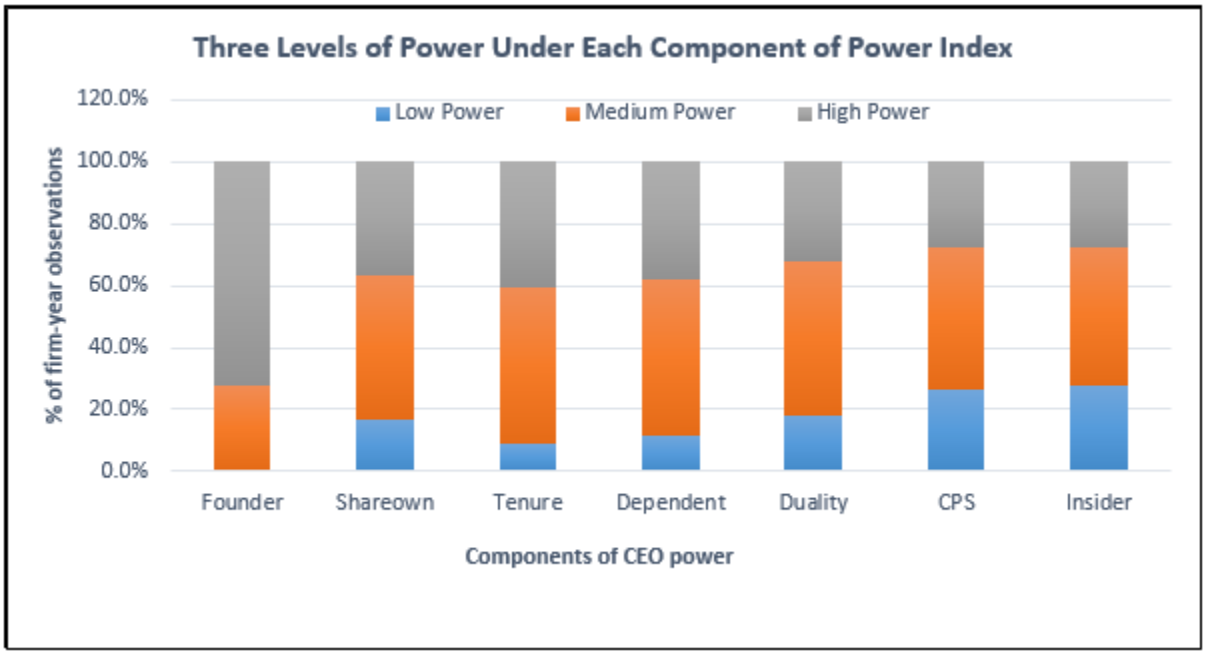


Figure 2 Different levels of power under each component of power index



This figure shows the percentage of firm-year observations with CEOs holding different levels of power under each component of the power index measure.

Table 1: Descriptive statistics and univariate analysis

This table presents the descriptive statistics of the dependent and control variables in Panel A, components of independent variables in Panel B, and univariate analysis in Panel C. The sample consists of Execucomp firms for the period 1993-2016. Appendix A1 provides a detailed description of the variables.

Panel A: Firm Characteristics

	N	Mean	Median	Std. Dev.	p25	p75
InvEff	21784	-5.470	-3.913	5.650	-7.146	-2.426
Under	12372	-4.816	-3.893	4.081	-6.588	-2.640
Over	9412	6.331	3.959	7.121	1.683	10.609
Slack	21784	1.834	0.459	3.671	0.100	1.498
Total-Q	21784	1.416	0.866	1.867	0.466	1.548
MB Ratio	21784	2.521	1.846	2.193	1.316	2.763
Leverage	21784	0.244	0.212	0.232	0.052	0.359
OCF	21784	0.119	0.102	0.144	0.052	0.168
Firm Size	21784	7.336	7.196	1.608	6.166	8.371
Tangibility	21784	0.304	0.227	0.251	0.113	0.429
Loss	21784	0.191	0.000	0.393	0.000	0.000
CEO Age	21784	55.250	55.000	7.425	50.000	60.000
Z-Score	21784	1.199	1.028	0.742	0.685	1.486
OP Cycle	21784	4.601	4.686	0.713	4.246	5.048
Dividend	21784	0.508	1.000	0.500	0.000	1.000

