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CEO Duality, Agency Costs, and Internal Capital Allocation Efficiency

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Abstract

This study examines the impact of CEO duality on firms' internal capital allocation efficiency. We observe that when the CEO is also chair of the board, diversified firms make inefficient investments, as they allocate more capital to business segments with relatively low growth opportunities over segments with high growth opportunities. The adverse impact of CEO duality on investment efficiency prevails only among firms that face high agency problems, as captured by high free cash flows, staggered board structure and low board independence. Depending on the severity of the agency problem, CEO duality is associated with a decrease in industry-adjusted investment in high growth segments of 1% to 2.1% over the following year, relative to those in low growth segments. However, CEOs' equity-based compensation curbs the negative effect of CEO duality on internal capital allocation efficiency. Overall, the findings of this study offer strong support for the agency theory and postulate the internal capital allocation policy as an important channel through which CEO duality lowers firm value in diversified firms.

Keywords: CEO duality; Internal capital allocation; Investment efficiency; Agency costs; Board structure; Equity-based compensation.

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1. Introduction

When a sole individual acts as both CEO and chair of the board of a firm, the resulting CEO duality creates one of the most contentious issues in the field of strategic leadership. In their meta-analysis, Dalton *et al.* (1998) find no empirical relation between CEO duality and firm performance, yet the debate about whether to join or separate CEO and chair positions continues to receive considerable attention from both practitioners and academics (see, for example, Rechner and Dalton, 1989, 1991; Donaldson and Davis, 1991; Daily and Dalton, 1992, 1993; Dalton *et al.*, 2007; Kim *et al.*, 2009; Dalton and Dalton, 2011; Krause and Semadeni, 2013; Yang and Zhao, 2014; Krause, 2017). While the global financial crisis triggered a wave of proposals to eliminate CEO duality and achieve independent board leadership, corporate leaders and policy-making bodies appear reluctant to adopt such an obligatory separation that suggests a “one size fits all” approach (Krause *et al.*, 2014). Even as recent years have seen a doubling of the number of firms that have separated their CEO and chair positions, most firms in Standard & Poor’s Execucomp continue to uphold CEO duality. During 1992-2013 the proportion of firms with CEO duality rarely drops below 50%.

Academic research on CEO duality focuses mainly on firm performance and to date remains rather controversial. The theoretical grounds for a link between CEO duality and accounting- or market-based performance are extensive, yet no comprehensive evidence is available to confirm it. According to Dalton and Dalton (2011), little consistency appears in extant studies that relate CEO duality to financial performance. Krause *et al.* (2014) accordingly call for research that considers moderating attributes that might alter the strength or direction of the relationship. Subsequently, Duru *et al.* (2016) uncover that board independence attenuates the negative effect of CEO duality on firm performance, while Yang and Zhao (2014) show that when their competitive environment changes, CEO duality firms outperform non-duality firms.

In contrast to prior literature, which mainly focuses on firm performance, we investigate how CEO duality affects the internal capital allocation policy in diversified firms.¹ A large sample of multi-segment U.S. firms over the period 1992-2013 provides compelling empirical evidence that CEO duality is detrimental to investment efficiency. Prior literature has however ignored the channel(s) through which CEO duality affects firm value; hence this study contributes to strategic leadership literature by identifying a pathway through which CEO duality offers managers of diversified firms an opportunity to extract private benefits by misallocating corporate resources across business segments.

This study also shows that the adverse effect of CEO duality on investment efficiency is only prevalent in firms that are potentially exposed to agency issues, particularly in the presence of high free cash flows and weak board governance. In addition, the results underscore the importance of CEOs' equity-based compensation as an important internal governance device to align the interest of the CEO and the shareholders, and as such to curb the negative effect of CEO duality on investment efficiency. Lastly, this study identifies CEO ability, CEO succession origin, and longevity of business segments as additional important moderating attributes that moderate the (negative) effect of CEO duality on investment efficiency.

The findings of this study provide strong support for the agency theory, which predicts that CEO duality reflects weaker board oversight and stronger managerial power, and suggests that boards should be independent from the management to prevent managerial entrenchment (Fama and Jensen, 1983; Eisenhardt, 1989). The findings emphasize that the adverse impact of CEO duality on corporate policies affecting value is contingent on a firm's board characteristics (Finkelstein and D'Aveni, 1994; Davidson *et al.*, 2004; Duru *et al.*, 2016); further, they support

¹ Internal capital allocation in diversified firms refers to the allocation of corporate resources to business segments for investment purposes. An efficient corporate resources allocation maximizes firm value. Following the seminal work of Rajan *et al.*, (2000), this is achieved when the capital allocation process favours segments with relatively high growth opportunities (i.e., high-*q* segments) over segments with low growth opportunities (i.e., low-*q* segments). Throughout this study, the terms *investment efficiency* and *internal capital allocation efficiency* are used interchangeably to denote the same economic phenomenon.

the notion about complementarities in corporate governance practices, which appear to be aligned with one another and mutually enhance the ability of those practices to achieve effective corporate governance (see, for example, Rediker and Seth, 1995; Aguilera *et al.*, 2008). In this vein, executive compensation is a powerful internal governance mechanism, able to mitigate the CEO duality rent-seeking behaviour (Fama and Jensen, 1983; Datta *et al.*, 2009). Finally, in the spirit of Dalton and Dalton (2011) and Krause *et al.* (2014), the findings suggest that any future attempts to advance research towards the strategic importance of this phenomenon should consider competing theories through the lenses of such moderating or mediating factors.

The remainder of this paper proceeds as follows. Section 2 details relevant literature, to provide the theoretical foundation for the testable hypotheses. Section 3 describes the sample and key variables used in the empirical analyses. Section 4 presents the results, and Section 5 concludes.

2. Literature review and hypotheses development

2.1. Literature review

Prior literature proposes two main competing theories to understand the relation between CEO duality and firm performance: agency and stewardship theories (see, for example, Fama and Jensen, 1983; Eisenhardt, 1989; Donaldson and Davis, 1991). Agency theory predicts that agents commit to opportunistic behaviour and indulge in excessive benefits for themselves, at the expense of shareholder' interests. CEO duality is therefore undesirable from this perspective, because it grants excess power to a single executive, weakening board monitoring, fostering managerial entrenchment and negatively affecting firm performance (Finkelstein and D'Aveni, 1994; Dalton *et al.*, 1998; Krause *et al.*, 2014). This view appears widely supported by practitioners and a growing group of scholars advocating CEO and chair separation, arguing that CEO duality weakens corporate governance (for example, Lublin, 2009; Iannelli, 2013; Krause, 2017).

In contrast, stewardship theory asserts that CEO duality can be beneficial for firm performance, because it ensures cohesive leadership, signals firm stability, and inspires confidence in firm management (Donaldson and Davis, 1991). Expertise and knowledge can result from CEO duality, along with faster decision-making and status rewards for executives (Finkelstein and D'Aveni, 1994; Boyd, 1995; He and Wang, 2004). Therefore, a fundamental implication of stewardship theory is that CEO duality enhances firm performance by reducing costs and inefficiencies that can result from separating the two roles (Brickley *et al.*, 1997).

Elsayed (2010) adopts a more nuanced view on the determinants of board leadership, and emphasizes that the optimal leadership structure varies with the context in which firms are operating (see also, He and Wang, 2009; Ramdani and Witteloostuijn, 2010; Krause and Semadeni, 2013; Krause, 2017). An important implication of this perspective is that agency theory and stewardship theory are complementary viewpoints, which explain different parts of the same picture.

Despite the strong theoretical predictions, the evidence for the impact of CEO duality on firm performance is at best mixed, with some studies providing empirical support for the agency perspective (for example, Rechner and Dalton 1991; Daily and Dalton 1994; Worrell *et al.*, 1997), and others endorsing the stewardship perspective (for example, Donaldson and Davis 1991; Boyd, 1995; Brickley *et al.*, 1997), while many others are inconclusive (for example, Rechner and Dalton 1989; Daily and Dalton 1992, 1993; Daily 1995; Baliga *et al.*, 1996).² Dalton *et al.*'s (1998) meta-analysis of board composition and leadership structure reveals little supporting evidence for the relationship between CEO duality and firm performance. Empirical research in more recent years has in consequence steered away from investigating the existence of a direct (and simple) duality-performance relationship, as researchers quest for new contexts

² See Krause *et al.* (2014) for an excellent review.

that could help them demystify the strategic importance of CEO duality (Dalton and Dalton, 2011; Krause *et al.* 2014; Yang and Zhao, 2014; Duru *et al.*, 2016; Krause, 2017).

