

CEO Duality, Agency Costs, and Internal Capital Allocations

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Abstract

This study examines the impact of CEO duality on investment allocation efficiency and firm value. When a CEO is also the chair of the board, the firm makes relatively more investments in business segments with low growth opportunities than do firms in which these roles are held by different individuals. Such capital (mis)allocations violate the internal capital market efficiency tenet, exhibiting negative overall value consequences. However, the adverse impact of CEO duality on investment efficiency and value prevails only in firms with low CEO compensation incentives. Overall, the findings of this study indicate that the capital allocation process is an important channel through which CEO duality lowers firm value, and compensation incentives are an important internal device to mitigate this negative value effect.

Keywords: CEO duality; Agency costs; Capital allocation; Investment efficiency.
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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 (Dalton *et al.*, 2007; Finkelstein *et al.*, 2009). 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 has continued to receive considerable attention from both practitioners and academics (see, e.g., 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; Yang and Zhao, 2014). While the global financial crisis triggered a wave of proposals to eliminate CEO duality and achieve independent board leadership, corporate leaders and associations 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, the majority of firms in Standard & Poor’s Execucomp continue to be governed by dual CEOs. During 1992–2013, the percentage of firms with dual CEO-chair roles at times reached as high as 64% and rarely dropped below 50%.

Academic research on CEO duality is equally unsettled. 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 (Dalton *et al.*, 2007). 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 variables that might alter the strength or direction of the relationship and mediating variables that can explain the channels through which the relationship occurs. Instead, extant literature mainly focuses on the performance implications of CEO duality,

neglecting any impact on corporate policies. The current study therefore seeks to investigate the impact of CEO duality on capital allocations and the associated firm value consequences deriving from this corporate policy.

Specifically, this study examines the investment efficiency implications of CEO duality and the valuation consequences of these investments. A sample of diversified U.S. firms over the period 1992–2013 provides compelling empirical evidence that CEO duality can have detrimental effects on the internal allocation of capital, causing overall losses in firm value. Prior literature has failed to consider the channel(s) through which CEO duality affects firm value; this study contributes to strategic leadership literature by identifying a pathway by which CEO duality affects firm value through engaging in unprofitable allocation of investment. Furthermore, this study addresses the valuation consequences of investments by specifically adopting a model that considers the value added to the firm by its investment activity, avoiding generic performance measures that refer to types of firm efficiency other than investments. In addition, the results underscore the significance of CEO compensation as an important agency risk moderator and suggest that the adverse impact of CEO duality on investment efficiency and value occurs only in environments that feature accentuated agency costs.

The remainder of the paper is organized as follows. Section 2 details relevant literature to provide a foundation for the testable hypotheses, pertaining to the relations among CEO duality, investment allocation, and the efficiency of investment allocation. 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 hypothesis development

2.1. Theoretical perspective on CEO duality

The dichotomous nature of duality reflects two central theoretical perspectives for examining CEO and board relationships: agency and stewardship theories (Fama and Jensen, 1983; Eisenhardt, 1989a,b; Donaldson and Davis, 1991). On the one hand, agency theory predicts that agents commit to opportunistic behaviour and indulge in excessive benefits for themselves, at the expense of shareholder interests. The board of directors is responsible for monitoring the CEO. Agency theory also predicts that insider directors act as negative catalysts on the board's ability to monitor the CEO objectively. In this view, CEO duality is undesirable, because it grants excess power to a single executive, entrenching the CEO and negatively affecting performance (Fama and Jensen, 1983; Eisenhardt, 1989a,b). This perspective appears widely supported by practitioners and a growing group of scholars who propose CEO and chair separation, arguing that CEO duality weakens corporate governance and that a conflict of interest is unavoidable when a CEO chairs the board (Iannelli, 2013).

On the other hand, stewardship theory asserts that the role of the CEO as the chair of the board ensures cohesive leadership, signals firm stability, and inspires confidence in firm management (Anderson and Anthony, 1986). As Donaldson and Davis (1991) and Finkelstein and D'Aveni (1994) emphasize, expertise and knowledge can result from CEO duality, along with faster decision making and status rewards for executives. Therefore, a critical implication of stewardship theory is that duality in the CEO and chair of the board positions is desirable, because it enhances firm performance by reducing costs and the inefficiencies that can result from the separation of the two roles.