Panel B: CEO power index and its components

	N	Mean	Median	Std. Dev.	p25	p75
Duality Dummy	21784	0.542	1.000	0.498	0.000	1.000
CPS	21784	0.376	0.380	0.125	0.304	0.449
Dep. Exec	21784	0.548	0.500	0.371	0.250	1.000
Insider Dummy	21784	0.472	0.000	0.499	0.000	1.000
Founder Dummy	21784	0.099	0.000	0.298	0.000	0.000
Share Ownership	21784	0.039	0.003	1.783	0.001	0.013
Tenure	21784	7.545	5.000	7.501	2.000	10.000
Power Index	21784	3.246	3.000	1.800	2.000	5.000
Power Dummy	21784	0.389	0.000	0.487	0.000	1.000

Panel C: Univariate analysis

Variable	Power dummy=0	Power dummy=1	Diff
InvEff	-5.223	-5.859	-0.6356***
	[0.000]	[0.000]	[0.000]
Under	-4.764	-4.905	-0.1408*
	[0.000]	[0.000]	[0.0641]
Over	5.875	6.973	1.0978***
	[0.000]	[0.000]	[0.000]

Table 2:

Panel A: Correlation matrix of the main variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) InvEff	1.000													
(2) Power Dummy	-0.055*	1.000												
(3) Total-Q	-0.277*	0.052*	1.000											
(4) MB Ratio	-0.261*	0.040*	0.860*	1.000										
(5) Slack	-0.157*	0.013	0.295*	0.278*	1.000									
(6) Leverage	0.027*	-0.030*	-0.085*	-0.011	-0.189*	1.000								
(7) OCF	-0.049*	-0.007	0.181*	0.104*	-0.015*	-0.011	1.000							
(8) Firm Size	0.150*	-0.090*	-0.110*	-0.154*	-0.231*	0.243*	0.241*	1.000						
(9) Tangibility	-0.007	-0.001	-0.103*	-0.035*	-0.393*	0.264*	0.273*	0.164*	1.000					
(10) Loss	0.004	-0.049*	-0.134*	-0.113*	0.077*	0.081*	-0.290*	-0.139*	-0.061*	1.000				
(11) CEO Age	0.118*	0.200*	-0.116*	-0.123*	-0.133*	0.040*	0.028*	0.152*	0.056*	-0.066*	1.000			
(12) Z-Score	0.049*	0.001	-0.050*	-0.001	-0.168*	-0.171*	-0.298*	-0.156*	-0.075*	-0.132*	0.003	1.000		
(13) OP Cycle	0.024*	0.023*	0.013*	0.034*	0.008	-0.050*	-0.024*	-0.039*	-0.297*	0.001	0.062*	-0.260*	1.000	
(14) Dividend	0.147*	-0.019*	-0.113*	-0.130*	-0.252*	0.058*	0.082*	0.358*	0.147*	-0.208*	0.180*	0.078*	-0.013	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Panel B: Correlation matrix of the components of CEO power Dummy

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Duality Dummy	1.000						
(2) Dependent. Exec. Dummy	0.215*	1.000					
(3) Tenure Dummy	0.260*	0.429*	1.000				
(4) Insider Dummy	-0.019*	-0.014*	-0.066*	1.000			
(5) Founder Dummy	0.140*	0.180*	0.327*	-0.058*	1.000		
(6) CPS Dummy	0.080*	0.011	-0.021*	0.143*	-0.093*	1.000	
(7) Share Ownership Dummy	0.124*	0.197*	0.360*	-0.018*	0.282*	-0.079*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Table 3: CEO Power and Investment Efficiency

This table presents regression results investigating the relation between CEO power and investment efficiency. In columns (1), (2), and (3), the dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. The independent variable is the dummy variable, power dummy, equal to one if the power index is greater than the sample median power index and zero otherwise. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	(1) InvEff	(2) Under	(3) Over
Power Dummy	**-0.4282*** **	**0.1067**	**0.9047*** **
	(0.000)	**(0.314)**	**(0.000)**
Slack	-0.0713***	0.1195***	0.1802***
	(0.006)	(0.000)	(0.000)
MB Ratio	-0.4704***	-0.5191***	0.4040***
	(0.000)	(0.000)	(0.000)
Leverage	-0.4471	-1.6245***	-0.4146
	(0.177)	(0.000)	(0.442)
OCF	-0.3769	-0.5061	-0.3205
	(0.553)	(0.369)	(0.754)
Firm Size	0.2664***	-0.0549	-0.6258***
	(0.000)	(0.330)	(0.000)
Tangibility	-0.0406	3.1055***	3.3045***
	(0.930)	(0.000)	(0.000)
Loss	0.3285***	-0.0753	-0.5519**
	(0.009)	(0.479)	(0.024)
CEO Age	2.1636***	-0.8748*	-4.8960***
	(0.000)	(0.063)	(0.000)
Z-Score	0.4496***	1.0701***	-0.0319
	(0.003)	(0.000)	(0.886)
OP Cycle	0.3290	0.6869***	-0.1640
	(0.100)	(0.000)	(0.609)
Dividend	0.5886***	-0.7407***	-2.0735***
	(0.000)	(0.000)	(0.000)
Observations	21,784	12,372	9,412
Adjusted R-squared	0.154	0.235	0.185
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Table 4: Types of CEO Power and Investment Efficiency