In this vein, some studies consider new empirical approaches and moderating factors to investigate the performance effect of CEO duality. For instance, He and Wang's (2009) findings show that CEO duality strengthens the already positive effect of innovative knowledge assets on firm performance. In another study, Ballinger and Marcel (2010) report that interim CEO successions are associated with lower performance during the period in which the interim serves, while CEO duality moderates the impact of this type of succession on firm performance. Similarly, Krause and Semadeni (2013) find that separation of the CEO and Chair positions positively (negatively) impacts future firm performance when current performance is poor (high), with the effect being most dramatic for demotion separations. More recently, Yang and Zhao (2014) rely on an exogenous shock to industry competition to show that, when there is a change in the firm's competitive environment, CEO duality firms outperform non-duality firms, with the difference in performance being greater for duality firms with better corporate governance. In a similar vein, Duru *et al.* (2016) show that the negative effect of CEO duality on firm performance is attenuated by the degree of board independence.

To conclude this review, despite a very rich literature investigating either the direct or moderating effects of CEO duality on firm performance, to the best of our knowledge, we still lack evidence about the possible channel(s) through which CEO duality affects firm policies and impacts firm performance.

2.2. Hypotheses

This study adopts the agency perspective of the firm to consider the internal capital allocation policy as a potential channel through which CEO duality might be detrimental to firm value. Several studies show that misallocation of internal capital in diversified firms leads to investment inefficiencies that are value-destructive (for example, Shin and Stulz, 1998; Rajan

et al., 2000; Scharfstein and Stein, 2000; Ahn and Denis, 2004; Ahn *et al.*, 2006; Datta *et al.*, 2009; Hovakimian, 2011; Duchin and Sosyura, 2013). While offering a variety of important insights, these studies focus on agency problems that arise from managerial self-interest, irrespective of the board leadership structure and of how CEO duality influences the internal capital allocation policy. In this spirit, we derive our two main hypotheses pertaining to the relationship between CEO duality and investment efficiency in diversified firms.

Agency problems arise from the separation of ownership and control in large corporations. In the absence of appropriate monitoring devices and incentive mechanisms, managers might be tempted to undertake actions that maximize their own utility (see, for example, Jensen and Meckling, 1976; Shleifer and Vishny, 1989) or simply enjoy the quiet life (Bertrand and Mullainathan, 2003). Since CEOs cannot easily diversify their employment risk, they may commit to investments that best serve their personal motives to entrench themselves and make their replacement much costlier to the firm (Shleifer and Vishny, 1989). In diversified firms, the value created from investments depends significantly on the efficiency of the allocation of capital across various business segments (Rajan *et al.*, 2000), but the discretion to allocate these corporate resources to business segments gives self-interested CEOs a ready opportunity to extract private benefits, by misallocating corporate resources.

Studies of CEO investment decisions consider the presence of “pet projects” that generate unduly high private benefits for the CEO (Shin and Stulz, 1998). As Shleifer and Vishny (1989) also show, managers have an incentive to allocate the firm’s resources to investments whose value is higher under them than under the best alternative. This result reflects an important aspect of the classic agency problem – that is, excessive investment in assets that are complementary to managers’ skills, background, or experience, even when such investments are unprofitable for the firm.

In diversified firms, agency theory maintains that CEOs can distil their private benefits of control by engaging in inefficient cross-subsidization, funding value-destroying projects, and

ceding to rent-seeking efforts of divisional managers by overinvesting in weak projects at the expense of good ones (Lamont, 1997; Shin and Stulz, 1998; Scharfstein and Stein, 2000; Rajan *et al.*, 2000). In support of this view, Ahn and Denis (2004) find that diversified firms allocate investment funds inefficiently. In a similar vein, Ahn *et al.* (2006) find that diversified firms invest more than their focused peers, this behaviour being driven by favouring overinvestments in low-growth business segments, to the detriment of segments with high growth opportunities that add value to the firm. Duchin and Sosyura (2013) consider the influence of managerial ties, measuring social connections that reflect mutual qualities or experiences between the CEO and divisional managers. Their findings suggest that under weak corporate governance, managerial ties tend to result in investment inefficiencies and lower firm value. Glaser *et al.* (2013) also uncover mechanisms by which more powerful and better connected divisional managers secure relatively more capital allocation in a financially slack environment. Such problems are more likely when decision management and decision control are delegated to the same agent, as happens when the CEO also chairs the board; under these circumstances, board monitoring weakens, and external monitoring, which seemingly could discipline CEO actions, is trivial, because the internal capital markets provide CEOs with a means to avoid monitoring from external financial markets.

Building on such burgeoning evidence, this study examines whether CEO duality leads to greater proneness to cultivate a domain for pursuing self-serving interests and engaging in opportunistic behaviours through the internal capital allocation process. According to Boyd (1995), CEO duality is detrimental to the balance between the CEO and the board, because it limits the board's efficacy in monitoring managerial actions. The CEO's excess power, because of the combined leadership structure, provides additional legitimacy to the board's control function and promotes a fruitful environment in which the CEO can engage in managerial actions that deviate from shareholders' interests. In the absence of a clear separation of the two

leadership roles, the board's role in overseeing managerial opportunism is curtailed (Zona, 2012).

In summary, a board may fail to interfere diligently in major corporate decisions because of its weak role when a CEO is too powerful. Accordingly, CEO duality can then lead to misallocation of capital to business divisions, including allocations of more investments to low growth, relative to high growth, segments. This leads to the first hypothesis:

Hypothesis 1: *Firms with CEO duality are expected to allocate relatively greater capital to low growth segments than to high growth segments (i.e., inefficient internal capital allocation).*

Following the meta-analysis of Dalton *et al.* (1998), scholars agree that CEO duality has an important role that differs according to circumstances. Duality can produce both positive and negative consequences under, different market settings (Boyd, 1995; Worrell *et al.*, 1997; He and Wang, 2009), moderating attributes originating from CEO and board characteristics (Krause *et al.*, 2014), and may well vary conditionally on the level of firm performance (Ramdani and Witteloostuijn, 2010; Krause and Semadeni, 2013; Krause, 2017). Drawing on both management and finance literature, this study further argues that firm context with potentially high agency problems amplifies the adverse effect of CEO duality on the internal capital allocation efficiency.

The extant literature advocates free cash flow as a proxy for the existence of potential agency issues. Firms with excess free cash flow encounter major agency problems, especially if their investment opportunities are limited (see, for example, Jensen, 1986; Lang *et al.*, 1991, Chung *et al.*, 2005). The agency costs arise because, when the firm holds too much excess cash, a powerful CEO can act opportunistically and seize personal gains from unnecessary value-destroying investments. Such resource misallocations may offer personal rewards, at the expense of shareholders' interests. Limited free cash flows instead inherently reduce managerial discretion and act as disciplining forces on CEOs who might be prone to misuse resources to

pursue their private goals. The degree of free cash flow availability thus should moderate the relationship between CEO duality and the efficiency of internal capital allocation.

Several management scholars argue that the performance impact of CEO duality is contingent on the board's characteristics (Finkelstein and D'Aveni, 1994; Davidson *et al.*, 2004; Duru *et al.*, 2016), and internal governance mechanisms can be substitutes for CEO duality (Rediker and Seth, 1995). Two important board characteristics considered in the literature are a board's independence and staggered boards. Independent board members, those with no ties to the company and its CEO, are better suited to improve the effectiveness of board monitoring and to sanction the CEO in case of underperformance (see, for example, Fama and Jensen, 1983; Weisbach, 1988). Duru *et al.* (2016) emphasize that board independence amplifies the positive effect of CEO duality on firm performance and mitigates the associated costs, which in turn leads to a more profitable balance between strong leadership and better board monitoring. The implementation of a staggered board is another board characteristic that has attracted the interest of scholars in finance and management.³ A staggered board may exacerbate agency problems and lead to CEO entrenchment, as it potentially insulates the firm from the pressure of the market for corporate control (Bebchuk *et al.*, 2002; Cohen and Wang, 2013; Amihud and Stoyanov, 2017). Therefore, board characteristics that curb (or heighten) agency problems may act as important moderating attributes in the relation between CEO duality and the efficiency of internal capital allocation.