2.2. CEO duality and firm performance

The impact of CEO duality on firm performance also has received increased attention in management literature. Noting the complexity and conflicting nature of the effects of CEO

duality on firm performance, Rechner and Dalton (1989) attempted to compare the shareholder returns of firms with and without dual CEO roles, but this early study uncovered no significant differences over the entire period under investigation. Even more notably, no such differences arise in any given year, in the form of higher or lower abnormal returns. Rechner and Dalton (1991) then sought to focus on accounting-based measures, but the results were clearly dissimilar from those stemming from their first study. That is, with the same sample, they found that firms with non-dual CEO roles significantly outperformed firms with CEO duality in each year, in explicit support of agency theory predictions. Intrigued by these inferences, multiple authors tested their assertions across various assumptions and predictions. Donaldson and Davis (1991), applying stewardship theory to the board leadership debate for the first time, concurred that firms with CEO duality should be more effective and outperform those with separated roles, because the mean shareholder return was significantly larger for the former. Daily and Dalton (1992, 1993) also addressed the impact of CEO duality on the performance of small firms, predicting that the impact of this combined leadership role would be more pronounced in smaller firms, because larger firms tend to be more inertial. Yet the accounting and market-based performance measures they used exhibited no significant relationship. Across all these early studies, the empirical analysis remains relatively simplistic, so they serve mainly as a backbone for current scholarly research on this topic.

With a meta-analysis of empirical studies of board composition and board leadership structure, Dalton *et al.* (1998) found no evidence of a relationship between CEO duality and firm performance. Rather, the different performance metrics in the available studies meant the direction of the relationship flipped at times. Accounting-based metrics exhibited a negative correlation between duality and firm performance; market-based measures suggested a somewhat positive link. However, neither correlation was large enough to

provide meaningful inferences for or against agency and stewardship theories. Structural independence seemed not to equate performance advantage (Dalton and Dalton, 2005). Instead, these results informed the research field that different metrics have varying impacts, depending on the circumstances.

This uneven disposition seemed to stop there, with Dalton *et al.*'s (1998) meta-analysis. But the more complex interactions and different outcomes associated with CEO duality suggest the need for investigations that go beyond an agency versus stewardship polarity.

2.3. CEO duality, capital allocation, and investment efficiency

Because CEOs obtain their wealth from a sole source, which provides income, reputation, and human capital, their position may be overinvested in the firms they run, compared to that of firms' shareholders. If CEOs cannot diversify their employment risk, they may commit to investments that best serve their personal motives to entrench themselves and make their replacement much more costly to the firm (Shleifer and Vishny, 1989). Yet headquarters still are endowed with residual rights of control that provide the CEO with the authority to choose the level of funding for individual projects (Stein, 1997). Overall then, the value created from investments in a firm depends significantly on the efficiency of the allocation of capital across various projects, but the ability to allocate these corporate resources to projects or 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 (Shleifer and Vishny, 1989; Shin and Stulz, 1998). As Shleifer and Vishny (1989) 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 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. For example, managers may be intrigued by investments that require their specific human capital and thus entrench them against potential replacement threats or increase their chances for a compensation raise. In that vein, self-interested CEOs have incentives to channel more resources to such segments, even if the marginal investment has a negative net present value.

Managers pursuing their own private goals and benefits also might tend to engage in empire building (Jensen and Meckling, 1976; Jensen 1986, 1993; Xuan, 2009). Stein (1997) however challenges this idea, because conditional on the level of investment, any allocation of resources should work toward enhanced efficiency. Nevertheless the power and prestige associated with managing a larger firm (Jensen, 1986; Stulz, 1990) or managerial compensation related to firm size (Jensen and Murphy, 1990) remain efficiency-destructing motives for CEO investments.

In a diversified firm, the CEO also derives private benefits of control from all divisions, whereas divisional managers extract private benefits only from their own divisions. Scharfstein and Stein (2000) account for both kinds of agency conflicts in their examination of resource misallocation and rent payments by the CEO to divisional managers, who unjustifiably receive a greater share of resources for their divisions. That is, CEOs can distill their private benefits of control by engaging in inefficient cross-subsidization, funding value-destroying projects, and ceding to rent-seeking efforts by divisional managers (Lamont, 1997; Shin and Stulz, 1998; Scharfstein, 1998). Duchin and Sosyura (2013) also 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 lower investment efficiency and firm value (Duchin and Sosyura, 2013). Glaser *et al.* (2013) also uncover mechanisms by

which more powerful, better connected divisional managers realize greater capital allocations in a financially slack environment. Such problems are more likely when decision management and decision control are delegated to the same agent; 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 means to avoid monitoring from external financial markets.

Building on such emerging 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. According to Boyd (1995), the combined role—chair of the board and CEO of the firm—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, as a result 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, separated hierarchical structure, resulting from the distinction between CEO and chairperson positions, the board's role in overseeing managerial opportunism is minimized (Zona, 2012).