This table presents regression results investigating the relation between types of CEO power and investment efficiency. The dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. The independent variable structural power is a dummy variable equal to one if the structural power index is greater than the sample median structural power index and zero otherwise, whereas structural power index is the sum of duality, cps, dependent executive and CEO only insider. Ownership power is a dummy variable equal to one if the ownership power index is greater than the sample median ownership power index and zero otherwise, whereas the ownership power index is the sum of stock ownership dummy and founder dummy. Expert power is the tenure dummy. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively

VARIABLES	(1) InvEff	(2) Under	(3) Over
Structural Power	**0.0569**	**0.0821**	**0.0065**
	(0.604)	**(0.427)**	**(0.973)**
Ownership power	**-0.3508****	**0.0537**	**0.7398*****
	(0.010)	**(0.704)**	**(0.000)**
Expert Power	**-0.4092*****	**-0.0032**	**0.6689*****
	(0.000)	(0.975)	(0.001)
Slack	-0.0712***	0.1197***	0.1788***
	(0.006)	(0.000)	(0.000)
MB Ratio	-0.4670***	-0.5184***	0.4022***
	(0.000)	(0.000)	(0.000)
Leverage	-0.4610	-1.6298***	-0.4230
	(0.163)	(0.000)	(0.430)
OCF	-0.3572	-0.5070	-0.3325
	(0.572)	(0.367)	(0.743)
Firm Size	0.2216***	-0.0532	-0.5507***
	(0.000)	(0.380)	(0.000)
Tangibility	0.0244	3.1035***	3.1498***
	(0.958)	(0.000)	(0.000)
Loss	0.3151**	-0.0762	-0.5419**
	(0.012)	(0.474)	(0.026)
CEO Age	2.4303***	-0.8443*	-5.1598***
	(0.000)	(0.081)	(0.000)
Z-Score	0.4465***	1.0687***	-0.0364
	(0.003)	(0.000)	(0.868)
OP Cycle	0.3329*	0.6889***	-0.1718
	(0.095)	(0.000)	(0.590)
Dividend	0.5772***	-0.7415***	-2.0801***
	(0.000)	(0.000)	(0.000)
Observations	21,784	12,372	9,412
Adjusted R-squared	0.156	0.235	0.187
Joint F-Test: Structural, ownership and expert power	7.926	0.274	10.463
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Table 5: Different Level of CEO Power and Investment Efficiency