Additionally, executive compensation is an important internal governance device to alleviate managerial slack and align managerial incentives with shareholder concerns (Jensen and Meckling, 1976; Hölmstrom, 1979). Equity-based compensation is known to attenuate agency costs by reducing the non-value-maximizing behaviour of managers (Shleifer and Vishny, 1989), and to promote collaboration in large diversified firms (Oxley and Pandher,

³ A staggered board is a board structure in which only a fraction of the directors is elected during a shareholder meeting, rather than all at once.

2016). In the spirit of agency theory, Datta *et al.* (2009) document that stock grants play an important role in motivating CEOs to make more efficient internal capital allocation decisions. As it helps to align managerial interests with those of shareholders, equity-based compensation may play an important role in curbing the negative effect of CEO duality on internal investment allocation.

Taken collectively, all these arguments lead to our second hypothesis:

Hypothesis 2: *The negative effect of CEO duality on internal capital allocation efficiency prevails only in diversified firms that are exposed to high agency problems.*

3. Data and empirical strategy

3.1. Sample and data sources

Four data sets serve to construct the sample with the required data: CEOs' equity-based compensation and characteristics from Execucomp, firm-level financial data from Compustat, segment-level financial data from the Compustat Industrial Segment (CIS) database, and corporate governance data from Institutional Shareholder Services (ISS). Our focus on internal capital allocation efficiency means that the primary tests require data of investments at the segment level. Since the analysis requires an intra-firm examination of such investments in business segments, the sample is restricted to diversified firms that report at least two segments, operating in different three-digit standard industrial classification (SIC) codes. This criterion is also important as diversified structures endow CEOs with additional discretion in allocating resources across business segments (Shin and Stulz, 1998; Rajan *et al.*, 2000), making it an ideal setting in which to investigate the agency implications of the rent-seeking CEO duality on internal capital allocation efficiency.

To attenuate distortions caused by small firms, which may have negligible sales or assets, the selection criteria require total sales of at least \$20 million. Financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4949), as well as firms with any divisions that operate

in these sectors, are excluded, because they are subject to specific regulations. Sales generally are allocated across the reported segments of a diversified firm, so the sum of all segment sales must be within 1% of the total firm sales (Berger and Ofek, 1995). For the purpose of industry benchmarking (defined by the median peer-focused firm), another requirement is the existence of at least five peer-focused firms in the same three-digit SIC for each segment of the sample of diversified firms. The final sample covers the period 1992-2013 and is made up of 4,168 firm-years and 10,740 segment-year observations.

3.2. Model specification and variable definitions

3.2.1. Baseline specification

To measure the effect of CEO duality on internal capital allocation efficiency, we adopt the following segment-level regression equation:

$$\begin{aligned}
 \text{Segment Investment}_{j,i,t} = & \alpha_i + \alpha_t + \beta_1 \text{CEO Duality}_{i,t-1} + \beta_2 \text{High-q Segment}_{j,i,t} \\
 & + \beta_3 \text{CEO Duality}_{i,t-1} \times \text{High-q Segment}_{j,i,t} + \beta_4 \text{Segment Controls}_{j,i,t} \\
 & + \beta_5 \text{Firm Controls}_{i,t-1} + \beta_6 \text{CEO Controls}_{i,t-1} + \varepsilon_{j,i,t}, \tag{1}
 \end{aligned}$$

where the dependent variable is the industry-adjusted investment of segment j at time t , defined as segment j 's capital expenditure-to-sales ratio minus the capital expenditure-to-sales ratio of the median peer-focused firm operating in the same three-digit SIC industry as segment j . Subscript i denotes the firm, and α_i and α_t are firm and year fixed-effects, respectively. Year fixed-effects control for changing economic and financing conditions through time. Firm fixed-effects help isolate intra-firm changes and allow us to better capture the sensitivity of segment investment to changes in the independent variable of interest. Firm fixed-effects also mitigate concerns about omitted variable biases due to time-invariant firm-level unobservable factors. It is also important to note that industry fixed-effects are indirectly controlled for using industry-adjusted segment variables.

The two independent variables of interest in Eq. (1) are *CEO Duality* and *High-q Segment*. *CEO Duality* is a dummy variable set equal to one for firm-years during which the CEO served also as the board chair, and zero otherwise. *High-q Segment* is a dummy variable set equal to one if the corresponding segment belongs to a high growth industry (high- q), and zero otherwise (low- q). Following Ahn *et al.* (2006) and Datta *et al.* (2009), a segment is classed as high- q if the Tobin's q of the median peer-focused firm in the corresponding three-digit SIC industry is greater than the sales-weighted average Tobin's q for the firm as a whole. To empirically investigate Hypothesis 1, we interact these two independent variables of interest (i.e., $CEO\ Duality \times High-q\ Segment$). A negative β_3 coefficient indicates that the capital allocation process in firms with CEO duality favours low- q over high- q segments, indicating the existence of inefficiencies in the capital allocation policy of the firm.⁴

The specification in Eq. (1) also controls for a large set of time-varying segment, firm, and CEO characteristics: *Segment Size*, the natural logarithm of the sales of the corresponding segment; *Relative Segment Size*, the segment's sales divided by the sum of sales across all segments of the firm; *Segment CF*, the industry-adjusted operating cash flow to sales ratio for the corresponding segment; *Other Segment CF*, the industry-adjusted operating cash flow to sales ratio for the firm's remaining segments; *Industry Tobin's q*, the Tobin's q ratio of the median peer-focused firm in the three-digit SIC code industry for the corresponding segment; *Institutional Own*, the proportion of institutional ownership in the firm's ownership structure; *Firm risk*, the variance of the firm's monthly excess stock returns during the fiscal year; *CEO Tenure*, the natural logarithm of one plus the length of time between the date when the person became the CEO and the current fiscal year end; and *CEO Own*, the proportion of CEO ownership in the firm. Detailed variable definitions are provided in the Appendix. To avoid

⁴ In our empirical framework, underinvestment in high- q segments is a measure of agency cost due to having CEO duality. This is captured by a negative β_3 coefficient in Eq. (1). The more negative β_3 , the higher the agency cost associated with CEO duality. The study by Ang *et al.* (2000) also relies on efficiency ratios as a measure for agency costs, but its focus is on operating expenses and efficient use of assets, while we focus on the efficiency of cross-segment capital allocation.

potential problems with outliers, all continuous variables are winsorized at the 1st and 99th percentiles of their distributions. We report robust standard errors that are heteroskedasticity-consistent and clustered at the firm level. Firm- and CEO-level right-hand side variables are lagged by one-period, to alleviate the concern that CEO duality and the firm's investment policy may be simultaneously determined in equilibrium.

3.2.2. Moderating attributes

Our study aims to shed light on whether the internal capital allocation policy is inefficient in firms characterized as facing potentially high agency problems. Empirically this is done by conditioning the regression coefficient of interest, β_3 , in Eq. (1), on prominent firm-specific and CEO-specific variables known to be correlated with agency issues, and therefore by capturing the potential misalignment of interests between the CEO and the shareholders. Such investigation is also in the spirit of recent studies probing for more research that considers moderating attributes that might alter the strength or direction of the relationship (see, for example, Krause *et al.*, 2014).

The first moderating attribute considered is the firm's free cash flow (*Free Cash Flow*). Firms with high free cash flow are associated with potentially severe agency problems, particularly in the presence of a powerful CEO (Jensen, 1986). Free cash flow is calculated as income before extraordinary items plus depreciation expense scaled by total assets.

Next, we rely on two important board characteristics known to be correlated with weak board monitoring and CEO entrenchment: board independence and staggered board (see, for example, Fama and Jensen, 1983; Weisbach, 1988; Bebchuk *et al.*, 2002). Board independence (*Board Independence*) is measured using the proportion of outside directors in a firm's board of directors. Staggered board (*Staggered Board*) is a dummy variable set equal to one in cases where not all members of the board are elected at the same time, and zero otherwise.

Following Jensen and Murphy (1990), we consider equity-based compensation as another moderating attribute, since its use can be an effective tool for aligning the interests of managers and shareholders by exposing managers' wealth to their firms' stock prices. To capture this, we use the CEO's *Incentive Ratio* as in Bergstresser and Philippon (2006), and the *Delta* as in Core and Guay (2002). The *Incentive Ratio* is calculated such that it captures the share of a hypothetical CEO's total compensation that would come from a 1% increase in the value of the equity of their company. The *Delta* gives the CEO's option portfolio price sensitivity estimated as the change in the risk-neutral value of the executive's portfolio for a 1% change in the price of the underlying stock. As such, the higher (lower) the *Incentive Ratio* or *Delta*, the more (less) sensitive the CEO's compensation to a change in the firm's stock price, implying potentially lower (higher) agency costs.