In summary, a board may fail to interfere in CEO investment decisions as a result of its weak role when a CEO is dictating the decision-making process, due to his or her simultaneous position as the chair of the board. CEO duality can then lead to misallocations of resources to projects, including allocations of more investments to low growth, relative to high growth, segments. This gives us the first hypothesis:

Hypothesis 1: Firms with combined CEO and chair positions make inefficient investments, allocating more to low growth segments than to high growth segments.

2.4. CEO duality and value added from the allocation policy

Firm performance receives substantial attention in prior studies that attempt to capture the overall impact of CEO duality on the firm by combining accounting and market-based performance measures. Faced however with equivocal support, researchers have also called for the consideration of other outcomes associated with CEO duality that are more proximal than firm performance (He and Wang, 2009; Krause *et al.*, 2014). For example, in relation to the investment channel through which CEO duality affects firm value, a model identifying the overall valuation consequence resulting from the firm's allocations is needed to incorporate this mediation mechanism. Such incorporation can help identify the differential value of dual CEOs investments and reveal the availability of valuable marginal investment opportunities. To address the aforementioned debate, this study predicts that CEO duality is a corporate governance regime that drives unprofitable investments and incrementally erodes firm value. The ability to allocate corporate resources presents the CEO with an opportunity to extract private benefits, at the cost of misallocating corporate resources. In these circumstances, board monitoring is weak, so CEO duality leads to corporate and investment decisions that end up being detrimental to shareholder value. Therefore:

Hypothesis 2: Combined CEO and chair positions have negative effects on the value added from the firm's capital allocation policy.

2.5. CEO duality and the impact of agency risk factors

Following the meta-analysis of Dalton *et al.* (1998), scholars agree that CEO duality has an important role that differs according to the circumstances. Duality can produce both positive and negative consequences in different market settings (Boyd, 1995), when the CEO and board have varying characteristics (Krause *et al.*, 2014), and may well vary conditional on the level of firm performance (Ramdani and Witteloostuijn, 2010). Drawing on both management and finance literature, this study argues that agency risk factors moderate the

relation between CEO duality and the firm's investment allocation and efficiency. Following the extant literature, we rely on free cash flow and compensation incentives to characterize the severity of agency issues within the firm.

Firms with excess free cash flow encounter major agency problems (Chung *et al.*, 2005), especially if their investment opportunities are limited (Gul, 2001). The agency costs arise because, when the firm holds too much excess cash, management can act opportunistically and derive personal gains from unnecessary value-destroying investments. Large amounts of excess cash may lead to managerial complacency or irrational optimism, and may be used by for political coalitions rather than for pursuing value-enhancing actions (Zona, 2012). Such resource misallocations may offer personal rewards, at the expense of shareholders. Limited free cash flows instead inherently reduce managerial discretion, so managerial waste and inefficiencies should be reduced, such that the limited free cash flows 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 among dual CEOs, resource allocations, and overall investment efficiency.

Past literature also highlights the effects of compensation on managerial incentives (Lambert *et al.*, 1991; Carpenter, 2000). Aligning executive incentives with shareholder interests is a direct way to mitigate agency problems; the absence of a relevant connection between CEO compensation and firm performance may raise questions about whether investments can be managed efficiently enough to enhance shareholder value. Mehran (1995) and Palia (2001) suggest that increasing executives' equity-based incentives creates value, and Hall and Liebman (1998) indicate a tripling of the median exposure of CEO wealth to firm value between 1980 and 1994. These trends may have exerted prevention impacts on prodigal empire building (Bergstresser and Philippon, 2006), such that firms with CEOs who are more incentivized, due to the connection of their overall compensation with stock prices,

exhibit greater alignment with the interests of shareholders. Thus, proper incentive provision, particularly equity-based compensation, should alleviate actions such as ceding to rent-seeking behaviours by divisional managers to extract private benefits or entrenchment efforts. Instead, these CEOs might be motivated to allocate investments better.

Another important effect of compensation on managerial incentives arises from the sensitivity of option-based compensation to stock prices. This exposure gives CEOs an incentive to alter the systematic and idiosyncratic risk of their firms, though the effect thus far has remained theoretically ambiguous. On the one hand, career concerns may encourage CEOs to decrease their firms' systematic risk while increasing their own exposure to their firms' risk (Coles *et al.*, 2006), but on the other hand, it can motivate CEOs to take more on idiosyncratic risks that promise to increase firm value (John and John, 1993). The empirical findings of Armstrong and Vashishtha (2012) support a strong positive relation between the sensitivity of option-based compensation to stock prices and the level of idiosyncratic risk, perhaps suggesting that the sensitivity of option-based compensation to stock prices incentivizes CEOs to invest more in positive net present value projects, which eventually increases their firms' idiosyncratic risk. Certain forms of option-based compensation thus may help alleviate the adverse impact of CEO duality on investment efficiency. Taking all this evidence together, we posit:

Hypothesis 3: Agency risks factors moderate the negative relationship between CEO duality and the allocation of investments, such that the relationship is weaker among firms with lower agency risks.