This table presents regression results investigating the relationship between different levels of CEO power and investment efficiency. The dependent variables are the measure of investment efficiency (InvEff) in columns (1)-(3), underinvestment (Under) in columns (4)-(6), and overinvestment (Over) in columns (7)-(9) respectively. The independent variable low power is an indicator variable equal to one if the power index value is 1 and 2 and zero otherwise, medium power is an indicator variable equal to one if the power index value is 3 and 4 and zero otherwise and high power is an indicator variable equal to one if the power index value is greater than 4 and zero otherwise. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	InvEff			Under			Over		
VARIABLES	Low	Medium	High	Low	Medium	High	Low	Medium	High
Low Power	**0.2982*** **			**-0.0830**			**-0.6554*** **		
	(0.004)			**(0.357)**			**(0.000)**		
Medium Power		**-0.1119**			**-0.0376**			**0.1813**	
		(0.231)			**(0.661)**			**(0.278)**	
High Power			**-0.4360*** **			**0.1764**			**0.8890*** **
			(0.005)			**(0.225)**			**(0.000)**
Slack	-0.0719***	-0.0716***	-0.0713***	0.1198***	0.1188***	0.1194***	0.1804***	0.1807***	0.1813***
	(0.006)	(0.006)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB Ratio	-0.4717***	-0.4737***	-0.4712***	-0.5190***	-0.5181***	-0.5192***	0.4064***	0.4102***	0.4050***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.4432	-0.4388	-0.4456	-1.6277***	-1.6287***	-1.6256***	-0.3705	-0.3653	-0.3836
	(0.181)	(0.185)	(0.178)	(0.000)	(0.000)	(0.000)	(0.492)	(0.500)	(0.477)
OCF	-0.3666	-0.3572	-0.3641	-0.5054	-0.5020	-0.5156	-0.3682	-0.4503	-0.3252
	(0.564)	(0.575)	(0.568)	(0.369)	(0.372)	(0.359)	(0.718)	(0.659)	(0.751)
Firm Size	0.2741***	0.2807***	0.2686***	-0.0562	-0.0576	-0.0531	-0.6469***	-0.6592***	-0.6389***
	(0.000)	(0.000)	(0.000)	(0.319)	(0.305)	(0.346)	(0.000)	(0.000)	(0.000)
Tangibility	-0.0425	-0.0410	-0.0444	3.1062***	3.1048***	3.1060***	3.3197***	3.3058***	3.3247***
	(0.927)	(0.930)	(0.924)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Loss	0.3427***	0.3588***	0.3371***	-0.0767	-0.0818	-0.0757	-0.5979**	-0.6492***	-0.5694**
	(0.006)	(0.004)	(0.007)	(0.472)	(0.445)	(0.477)	(0.014)	(0.008)	(0.020)
CEO Age	2.0010***	1.8316***	2.0460***	-0.8350*	-0.7693*	-0.8917*	-4.6006***	-4.2254***	-4.5976***
	(0.000)	(0.000)	(0.000)	(0.069)	(0.090)	(0.057)	(0.000)	(0.000)	(0.000)
Z-Score	0.4538***	0.4604***	0.4503***	1.0688***	1.0655***	1.0712***	-0.0409	-0.0552	-0.0291
	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)	(0.000)	(0.854)	(0.805)	(0.895)
OP Cycle	0.3264	0.3286	0.3279	0.6886***	0.6852***	0.6879***	-0.1700	-0.1734	-0.1655
	(0.104)	(0.104)	(0.102)	(0.000)	(0.000)	(0.000)	(0.600)	(0.597)	(0.605)
Dividend	0.5955***	0.6001***	0.5866***	-0.7420***	-0.7427***	-0.7400***	-2.0876***	-2.0975***	-2.0623***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Observations	21,784	21,784	21,784	12,372	12,372	12,372	9,412	9,412	9,412
Adjusted R-squared	0.154	0.153	0.154	0.235	0.235	0.235	0.183	0.181	0.184
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 6: Effect of Firm Complexity on Investment Efficiency

This table presents regression results investigating the relation between CEO power and investment efficiency when a firm's operations are more complex. From columns (1) to (3), the dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. The independent variable is the dummy variable, Power Dummy, equal to one if the power index is greater than the sample median power index and zero otherwise. Firm_Comp is an indicator variable equal to one if the number of geographical and business segments is greater than the sample median for each year. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)
		FIRM_COMP	
VARIABLES	InvEff	Under	Over
Power Dummy	-0.6050***	0.0574	1.1875***
	(0.000)	(0.718)	(0.000)
Power dummy*Firm_Comp	**0.4375****	**0.1200**	**-0.8124****
	(0.039)	**(0.566)**	**(0.018)**
Firm_Comp	0.1747	0.1071	-0.2366
	(0.300)	(0.528)	(0.369)
Slack	-0.0851***	0.1167***	0.1955***
	(0.003)	(0.002)	(0.000)
MB Ratio	-0.4895***	-0.5436***	0.4187***
	(0.000)	(0.000)	(0.000)
Leverage	-0.4190	-1.4108***	-0.1736
	(0.218)	(0.000)	(0.768)
OCF	-0.2634	-0.0547	-0.0237
	(0.684)	(0.920)	(0.982)
Firm Size	0.2698***	-0.0333	-0.6120***
	(0.000)	(0.580)	(0.000)
Tangibility	-0.2376	2.7309***	3.1530***
	(0.620)	(0.000)	(0.000)
Loss	0.3186**	-0.0796	-0.5541**
	(0.015)	(0.485)	(0.030)
CEO Age	2.1660***	-0.8186*	-4.6705***
	(0.000)	(0.096)	(0.000)
Z-Score	0.4831***	1.1236***	-0.0600
	(0.002)	(0.000)	(0.795)
OP Cycle	0.3447*	0.6106***	-0.2965
	(0.099)	(0.001)	(0.360)
Dividend	0.4615***	-0.8577***	-1.9346***
	(0.005)	(0.000)	(0.000)
Observations	19,250	10,931	8,319
Adjusted R-squared	0.161	0.238	0.190
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Table 7: Impact of Product Market Competition