All the moderating attributes are measured with a one-year lag relative to the internal capital allocation policy, to ensure that the attributes are not affected by the investment decision. Detailed definitions of all the moderating variables appear in the Appendix.

3.3. Descriptive statistics

Table 1 presents summary statistics on CEO and firm characteristics in Panel A, and on segment characteristics in Panel B. The proportion of firm-year observations with CEO duality is 67% in our sample, a proportion similar to that reported by Yang and Zhao (2014). The average tenure of the CEOs is 7.6 years and the average CEO is about 57 years old, figures similar to those reported in Andreou *et al.* (2017b). Institutional investors own on average 37% of the firm's equity capital, while the CEO owns slightly less than 3%.

At the segment-level, the average industry-adjusted investment is 0.5%, close to the magnitude reported by Rajan *et al.* (2000) and Ahn *et al.* (2006). The mean size of the segment is about 456 million USD, the average segment generates about 34% of the firm's sales, and the industry-adjusted ratio of cash flows to sales exhibits a mean of 15.4%, while the same ratio

for the firm's remaining segments is 16.2%. Finally, the industry Tobin's q displays a mean of 1.54, and about 49% of a firm's segments are classified as having high- q growth opportunities.

[Table 1 here]

Table 2 reports the correlation matrix for the variables considered. Most variables correlate with CEO duality and exhibit the expected sign. For example, under the agency view, Shleifer and Vishny (1989) and Jensen (1986) imply that CEO duality should be pronounced for bigger firms (correlation with *Segment Size* is 0.177, p -value <0.01), Amihud and Lev (1981) suggest that CEO duality firms show a tendency to reduce their own risk (correlation with *Firm Risk* is -0.083, p -value <0.01 , and *CEO Own* is -0.011, p -value <0.10), and as suggested by Jensen and Murphy (1990), such firms engage in self-interested actions at the expense of shareholders to reap private benefits and thus destruct value (correlation with *Industry Tobin's q* is -0.019, p -value <0.01). Further, it is evident that none of the correlations is high enough to raise concerns over multicollinearity.⁵

[Table 2 here]

4. Empirical findings

4.1. Baseline specification

In the context of diversified firms, an efficient internal capital allocation policy prioritizes business segments with high growth opportunities (high- q segments) in directing its resources (Rajan *et al.*, 2000). To examine the relation between CEO duality and internal capital allocation efficiency, Table 3 reports the estimation results of Eq. (1).

Model (1) investigates a specification without the interaction term (*CEO Duality* \times *High- q Segment*), whereby the coefficient estimate of *CEO Duality* is equal to 0.005 (p -

⁵ We rely on the variance inflation factor (VIF) to identify the presence of multicollinearity among the predictors of all the regression models. All the predictors in Eq. (1) have a VIF that is in principle lower than 3.9, which indicates the absence of severe multicollinearity issues in our models.

value <0.05). This indicates that firms following a CEO-Chair leadership structure in year $t-1$ on average increase their industry-adjusted segment investment by 0.5% over the next year. Overall, model (1) suggests that firms with CEO duality overinvest, relative to firms in which these roles are held by different individuals. This result alone squares with agency theory, supporting the view that diversified firms appear to incubate entrenched managers who engage in self-interested investments at the expense of shareholders to reap private benefits by overinvesting and growing their firms beyond their optimal size (Jensen and Meckling, 1976; Aggarwal and Samwick, 2003).

In model (2), the coefficient estimate of *CEO Duality* measures the effect of CEO duality on investment in low- q segments, while the interaction term measures the differential impact of CEO duality on investment in high- q segments. The coefficient estimate of *CEO Duality* is equal to 0.01 (p -value <0.01) and shows that the overinvestment pattern identified in model (1) is mainly concentrated in low- q segments. The coefficient of the *CEO Duality* \times *High- q Segment* (i.e., coefficient β_3 in Eq. (1)), which is equal to -0.009 (p -value <0.05), shows that firms with CEO duality fail to give priority to high- q segments in their capital allocation policy, a result which lends support to Hypothesis 1. As such, our findings contradict the efficient internal capital markets paradigm (see, for example, Stein, 1997; Shin and Stulz, 1998), according to which diversified firms should channel corporate resources first to divisions with high growth opportunities, which can add value. The findings also suggest that part of the observed investment inefficiency documented in prior studies (for example, Rajan *et al.*, 2000; Ahn *et al.*, 2006; Datta *et al.*, 2009; Hovakimian, 2011; Duchin and Sosyura, 2013) stems from the increased power and the self-interested internal investment behaviour associated with CEO duality.⁶

⁶ These results remain unchanged under different treatments, in particular where: (i) instead the industry is defined at the four-digit SIC, (ii) the models are re-estimated by excluding crisis-years 2001 and 2007-2008, (iii) CEO turnover threat effects are controlled for by using a dummy variable that is set equal to one when there is a change in a firm's CEO in the leading year, and zero otherwise, and (iv) CEO age-related voluntary turnover is controlled for by using a dummy variable that takes the value of one if the CEO is of age 65 or above, and zero otherwise.

To assess the robustness of our baseline findings, in model (3) we replace the firm fixed-effects with random-effects that allow for random differences in segment investment across firms. This specification makes use of both time-series and cross-sectional variations, and controls for the effect of unobservable firm heterogeneity on segment investment. Importantly, model (3) shows that the main findings are insensitive to the way we control for unobservable firm heterogeneity.

Another empirical issue we tackle is the potential endogeneity in the relation between CEO duality and investment efficiency. The firm's internal capital allocation policy may be both a result of CEO duality and itself a determinant of the firm's decision to adopt CEO duality.⁷ To account for the possibility of an endogenous relationship between CEO duality and investment efficiency, we use an instrumental variable (IV) approach to estimate the main regression equation using two-stage least squares. To implement the IV approach, we need instruments that are correlated with CEO duality (i.e., the relevance criterion), and concurrently are exogenous to the investment decision (i.e., the exclusion criterion). To instrument CEO duality, we use CEO age, as well as a dummy variable that takes a value of one if the CEO's age is greater than the industry mean age in the same three-digit SIC industry for a given year, and zero otherwise. Our two instruments are valid in the sense that they satisfy both the relevance and exclusion criteria: (i) it is highly probable that CEO duality is significantly and positively related to CEO age (Linck *et al.*, 2008; Yang and Zhao, 2014); (ii) to the best of our knowledge, there is no evidence showing that CEO age directly affects the internal capital allocation efficiency. Models (4) and (5) in Table 3 display the results from the second-stage IV estimation, with CEO age and the CEO age dummy as instruments, respectively. Consistent with our initial results, in both models the positive and significant impact of CEO duality on

⁷ However, it is important to emphasize that Iyengar and Zampelli (2009) find no evidence that CEO duality is a structure intentionally chosen to optimize firm performance; if the firm chooses a dual leadership regime, the reason for this choice is not performance-related.

segment investment persists (p -value <0.05 and p -value <0.10 , respectively). The interaction term also remains negative and highly significant (p -value <0.05 in both models). Therefore, the IV approach lends further credence to the notion that CEO duality adversely affects the internal capital allocation efficiency in diversified firms.⁸

The study has thus far provided strong evidence regarding the adverse impact of CEO duality on investment efficiency at the *segment level*. As further analysis, we investigate whether the segment-level investment inefficiency transpires in investment misallocations aggregated at the firm level, using two overall measures of efficiency. First, following Ahn and Denis (2004), we compute the relative investment efficiency (*RINV*), which accounts for a firm's capital allocations across all the segments it operates in, by measuring whether (or not) allocations toward the relatively high- q segments outweigh allocations to its relatively low- q . Second, we follow Rajan *et al.* (2000) (see also Ahn *et al.* (2006) and Datta *et al.*, 2009) in computing an overall measure of value added by capital allocations, namely relative value added (*RVA*). In essence, *RVA* postulates that firm value is created when segments with better growth opportunities than those that the firm is facing as a whole receive relatively more resources compared to segments with inferior growth opportunities than those that the firm is facing as a whole. The use of *RINV* and *RVA* as dependent variables allows us to discern at the *firm level* the impact of CEO duality on, respectively, the firm's investment efficiency and the

⁸ Following the suggestion of two anonymous referees, we conduct additional endogeneity tests. First, we employ the Herfindahl-Hirschman index (HHI) as an instrument to proxy for weak governance in a firm (see, for example, Chhaochharia *et al.*, 2016; Gu, 2016) that could increase the likelihood of observing CEO duality. HHI is computed for each of the 48 Fama and French (1997) industries based on the firms in the Compustat universe following the estimation scheme in Giroud and Mueller (2011). Second, Elsayed (2010) suggests that corporate leadership structure must be viewed as a dynamic process, contingent on the context, actors and time. In this vein, we simultaneously use firm size and age to instrument CEO duality. Consistent with the other IV estimations presented in Table 3, for both abovementioned tests, the interaction term (*CEO Duality* \times *High- q Segment*) remains negative and significant (p -value <0.10 , or better). Third, we estimate a system GMM in the spirit of Abdallah *et al.* (2015) to find again that the interaction term remains negative and significant (p -value <0.05).

resulting value creation.⁹ Like the segment-level evidence, these findings show strong negative relations between CEO duality and these two firm-level measures.

Taking all the evidence together, both segment- and firm-level analyses provide strong empirical support for Hypothesis 1 as we demonstrate that CEO duality leads to the allocation of relatively more capital to low- q than high- q segments, which substantiate severe internal capital allocation inefficiencies.

4.2. Moderating effects

If CEO duality leads to investment inefficiency on average, are there also factors that can exacerbate or mitigate its impact? Do shareholders of firms with potentially high agency issues suffer more from the existence of CEO duality in the context of cross-segment capital allocation? Does equity-based compensation attenuate the adverse effect of CEO duality on investment efficiency? This subsection provides answers to these questions by examining the moderating role of firm-specific and CEO-specific variables known to be correlated with the severity of agency problems within the firm.

We first consider a firm's *Free Cash Flow* and two important board characteristics, namely, *Staggered Board* and *Board Independence*, as moderating variables for the relation between CEO duality and the efficiency of internal capital allocation. Next, we rely on the *Incentive Ratio* and *Delta* of the CEO's compensation package as proxies for the importance of equity-based compensation as an incentive mechanism. With the help of each of these variables as measured in year $t-1$, we split the sample into two subsamples that characterize firm context with potentially *high* and *low* agency problems, respectively. Then for each of these subsamples, we estimate the specification in Eq. (1) and report the results in Tables 4 and 5.

⁹ Due to space limitations, detailed descriptions of the *RINV* and *RVA* measures, as well as the model specifications and results are included in the online appendix.

Models (1) and (2) in Table 4 report on the subsample of firms with high (above the yearly median value) and low (below the yearly median value) free cash flows, respectively. Models (3) and (4) report on the subsample of firms with and without a staggered board structure, respectively. Models (5) and (6) report on the subsample of firms with a low (below the yearly median value) and high (above the yearly median value) percentage of independent board members, respectively. High free cash flow, the existence of staggered board, and low board independence denote firm contexts with potentially high agency problems, and it is in these firms that we expect the adverse effect of CEO duality on investment efficiency to be more substantial.

[Table 4 here]

Table 4 shows that the positive effect of CEO duality on segment overinvestment tendency prevails only in models (1), (3), and (5). These are the subsamples of observations with potentially high agency problems. Likewise, the coefficient of *CEO Duality* \times *High-q Segment* is negative and statistically significant (p -values <0.05) only in these models. For instance, as depicted in model (1), firms with high free cash flows that feature CEO duality in year $t-1$ decrease their industry-adjusted investment in high- q segments by 1.0% over the next year, relative to their industry-adjusted investment in low- q segments. Likewise, as shown in model (3), firms with staggered board structure reduce their investment in high- q segments by 2.1%, whereas as per model (5) the reduction in high- q is 1.2% in the case of firms with low board independence. Both *CEO Duality* and *CEO Duality* \times *High-q Segment* are not statistically significant in models (2), (4), and (6), which are the subsamples of firms with potentially low agency problems. These results emphasize that low free cash flows, the absence of staggered board structure, and high board independence are all firm contexts that are beneficial to the balance between strong leadership and better board monitoring.¹⁰ As such, they help to avoid

¹⁰ Further, we consider other measures of board governance that could influence board monitoring, particularly board size, gender diversity and the complexity of corporate structure. We re-estimate our baseline model for the

situations according to which powerful CEOs can extract private benefits through misallocating corporate resources.

The low or high agency problems subsamples in Table 5 include observations below or above the yearly median values of, respectively, the *Incentive Ratio* in models (1) and (2), and *Delta* in models (3) and (4), as measured in year $t-1$. The results show that the negative impact of CEO duality on investment efficiency concentrates only in firms with potentially high agency problems, due to the absence of enough incentives (models (1) and (3) featuring low *Incentive Ratio* and low *Delta*, respectively), while the adverse impact of CEO duality on investment efficiency disappears in the subsample of firms with potentially low agency problems (models (2) and (4) featuring high *Incentive Ratio* and high *Delta*, respectively). In general, these findings follow in spirit those of Table 4, whereby the positive coefficients of *CEO Duality* reveal a clear tendency of over-investments in low- q segments, while the negative coefficients of *CEO Duality* \times *High- q Segment* offer strong evidence of under-investments in high- q segments. Overall, there is compelling evidence that the existence of agency problems allows CEO duality to manifest rent-seeking behaviours that erode a firm's internal investment efficiency, even though equity-based compensation can be effective in mitigating such inefficiencies.

[Table 5 here]

subsamples of firms with *small vs. large* board size, *no females on board vs. at least one female on board* and *simple vs. complex corporate structure*. Our expectation is that larger boards, no females on board and complex firms would associate with poorer monitoring and thus weaker corporate governance structures that accentuate agency problems. Unreported results reveal a negative relation between CEO duality and investment efficiency for the subsample of firms with a large board; however, this relation is not statistically significant. A finer slicing of the data between small-, medium- and large-sized boards reveals a negative relation between CEO duality and investment efficiency only for firms with medium-sized boards (hence giving rise to a U-shape relationship). The results also reveal a weak negative relation (p -value <0.10) between CEO duality and investment efficiency only for the subsample of firms with no females on board. Finally, the results show a strong negative effect of CEO duality on investment efficiency only in the case of complex firms (p -value <0.01).

Collectively, the results of Tables 4 and 5 highlight the importance of firm contexts associated with high agency problems in moderating the negative effect of CEO duality on the internal capital allocation efficiency and provide strong support for Hypothesis 2. These findings also complement prior literature (see, for example, Finkelstein and D'Aveni, 1994; Rediker and Seth, 1995; Davidson *et al.*, 2004; Aguilera *et al.*, 2008; Duru *et al.*, 2016), as they offer additional evidence in support of the substitution hypothesis of internal corporate governance devices.

4.3. Additional moderating attributes

This subsection investigates additional attributes that might potentially moderate the relation between CEO duality and internal investment efficiency. The considered attributes are (i) CEO ability, (ii) CEO succession origin, and (iii) segment longevity, all measured in year $t-1$.¹¹ Table 6 reports the results.

The managerial ability index we use, which has been developed by Demerjian *et al.* (2012), relies on data envelopment analysis and measures managers' efficiency in generating revenues (see the Appendix for a description of the index construction). Intuitively, we expect CEO duality to promote strong leadership and to be more beneficial to firm value when the CEO also has high ability, as this is a situation where the manager has the least need to opt for rent-seeking behaviour.¹² This expectation is founded on two reasons. First, Demerjian *et al.* (2012) find that replacing CEOs with more able CEOs is associated with improvements in subsequent firm performance, whereas the reverse is true for less able CEOs. Second, Andreou *et al.* (2017a) find a strong positive relation between CEO ability and capital expenditures

¹¹ We thank an anonymous referee for suggesting these additional tests.