This table presents regression results investigating the impact of product market competition on the relation between CEO power and investment efficiency. The dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. The independent variable is the dummy variable, power dummy, equal to one if the power index is greater than the sample median power index and zero otherwise. The definition of the competition measure TNIC3TSIMM and HHI is in Appendix A1. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	TNIC3TSIMM			HHI		
VARIABLES	InvEff	Under	Over	InvEff	Under	Over
Power Dummy	-0.1426	0.0632	0.3495	-0.2409	0.2722**	0.7496***
	(0.284)	(0.631)	(0.135)	(0.104)	(0.031)	(0.004)
Power*TNIC3SIMM	**-0.5683*** **	**0.0938**	**0.9610*** **			
	(0.007)	**(0.604)**	**(0.006)**			
TNIC3TSIMM_dummy	-0.1884	0.4392***	0.9238***			
	(0.255)	(0.008)	(0.000)			
Power*HHI				**-0.4070***	**-0.3552***	**0.3369**
				(0.053)	**(0.068)**	**(0.346)**
HHI_dummy				0.4446**	0.4462***	-0.2702
				(0.010)	(0.008)	(0.358)
Slack	-0.0654**	0.1143***	0.1652***	-0.0734***	0.1163***	0.1810***
	(0.011)	(0.001)	(0.000)	(0.004)	(0.001)	(0.000)
MB Ratio	-0.4576***	-0.5224***	0.3774***	-0.4676***	-0.5170***	0.4021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.4845	-1.5835***	-0.2051	-0.4498	-1.6268***	-0.4145
	(0.158)	(0.000)	(0.713)	(0.173)	(0.000)	(0.442)
OCF	-0.3316	-0.5447	-0.5023	-0.4187	-0.5563	-0.3042
	(0.603)	(0.336)	(0.623)	(0.509)	(0.321)	(0.766)
Firm Size	0.2718***	-0.0672	-0.6549***	0.2643***	-0.0554	-0.6230***
	(0.000)	(0.230)	(0.000)	(0.000)	(0.325)	(0.000)
Tangibility	0.0001	3.0066***	3.1347***	-0.0381	3.0969***	3.3003***
	(1.000)	(0.000)	(0.000)	(0.935)	(0.000)	(0.000)
Loss	0.3425***	-0.1121	-0.6314**	0.3182**	-0.0856	-0.5451**
	(0.007)	(0.299)	(0.010)	(0.010)	(0.419)	(0.025)
CEO Age	2.1910***	-0.7752*	-4.8695***	2.1741***	-0.8571*	-4.8923***
	(0.000)	(0.099)	(0.000)	(0.000)	(0.068)	(0.000)
Z-Score	0.4453***	1.1163***	0.0700	0.4564***	1.0800***	-0.0333
	(0.003)	(0.000)	(0.758)	(0.002)	(0.000)	(0.880)
OP Cycle	0.3336*	0.7293***	-0.1701	0.3367*	0.6986***	-0.1653
	(0.096)	(0.000)	(0.589)	(0.091)	(0.000)	(0.605)
Dividend	0.5130***	-0.6910***	-1.8592***	0.5860***	-0.7472***	-2.0776***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	21,449	12,179	9,270	21,784	12,372	9,412
Adjusted R-squared	0.155	0.236	0.192	0.155	0.236	0.185
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 8: Impact of External and Internal Governance

This table presents regression results investigating the impact of strong governance on the relation between CEO power and investment efficiency. From columns (1) to (9), the dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. The independent variable is the dummy variable, Power Dummy, equal to one if the power index is greater than the sample median power index and zero otherwise. The definition of the governance measure Analysts, Block, and Total Inst are in Appendix A1. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Analysts			Block			Total Inst		
VARIABLES	InvEff	Under	Over	InvEff	Under	Over	InvEff	Under	Over
Power Dummy	-0.4275***	0.1787	0.8415***	-0.3382**	0.1173	0.8143***	-0.4005**	0.0826	0.7888***
	(0.005)	(0.196)	(0.001)	(0.018)	(0.349)	(0.001)	(0.013)	(0.561)	(0.004)
Power*Analysts	**0.0003**	**-0.1621**	**0.1060**						
	(0.999)	**(0.381)**	**(0.773)**						
Analysts	-0.0246	0.5182***	0.4466*						
	(0.866)	(0.000)	(0.088)						
Power*Block				**-0.2887**	**-0.0364**	**0.3249**			
				(0.101)	**(0.822)**	**(0.299)**			
Block				0.5126***	0.1291	-0.7214***			
				(0.000)	(0.261)	(0.000)			
Power*Total_Inst							**-0.0968**	**0.0370**	**0.3099**
							(0.626)	**(0.838)**	**(0.353)**
Total-Inst							0.1853	0.0254	-0.1991
							(0.169)	(0.854)	(0.352)
Observations	21,784	12,372	9,412	21,378	12,111	9,267	21,359	12,098	9,261
Adjusted R-squared	0.154	0.237	0.185	0.158	0.237	0.189	0.157	0.236	0.187
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 9: Split Sample Analysis by the Overinvestment Likelyhood and Financial Constraints