¹² Although the managerial ability index measures the ability of the whole management team, Demerjian *et al.* (2012) document that a substantial portion of the index variance is explained by CEO fixed-effects and as such can be used to quantify CEO managerial ability. In this regard, many subsequent studies have used this measure to investigate the effects of CEO managerial ability on different firm policies and outcomes (for example, Andreou *et al.*, 2017a).

during the crisis period, which remains robust in the presence of a large array of control variables capturing corporate governance attributes, executive compensation incentives and CEO characteristics. Taken together, their results are consistent with the view that high CEO ability helps to mitigate under-investment problems, which in turn increases firm value. To test this premise, models (1) and (2) of Table 6 report the results for the subsample of firms with low and high CEO ability, respectively. The low and high subsamples include observations below or above the yearly median values of the managerial ability index. Evidently, the negative effect of CEO duality on investment efficiency prevails only in model (1), indicating that powerful CEOs with low managerial ability are more inclined to develop entrenchment strategies, perhaps to hedge their employment risk and extract private benefits which they cannot otherwise achieve due to incompetency and mediocre talent.

We next assess whether the impact of CEO duality on investment efficiency relates to the CEO succession origin. Karaevli (2007) argues that externally hired CEOs are more likely to be performance- and change-oriented in comparison to internally promoted CEOs.¹³ In addition, internally hired CEOs, having strong ties within the firm and its business segments, might be more tempted to deviate from an efficiency-driven capital allocation process. This reasoning also resonates with the internal capital market efficiency literature, which aims to explain misallocation of resources and rent-payment by the CEO to the divisional managers, who receive unjustifiably more resource allocation for their divisions (Scharfstein and Stein, 2000; Rajan *et al.*, 2000; Duchin and Sosyura, 2013). We therefore expect the adverse effect of CEO duality to be prevalent particularly in the subsample of internally hired CEOs. In general, we classify a CEO as externally hired if the appointed CEO has tenure of fewer than 365 days in the firm (more details on the classification definition are provided in the Appendix.) Models

¹³ See also Georgakakis and Ruigrok (2017) for the performance effect of CEO succession origin. The authors propose an integrated multilevel framework that examines the conditions under which the benefits of outside CEO succession outweigh the costs.

(3) and (4) in Table 6 report respectively on internally and externally hired CEOs, where the interaction term (*CEO Duality* \times *High-q Segment*) in model (3) is negative and statistically significant (p -value <0.01). As expected, the results indicate that the inefficient internal capital allocation of powerful CEOs is due to the investment behaviour of internally hired CEOs.

Finally, we consider the longevity of the respective segment. It could be argued that powerful CEOs may find it more convenient for their own personal motives and risk reduction tendencies to invest in a long-lived segment, which has proved to survive through the years, rather than bearing the uncertainty related to younger segments, still unknown as to whether they will be able to survive and succeed in the long-run. It is also plausible that older divisions and their divisional managers may have more power and more say over the allocation process of the firm or could be better connected to the CEO (see Duchin and Sosyura, 2013, for similar arguments). Therefore, we expect to find more investment inefficiency in the allocation process in long-lived business segments. The results in models (5) and (6) offer support for these conjectures.

Overall, the results of Table 6 provide additional evidence that is broadly consistent with the agency view of the firm (Jensen and Meckling, 1976; Fama and Jensen, 1983; Shleifer and Vishny, 1989; Shin and Stulz, 1998; Scharfstein and Stein, 2000). CEOs' risk reduction, rent extraction, and entrenchment tendencies potentially explain the existence of inefficient allocation of internal capital in firms with CEO duality.¹⁴

¹⁴ A potential alternative explanation to this agency view, is the case of a dutiful CEO-Chair who may not be adequately effective in creating value through the capital allocation policy due to her involvement in other (non-executive related) tasks, such as fostering board and individual director effectiveness or offering their services to the board of other firms. Two reasons repudiate this explanation. First, the capital policy of a dutiful CEO-Chair should not necessarily result in severe (and systematic) misallocation, as also evidenced in our sample. This is what is expected under a responsible and well-functioning board, that is not dictated by a powerful CEO, which would take all necessary actions to separate the two roles (i.e., to demote the CEO-Chair role to a CEO only) if the CEO becomes overwhelmed with board-related duties. Second, an empirical investigation using the number of outside directorships, to proxy for dutiful CEOs who devote time to non-executive tasks outside their firms, reveals no significant relation difference between the capital allocation policies of dutiful vs non-dutiful CEOs who also chair the board of their firms.

5. Conclusion

Building on evidence from agency theory and strategic leadership literature, this study shows that CEO duality produces a governance context that may encourage CEOs to direct corporate resources inefficiently. Prior research on CEO duality has produced notable conflicting evidence, likely due to its rather monotonic focus on accounting or market-based performance outcomes. This study posits internal capital allocation in diversified firms as a potential channel through which CEO duality may negatively affect firm value.

This study offers compelling empirical evidence that CEO duality leads to investment decisions that are detrimental to overall firm value. The evidence of investment misallocation and inefficiency suggests that when board monitoring becomes weak (because power is concentrated in the hands of a sole agent) and external monitoring is trivial (because internal capital markets help the agent avoid monitoring from external markets), agency costs manifest, to the detriment of the firm's shareholders.

Two important points arise from this study. First, firm contexts associated with high agency problems exacerbate the adverse effect of CEO duality on the internal capital allocation efficiency. In this context, equity-based compensation is an important internal governance tool that has the potential to curb investment inefficiency in diversified firms with CEO duality. Second, unlike prior literature that focuses mainly on direct relations with firm performance metrics, this study provides an agency perspective on CEO duality pertaining to the internal capital allocation policy. The results of this study add to both the strategic leadership literature and internal capital markets literature, while also illustrating board structure and executive compensation as important moderators of the relation between CEO duality and investment efficiency in diversified firms.

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Appendix

Detailed variable definitions

Dependent variable (measured in year t)

Segment Investment: Industry-adjusted segment investment, defined as the segment's capital expenditure-to-sales ratio minus the capital expenditure-to-sales ratio of the median peer-focused firm operating in the same three-digit SIC industry as the segment (requiring at least five focused firms in the industry).

Firm-level independent variables (measured in year $t-1$)

CEO Duality: A dummy variable that takes the value of one for the firm-years that the CEO is also the chair of the board, and zero otherwise.

Institutional Own: The proportion of institutional ownership in the firm ownership structure, defined as the ratio of the number of common shares held by institutional investors to the total shares outstanding of the firm.

Firm risk: The variance of monthly stock returns of the firm minus the risk-free rate during the fiscal year. The risk-free rate is the US government security with a 1-year yield period.

CEO Tenure: The natural logarithm of one plus the length of time between the date when the person became the CEO and the current fiscal year end.

CEO Own: The proportion of CEO ownership in the firm ownership structure, defined as the ratio of the number of common shares held by the CEO to the total shares outstanding of the firm.

Segment-level independent variables (measured in year t)

Segment Size: The natural logarithm of the sales of the segment.

Relative Segment Size: Segment's sales divided by the sum of sales across all segments of the firm.

Segment CF: Industry-adjusted operating income to sales ratio for the corresponding segment (requiring at least five peer-focused firms in the industry).

Other Segment CF: Industry-adjusted operating income to sales ratio for the firm's remaining segments (requiring at least five peer-focused firms in the industry).

Industry Tobin's q : The Tobin's q of the median peer-focused firm in the three-digit SIC industry for the corresponding segment, with Tobin's q being equal to the market value of assets divided by the book value of assets (requiring at least five peer-focused firms in the industry).

High- q Segment: A dummy variable set equal to one if the Tobin's q of the median peer-focused firm in the segment's three-digit SIC industry is greater than the sales-weighted Tobin's q for

the firm as a whole, and zero otherwise (requiring at least five peer-focused firms in the industry).

Moderating Attributes (measured in year $t-1$)

Free Cash Flow: Calculated as income before extraordinary items plus depreciation expense scaled by total assets.

Staggered Board: In a given year, a firm has a staggered board if not all members of the board are elected at the same time.

Board Independence: Calculated as the percentage of independent/outside directors in the firm's board of directors.

Incentive Ratio: CEO's equity-based incentive ratio is estimated as in Bergstresser and Philippon (2006). The incentive measure is calculated such that it captures the share of a given CEO's total compensation that would result from a 1% increase in the value of the equity of his or her company. Specifically,

$$\text{Incentive Ratio} = \text{ONEPCT} / (\text{ONEPCT} + \text{SALARY} + \text{BONUS}),$$

where $\text{ONEPCT} = 0.01 * \text{PRICE} \times (\text{SHARES} + \text{OPTIONS})$; PRICE is the firm share price; SHARES is the number of shares held by the CEO; OPTIONS is the number of options held by the CEO; and SALARY and BONUS are the CEO salary and bonus, respectively.

Delta: A CEO's equity portfolio price sensitivity is estimated as the change in the risk-neutral value of the executive's portfolio for a 1% change in the price of the underlying stock. The parameters of the Black and Scholes formula follow the definitions as in Core and Guay (2002).

Managerial Ability: An index developed by Demerjian *et al.* (2012). The measure results from the use of data envelopment analysis (DEA), which calculates unit-specific relative efficiency to produce an estimate of how efficiently managers use their firms' resources. Because the efficiency measure generated by the DEA estimation is attributable to both the firm and the manager, Demerjian *et al.* (2012) purge the DEA-generated firm efficiency measure of key firm-specific characteristics that are expected to aid (firm size, market share, positive free cash flow, and firm age) or hinder the management's efforts (complex multi-segment and international operations). The residual efficiency resulting from a Tobit regression in the spirit of Demerjian *et al.* (2012) is the efficiency attributable to the management team of the firm.

Internally Promoted CEO: This dichotomous variable identifies firms with CEOs that are internally (or externally) promoted. Founder CEOs, and appointed CEOs who have tenure of at least 365 days in the firm are classified as internal. If the date of joining the firm is not available, then the CEO must have executive directorship tenure of at least one year to be classified as internally promoted.

Long-lived Business Segment: This dichotomous variable identifies business segments with a long (or short) life-span in the firm. Following Adelino *et al.* (2017), we use the cut-off point of five years to differentiate between long-lived and short-lived business segments. The age of the segment is the number of years the segment has been listed on the Compustat Industrial Segment (CIS) database.

Tables

Table 1. Descriptive Statistics

Variable	Mean	Minimum	Median	Maximum	St. Deviation
<i>Panel A. CEO and Firm Characteristics</i>					
CEO Duality	0.673	0.000	1.000	1.000	0.469
CEO Tenure	7.598	0.496	5.332	37.996	7.344
CEO Age	56.90	41.00	57.00	77.00	6.622
CEO Own	0.028	0.000	0.013	0.276	0.046
Institutional Own	0.368	0.000	0.353	1.000	0.183
Firm Risk	0.014	0.001	0.008	0.311	0.023
<i>Panel B. Segment Characteristics</i>					
Segment Investment	0.005	-0.402	-0.001	0.495	0.091
Segment Size	6.122	-1.269	6.177	9.707	1.731
Relative Segment Size	0.341	0.000	0.274	0.998	0.257
Segment CF	0.154	-1.185	0.145	0.836	0.194
Other Segment CF	0.162	-0.975	0.151	0.673	0.131
Industry Tobin's q	1.539	0.851	1.386	4.860	0.560
High-q Segment	0.489	0.000	0.000	1.000	0.499

Notes. This table reports the summary statistics on the CEO, firm, and segment variables used in the analyses. The sample covers the period 1992-2013 and is made up of 10,740 segment-year observations. Segment-level variables are measured in year t , and CEO- and firm-level variables in year $t-1$. The definitions of all the variables are provided in the Appendix.

Table 2. Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9	10	11
1. CEO Duality											
2. Segment Investment	-0.004										
3. Segment Size	0.177***	-0.013***									
4. Relative Segment Size	0.005	-0.048***	0.220***								
5. Segment CF	0.021***	-0.012**	0.252***	0.047***							
6. Other Segment CF	0.016**	0.013***	0.195***	-0.145***	0.265***						
7. Industry Tobin's q	-0.019***	-0.002	-0.132***	-0.013***	-0.043***	-0.026***					
8. High-q Segment	-0.008	-0.017***	-0.051***	-0.042***	-0.015***	0.001	0.431***				
9. Institutional Own	0.023***	0.016***	-0.119***	0.020***	-0.046***	-0.045***	-0.028***	0.003			
10. Firm Risk	-0.083***	-0.014***	-0.320***	0.053***	-0.175***	-0.209***	0.063***	0.005	0.011*		
11. CEO Tenure	0.210***	0.004	-0.083***	-0.001	-0.036***	-0.024***	0.041***	0.009	0.001	0.145***	
12. CEO Own	-0.011*	-0.001	-0.005	0.001	0.01	0.015**	-0.004	-0.004	-0.003	-0.001	-0.005

Notes. All the variable definitions are provided in the Appendix. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 3. CEO duality and internal capital allocation efficiency

	(1)	(2)	(3)	(4)	(5)
	Fixed Effects		Random Effects	Instrumental Variable (IV)	
Segment Size	-0.017*** (0.004)	-0.017*** (0.004)	-0.007*** (0.001)	-0.019*** (0.005)	-0.019*** (0.005)
Relative Segment Size	0.045*** (0.013)	0.045*** (0.013)	0.011** (0.005)	0.052*** (0.014)	0.051*** (0.015)
Segment CF	-0.025 (0.019)	-0.025 (0.012)	-0.025*** (0.005)	-0.025 (0.019)	-0.025 (0.019)
Other Segment CF	-0.001 (0.022)	-0.001 (0.022)	0.008 (0.008)	-0.005 (0.022)	-0.004 (0.022)
Industry Tobin's q	0.001 (0.002)	0.001 (0.002)	0.003 (0.002)	0.001 (0.002)	0.002 (0.002)
High-q Segment	-0.003 (0.003)	0.003 (0.004)	0.002 (0.003)	0.015 (0.009)	0.015 (0.010)
Institutional Own	0.002 (0.008)	0.002 (0.008)	-0.009 (0.008)	0.006 (0.009)	0.006 (0.009)
Firm Risk	-0.053 (0.042)	-0.053 (0.042)	-0.067 (0.053)	-0.039 (0.043)	-0.038 (0.043)
CEO Tenure	0.001 (0.001)	0.001 (0.002)	0.001 (0.001)	-0.004 (0.003)	-0.004 (0.004)
CEO Own	0.026 (0.040)	0.027 (0.041)	-0.020 (0.027)	0.001 (0.000)	0.001 (0.000)
CEO Duality	0.005** (0.002)	0.010*** (0.003)	0.008** (0.003)	0.052** (0.024)	0.049* (0.028)
CEO Duality × High-q Segment		-0.009** (0.005)	-0.009*** (0.004)	-0.028** (0.013)	-0.028** (0.013)
N	10,740	10,740	10,740	10,687	10,687
R ²	0.239	0.239	0.213	0.239	0.239

Notes. This table reports segment investment regression results for the years 1992-2013. Models (1) and (2) present the results with firm and year fixed-effects, while model (3) presents the results with random effects. Models (4) and (5) present the results from the second-stage estimation of the instrument variable (IV) approach. In model (4) the IV analysis instruments CEO duality using the natural logarithm of CEO age, while a dummy variable that takes a value of one if the age of the CEO is higher than industry mean age in a given year, and zero otherwise is utilized as the instrument in model (5). In all specifications, the dependent variable is the industry-adjusted segment investment in fiscal year t . Segment-level variables are measured in year t , and CEO- and firm-level variables in fiscal year $t-1$. All variable definitions are provided in the Appendix. Regression models are estimated with year fixed-effects. Robust standard errors that are heteroskedasticity-consistent and clustered at the firm level are reported in parentheses. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 4. CEO duality and internal capital allocation efficiency: The moderating role of free cash flow, staggered board, and board independence

	(1)	(2)	(3)	(4)	(5)	(6)
	Free Cash Flow		Staggered Board		Board Independence	
	High	Low	Yes	No	Low	High
Segment size	-0.021*** (0.006)	-0.014** (0.007)	-0.018*** (0.003)	-0.022*** (0.003)	-0.023*** (0.003)	-0.018*** (0.003)
Relative Segment Size	0.072*** (0.017)	0.022 (0.022)	0.054*** (0.013)	0.079*** (0.014)	0.078*** (0.012)	0.035*** (0.012)
Segment CF	-0.034 (0.023)	-0.014 (0.029)	0.020** (0.010)	0.003 (0.011)	-0.063*** (0.009)	-0.002 (0.009)
Other Segment CF	0.019 (0.038)	-0.036* (0.021)	0.047** (0.019)	-0.037** (0.018)	-0.031* (0.016)	0.019 (0.018)
Industry Tobin's q	-0.001 (0.003)	0.001 (0.005)	-0.003 (0.004)	-0.001 (0.005)	-0.009** (0.004)	0.008** (0.004)
High-q Segment	0.004 (0.005)	0.005 (0.008)	0.012** (0.006)	0.005 (0.007)	0.010* (0.005)	-0.006 (0.006)
Institutional Own	0.004 (0.009)	0.012 (0.018)	0.017 (0.018)	0.015 (0.024)	0.030* (0.018)	-0.027 (0.018)
Firm Risk	-0.100** (0.049)	-0.007 (0.069)	-0.170 (0.126)	0.014 (0.147)	-0.154 (0.118)	0.063 (0.097)
CEO Tenure	-0.001 (0.002)	-0.002 (0.002)	0.002 (0.002)	0.001 (0.003)	-0.002 (0.003)	-0.003 (0.002)
CEO Own	-0.024 (0.043)	-0.014 (0.063)	-0.008 (0.085)	-0.088 (0.118)	-0.021 (0.069)	0.123 (0.104)
CEO Duality	0.017*** (0.005)	0.004 (0.006)	0.011* (0.007)	0.011 (0.008)	0.019*** (0.007)	0.006 (0.007)
CEO Duality × High-q Segment	-0.010** (0.005)	-0.010 (0.008)	-0.021*** (0.006)	-0.004 (0.008)	-0.012** (0.006)	-0.001 (0.007)
N	6,774	3,966	3,068	2,109	2,911	3,093
R ²	0.295	0.263	0.305	0.314	0.350	0.330