This table presents a split sample analysis. The dependent variables are the measure of investment efficiency (InvEff), and overinvestment (Over), respectively. The independent variable is the Power Dummy that is equal to one if the power index is greater than the sample median power index and zero otherwise. In panel A, from column (1) to (4), OverFirm represents overinvestment likelihood from Biddle et al. (2009), and from column (5) to (8) the HP index represents size and age constraint index from Hadlock and Pierce (2010). In Panel B, the KZ indexes represent the financial constraint index from Kaplan and Zingales (1997). Bond-rating is defined in Appendix A1. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values calcualted based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Overinvestment Likelihood and Firm SIZE and Age (HP) Constrained

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OverFirm				HP Index			
	InvEff		Over		InvEff		Over	
VARIABLES	Low	High	Low	High	Low	High	Low	High
Power Dummy	**-0.3260****	**-0.9334*****	**1.2634*****	**1.3943*****	**-0.0513**	**-0.5993****	**0.3881**	**0.6668***
	(0.036)	**(0.003)**	**(0.001)**	**(0.000)**	**(0.746)**	**(0.025)**	**(0.134)**	**(0.066)**
Observations	5,974	4,812	1,776	3,050	5,446	5,446	1,608	3,256
Adjusted R-squared	0.182	0.141	0.183	0.163	0.166	0.139	0.134	0.133
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel B: Financial Constraint and Investment Efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	KZ Index				Bond Rating			
	InvEff		Over		InvEff		Over	
VARIABLES	Low	High	Low	High	Uncons	Cons	Uncons	Cons
Power Dummy	**-1.0163*****	**-0.2715**	**1.3467*****	**0.7431***	**-0.4395*****	**-0.3497***	**1.0507*****	**0.5904****
	(0.000)	**(0.152)**	**(0.000)**	**(0.067)**	**(0.001)**	**(0.067)**	**(0.000)**	**(0.041)**
Observations	5,441	5,441	3,062	1,995	13,895	7,889	5,266	4,146
Adj. R-squared	0.156	0.176	0.193	0.185	0.161	0.158	0.195	0.176
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 10: 3SLS Regression

This table presents the results from 3SLS IV regressions addressing potential endogeneity. The dependent variable in column (1), (3), and (5) representing 1st stage results is CEO power dummy equal to one if the power index is greater than sample median power index. The dependent variables in column (2), (4), and (6) representing 3rd stage results are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. IndPower is the average industry (Fama-French 48) power measured from sample power index data from Execucomp. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	1st Stage	3rd Stage	1st Stage	3rd Stage	1st Stage	3rd Stage
VARIABLES	CEO Power	InvEff	CEO Power	Under	CEO Power	Over
IndPower	0.6877***		0.5535***		0.8742***	
	(0.000)		(0.000)		(0.000)	
Power(Instrumented)		**-2.5123****		**-1.4747**		**3.6538****
		(0.032)		**(0.251)**		**(0.036)**
Slack	0.0013	-0.0709***	-0.0111	0.1133***	0.0032	0.1777***
	(0.833)	(0.006)	(0.186)	(0.001)	(0.658)	(0.000)
MB Ratio	0.0213***	-0.4529***	0.0224**	-0.5062***	0.0174*	0.3834***
	(0.010)	(0.000)	(0.043)	(0.000)	(0.092)	(0.000)
Leverage	-0.0496	-0.4818	-0.1220	-1.6903***	0.1565	-0.5734
	(0.516)	(0.145)	(0.165)	(0.000)	(0.180)	(0.301)
OCF	-0.1357	-0.4822	0.1091	-0.4407	-0.3562**	0.0721
	(0.317)	(0.453)	(0.539)	(0.436)	(0.034)	(0.946)
Firm Size	-0.0917***	0.1986***	-0.0783***	-0.0981	-0.1046***	-0.5228***
	(0.000)	(0.002)	(0.000)	(0.143)	(0.000)	(0.000)
Tangibility	0.0211	-0.0326	-0.0103	3.1005***	0.0285	3.2878***
	(0.850)	(0.944)	(0.940)	(0.000)	(0.852)	(0.000)
Loss	-0.2173***	0.1698	-0.1446***	-0.1541	-0.3044***	-0.2534
	(0.000)	(0.270)	(0.000)	(0.209)	(0.000)	(0.425)
CEO Age	2.3640***	3.9241***	2.6304***	0.5624	2.2102***	-7.1074***
	(0.000)	(0.000)	(0.000)	(0.652)	(0.000)	(0.000)
Z-Score	-0.0734**	0.3967***	-0.1162**	1.0089***	-0.0669	0.0335
	(0.034)	(0.009)	(0.012)	(0.000)	(0.124)	(0.882)
OP Cycle	-0.0126	0.3234	-0.0213	0.6780***	-0.0337	-0.1353
	(0.735)	(0.109)	(0.651)	(0.000)	(0.483)	(0.678)
Dividend	-0.0674*	0.5377***	-0.0480	-0.7681***	-0.0562	-2.0139***
	(0.094)	(0.001)	(0.328)	(0.000)	(0.307)	(0.000)
Observations	21,784	21,784	12,372	12,372	9,412	9,412
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Pseudo R-squared	0.063		0.070		0.068	
Adjusted R-squared		0.153		0.235		0.182

Table 11: Alternative Measures of CEO Power and Investment Efficiency

This table presents the results using the alternative measures of CEO Power. The dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. In columns (1)-(3), the independent variable PCA index is the power index measured using principal component analysis. In columns (4)-(6), the independent variable is the residual power measured regressing six components of the power index (excluding tenure dummy) on tenure dummy. In columns (7)-(9), the log of power index is the independent variable. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-Values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	PCA Index			Control for CEO Tenure			Log of Power Index		
VARIABLES	InvEff	Under	Over	InvEff	Under	Over	InvEff	Under	Over
Power(PCA)	-0.4043***	-0.0294	0.5333***						
	(0.000)	(0.741)	(0.000)						
Residual_Power				-0.2614**	0.0809	0.6315***			
				(0.038)	(0.522)	(0.001)			
Log(Power_Index)							-0.5112***	0.0668	1.0058***
							(0.000)	(0.548)	(0.000)
Observations	21,784	12,372	9,412	21,784	12,372	9,412	21,784	12,372	9,412
Adjusted R-squared	0.158	0.235	0.188	0.154	0.235	0.182	0.155	0.235	0.185
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 12: CEO Power and Alternative Measures of Investment Efficiency

This table presents the robustness results using alternative measures of investment efficiency. The dependent variables are the measure of investment efficiency (InvEff), underinvestment (Under), and overinvestment (Over) respectively. In columns (1)-(3), we apply the Eq.(4) following Chen et al. (2014) model. In columns (4)-(6), we apply the Eq.(5) following McLean et al.(2012) Model. In columns (7)-(9), we remove the bottom and top decile residuals, and in columns (10)-(12), we apply Eq. (6) following Richardson (2006) model. A constant term is included in all models but is omitted for brevity. The definitions of all variables are in Appendix A1. P-values, based on robust standard errors adjusted for heteroskedasticity and clustered at the firm level, are reported in brackets below the coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Chen et al.(2014) Model			McLean et al.(2012) Model			Richardson (2006) Model			Removing bottom and top decile		
VARIABLES	InvEff	Under	Over	InvEff	Under	Over	InvEff	Under	Over	InvEff	Under	Over
Power dummy	-0.3752***	-0.0368	0.6595***	-0.3635***	-0.0923	0.5672***	-0.1992***	-0.0487	0.3397***	-0.4150***	0.0887	0.8508***
	(0.001)	(0.732)	(0.000)	(0.003)	(0.425)	(0.007)	(0.001)	(0.432)	(0.000)	(0.001)	(0.412)	(0.000)
Observations	25,448	14,898	10,550	25,460	14,659	10,801	24,966	13,396	11,570	22,915	13,328	9,587
Adj. R-squared	0.185	0.204	0.254	0.185	0.276	0.221	0.171	0.210	0.154	0.161	0.247	0.182
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix A1