Notes. This table reports segment investment regression results for the years 1992-2013. Models (1) and (2) report the results for the subsamples of firms that have high and low free cash flows, respectively. These high and low subsamples are formed based on the yearly median values of the *Free Cash Flow* variable in fiscal year $t-1$. Models (3) and (4) report the results for the subsamples of firms based on whether or not the firm has a staggered board in fiscal year $t-1$. Models (5) and (6) report the results for the subsamples of firms based on whether the firm has a low or high percentage of independent board members, respectively. The high and low subsamples are formed based on the yearly median values of the percentage of independent board members in fiscal year $t-1$. In all the model specifications, the dependent variable is the industry-adjusted segment investment in fiscal year t . Segment-level variables are measured in fiscal year t , and CEO- and firm-level variables in fiscal year $t-1$. All variable definitions are provided in the Appendix. Regression models are estimated with year and firm fixed-effects. Robust standard errors that are heteroskedasticity-consistent and clustered at the firm level are reported in parentheses. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 5. CEO duality and internal capital allocation efficiency: The moderating role of CEO equity-based compensation

	(1)		(2)		(3)		(4)	
	Incentive Ratio		Delta		Low		High	
	Low	High	Low	High	Low	High	Low	High
Segment size	-0.018*** (0.006)	-0.017*** (0.006)	-0.022*** (0.006)	-0.012*** (0.005)				
Relative Segment Size	0.049** (0.020)	0.047** (0.019)	0.057*** (0.020)	0.035** (0.016)				
Segment CF	-0.018 (0.030)	-0.033 (0.021)	-0.008 (0.030)	-0.056*** (0.018)				
Other Segment CF	0.019 (0.022)	-0.021 (0.041)	-0.019 (0.024)	0.003 (0.036)				
Industry Tobin's q	0.003 (0.003)	0.001 (0.004)	0.001 (0.003)	0.001 (0.004)				
High-q Segment	0.007 (0.005)	0.001 (0.006)	0.003 (0.005)	0.003 (0.005)				
Institutional Own	0.005 (0.012)	-0.003 (0.013)	0.002 (0.013)	0.010 (0.011)				
Firm Risk	-0.093 (0.070)	-0.017 (0.056)	-0.080 (0.060)	0.002 (0.077)				
CEO Tenure	-0.001 (0.002)	0.003* (0.002)	-0.001 (0.002)	0.002 (0.002)				
CEO Own	-0.041 (0.053)	0.064 (0.077)	0.061 (0.093)	0.035 (0.043)				
CEO Duality	0.016*** (0.005)	0.002 (0.005)	0.013** (0.005)	0.004 (0.004)				
CEO Duality × High-q Segment	-0.017*** (0.007)	-0.004 (0.006)	-0.012* (0.007)	-0.007 (0.005)				
N	5,389	5,351	5,229	5,511				
R ²	0.242	0.298	0.255	0.285				

Notes. This table reports segment investment regression results for the years 1992-2013. Models (1) and (2) use the *Incentive Ratio* variable, which captures the share of the CEO's total compensation that comes from a 1% increase in the firm stock price, while models (3) and (4) use the CEO's equity portfolio price sensitivity, denoted *Delta*, which is estimated as the change in the risk-neutral value of the executive's equity portfolio for a 1% change in the price of the underlying stock. The low and high subsamples include firms below and above the yearly median values of the corresponding variable, respectively, as measured in fiscal year $t-1$. In all model specifications, the dependent variable is the industry-adjusted segment investment in fiscal year t . Segment-level variables are measure in fiscal year t whereas CEO- and firm-level variables in fiscal year $t-1$. All variable definitions are given in the Appendix. Regression models are estimated with year and firm fixed-effects. Robust standard errors that are heteroskedasticity-consistent and clustered at the firm level are reported in parentheses. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 6. CEO duality and internal capital allocation efficiency: Additional results with moderating attributes

	(1)	(2)	(3)	(4)	(5)	(6)
	Low Managerial Ability	High Managerial Ability	Internally Promoted CEO	Externally Promoted CEO	Long-lived Business Segment	Short-lived Business Segment
Segment size	-0.014*** (0.002)	-0.010*** (0.002)	-0.021*** (0.005)	-0.020* (0.011)	-0.021** (0.009)	-0.012** (0.006)
Relative Segment Size	0.036*** (0.009)	0.048*** (0.008)	0.067*** (0.017)	0.065** (0.031)	0.067*** (0.025)	0.035* (0.019)
Segment CF	-0.076*** (0.007)	-0.058*** (0.007)	-0.016 (0.024)	-0.021 (0.041)	0.028 (0.035)	-0.068*** (0.023)
Other Segment CF	0.025** (0.012)	-0.021* (0.012)	0.022 (0.028)	-0.016 (0.033)	0.019 (0.039)	-0.024 (0.027)
Industry Tobin's q	-0.001 (0.003)	0.001 (0.003)	-0.001 (0.003)	0.010 (0.006)	-0.006 (0.004)	0.001 (0.003)
High-q Segment	0.011*** (0.004)	-0.001 (0.003)	0.009 (0.006)	-0.003 (0.009)	0.008 (0.007)	-0.002 (0.004)
Institutional Own	0.018 (0.012)	-0.005 (0.011)	0.010 (0.012)	-0.006 (0.021)	-0.011 (0.018)	-0.003 (0.012)
Firm Risk	-0.108 (0.071)	-0.029 (0.070)	-0.082 (0.067)	0.018 (0.065)	0.026 (0.060)	-0.014 (0.059)
CEO Tenure	0.001 (0.002)	-0.002 (0.002)	0.001 (0.002)	0.004 (0.004)	0.001 (0.002)	-0.002 (0.003)
CEO Own	-0.026 (0.043)	0.060 (0.053)	-0.027 (0.062)	-0.035 (0.106)	-0.097 (0.086)	0.083** (0.038)
CEO Duality	0.007** (0.004)	0.016*** (0.004)	0.012*** (0.004)	0.024* (0.013)	0.008 (0.005)	0.009* (0.006)
CEO Duality × High-q Segment	-0.017*** (0.005)	-0.003 (0.004)	-0.016*** (0.006)	-0.008 (0.010)	-0.015** (0.007)	-0.003 (0.005)
N	4,149	5,253	6,804	2,269	3,845	4,900
R ²	0.316	0.318	0.279	0.295	0.271	0.263

Notes. This table reports segment investment regression results for the years 1992-2013. Models (1) and (2) report the results for the subsamples of firms with low and high managerial ability in fiscal year $t-1$, which are firms below and above the yearly median values of the managerial ability index of Demerjian et al. (2012), respectively. Models (3) and (4) report the results for the subsamples of firms with CEOs that are internally promoted and CEOs that are externally promoted, respectively. Models (5) and (6) report the results for the subsamples of firms with segments that are newer to the firm (age of five years or younger) and segments that are older to the firm (five years and older), respectively. In all the model specifications, the dependent variable is the industry-adjusted segment investment in fiscal year t . Segment-level variables are measured in fiscal year t , and CEO- and firm-level variables in fiscal year $t-1$. All variable definitions are given in the Appendix. Regression models are estimated with year and firm fixed-effects. Robust standard errors that are heteroskedasticity-consistent and clustered at the firm level are reported in parentheses. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.