Dependent Variable	**Variable definitions**
InvEff	Investment efficiency is the absolute value of the residual from a simple investment model (Eq. (2)) multiplied by minus one
Under	Underinvestment is the negative residuals from a simple investment model (Eq. (2))
Over	Overinvestment is the positive residuals from a simple investment model (Eq. (2))
Independent Variable	
Power dummy	The indicator variable power dummy equals one if the CEO Power Index is above the sample median, and zero otherwise
Control Variables	
Slack	The ratio of cash and short-term investments to PP&E
MB Ratio	(Fiscal annual closed price * common shares outstanding + total assets - total common equity)/lagged total assets
Leverage	Long-term debt plus debt in current liabilities, scaled by lagged total assets
OCF	The ratio of the cash flow from operations to sales
Firm Size	Log of the total book value of assets
Tangibility	The ratio of net property, plant, and equipment to lagged total assets
Loss	An indicator variable that takes the value of one if net income is negative, and zero otherwise
CEO Age	Log of CEO age
Z-Score	0.033*(pretax income/total assets)+(sale/total assets) + 0.014*(retained earnings/total assets) + 0.012* ((current assets-current liabilities)/total assets)+ 0.006*(market value of common stock/total liabilities)
OP Cycle	The natural log of receivables to sales plus inventory to cost of goods sold multiplied by 360
Dividend	An indicator variable equals one if the firm paid cash or common dividend, and zero otherwise.
CEO Power Measure	
CEO Duality	Dummy variable equal to one if the CEO is also the chairman of the board.
CEO Pay Slice	Dummy variable equal to one if CPS is greater than yearly industry median CPS available in Execucomp database. CPS is constructed as the ratio of CEO total compensation to the aggregate total compensation of the top five executives in the management team including the CEO.
CEO insider	Dummy if CEO is the only insider(sits as a director) in the board
Dep. Exec.	The fraction of top 4 non-CEO executives appointed (FTA) during the current CEO's tenure. Dep. Exec. is an indicator variable equal to one if FTA is greater than median FTA.
CEO's founder	Dummy variable equal to one if the CEO is a founder of the company
CEO Stock Ownership	Dummy variable equal to one if the percentage of shares held by the CEO is above the yearly industry median stock ownership data available in Execucomp database.
CEO Tenure	Dummy variable equal to one if a CEO's tenure is greater than the yearly industry median tenure data available in Execucomp database.

	Tenure is the number of years since the CEO was appointed.
Power Index	Sum of seven categorical variables measuring duality, CPS, CEO only insider, dependent executive, CEO founder, CEO stock ownership, and CEO tenure.
Governance Variable	
Total_Inst	The percentage of firm shares held by institutional investors. We use an indicator variable that equals 1 (0) if the firm-year observation is above (below) the sample yearly median total institutional ownership.
Block Holder	Blockholders are defined as shareholders who own at least 5% of the firm's outstanding shares. We use an indicator variable that equals 1 (0) if the firm-year observation is above (below) the yearly sample median number of block holders.
Analysts	The number of analysts following the firm in the current fiscal year as provided by IBES. We use an indicator variable that equals 1 (0) if the firm-year observation is above (below) the sample yearly median number of analysts following the firm.
Firm Complexity	
Firm_Comp	An indicator variable that equals 1 (0) if the firm-year observation is above (below) the yearly sample median number of geographical and business segments.
Market Competition	
HHI	Compustat Herfindahl-Hirschman Index: The sum of the squares of percentage market share of all firms in Compustat in each SIC 2 digit industry. HHI is an indicator variable if equal to one if the HHI is less than the sample median for the year and zero otherwise.
TNIC3TSIMM	Hoberg and Phillips (2016) is a text-based total similarity measure index to compute product market competition. TNIC3TSIMM is an indicator variable equal to one if TNIC3TSIMM is greater than the sample median for the year and zero otherwise.
Constrained Index	
OverFirm	A ranked variable based on the average of a ranked (deciles) measure of cash and leverage. Leverage is multiplied by minus one before ranking so that both variables are increasing in the likelihood of over-investment.
HP Index	Size and age constraints from Hadlock and Pierce (2010), estimated as −0.737 Size +0.043 Size2–0.040 Age, where Size is the log of total assets, and Age is the number of years the firm is listed with a non-missing stock price on Compustat.
KZ Index	Financial constraints from Kaplan and Zingales (1997), estimated as 1.002*OCF + 0.283*MB + 3.319*leverage -39.368*dvnd -1.315*slack, where OCF is the cash flow, MB is the market to book ratio, leverage is the book leverage, dvnd is the sum of cash and preferred dividend and slack is the cash and short-term investments
Bond rating	Following an approach similar to that in Denis and Sibilkov (2010), firms are classified as financially unconstrained if they have had their long- term debt rated by Standard & Poor's and their debt is not in default (rating of "D" or "SD"). Firms are classified as constrained if they have debt outstanding that year, but the long-term debt rating is unavailable. Firms with no debt outstanding are classified as unconstrained.