Hypothesis 4: Agency risks factors moderate the negative relationship between CEO duality and the value from the firm's allocation policy, such that the relationship is weaker among firms with lower agency risks.

3. Sample and variable description

3.1. Sample

Three sets of databases serve to construct the sample with the required data: Standard & Poor's Execucomp, firm-level financial data from Compustat, and segment-level financial data from the Compustat Industrial Segment (CIS) database. The focus on the investment efficiency of dual CEOs means that the primary tests require data on investment expenditures at the segment level, the only way to observe capital allocations and their overall valuation effect. Thus, the analysis requires an intra-firm examination of the allocations of capital expenditures to divisions; for this purpose, the study 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 necessary for two main reasons. First, data about the allocation of capital expenditures across industries are available for diversified firms, which facilitate an investigation of intra-firm investment efficiency. In this respect, research on internal capital markets offers a good starting point for gaining initial insights into how CEO duality leads to certain investment decisions, whether the investments are efficient, and whether they translate into firm value. Second, diversified structures endow CEOs with additional discretion in allocating resources across business segments, so it is of interest to investigate how the dual role of the CEO produces the allocation of resources and affects the value of firms, as well as whether agency risk moderators alter these relations (Rajan *et al.*, 2000; Scharfstein, 1998; Shin and Stulz, 1998).

The sample begins in 1992, which is the year Execucomp coverage commences. To steer clear of distortions caused by small firms, which may have sales or assets near zero, 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 any divisions that operate in these sectors, are excluded, because they are subject to specific capital structure regulations. Firms

lacking the required data at the firm or segment level also are excluded from the sample (Ahn *et al.*, 2006). 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). A portfolio of single-segment industry peers for the sample of multi-segment firms is another requirement. Finally, for each division of a multi-segment firm, we require five industry-matched firms, based on the three-digit SIC code. The final sample, for the period 1992–2013, includes 11,403 segment-year and 5,480 firm-year observations.

3.2. Key variables

CEO Duality, the main independent variable of the study is a binary variable coded to be equal to one for any firm year the CEO served as the board chair and zero otherwise. It is measured at the year-end, prior to the year of the allocation efficiency and value measures, because CEO duality in year $t - 1$ likely influences the internal capital allocation and firm valuation in the current year t .

For capital allocations and efficiency we use (1) industry-adjusted investment (*Segment Investment*). To further examine the efficiency and valuation consequences of these investments we employ (2) relative value added (*RVA*), which adds the weighted transfer across all segments of a firm in a year, to achieve a sum that represents the relative value added by capital allocation, and (3) relative investment (*RINV*), which generally captures the degree to which a division's capital expenditure reflects its relative investment opportunities. Positive values for each measure indicate that the firm invests relatively more in its high Tobin's- q (high- q) segments than in its Tobin's- q (low- q) segments.

With regards to the agency risk moderators, we employ (1) CEO equity-based incentives (*Incentive Ratio*), which rely on CEO compensation incentives as a proxy for agency risk, as in Bergstresser and Philippon (2006), (2) the CEO's portfolio sensitivity of option-based compensation to stock prices (*Delta*) as in Guay (1999) and Core and Guay

(2002), and (3) the firm's free cash flows (*FCF*) defined as the cash flows in excess of what is needed to fund all projects with positive net present values when discounted by the relevant cost of capital (Jensen, 1986).

Detailed definitions of these variables as well as of the other controls appear in the appendix.

4. Empirical findings

4.1. Descriptive statistics

Table 1 reports the correlations for the study variables. Most variables correlate with CEO duality and exhibit the expected sign. None of the correlations is high enough to raise concerns over multicollinearity. Table 2 presents summary statistics for the firm characteristics, internal capital market efficiency measures, and CEO characteristics for the firm-years of diversified firms. The most notable observation is that firms have a mean and median relative value added, or *RVA*, is -0.04 (-0.01), and for the relative investment ratio, or *RINV*, the values are -0.15 (-0.05). With the assumption that the industry Tobin's *q* is a good proxy for the marginal *q* of the diversified firm's segment, these values suggest that the sample of diversified firms allocate too little capital to their segments in high-growth industries. Thus, similar to earlier studies of investment policy in diversified firms, this sample of diversified firms indicates inefficient internal capital allocation, on average.

[Table 1 here]

[Table 2 here]

Table 2 also reveals segment-level characteristics. Each segment's mean industry investment as captured by the industry-adjusted capital expenditure to sales (*Segment Investment*) is around 0.01. The industry-adjusted ratio of cash flows to sales (*Segment CF / Sales*) exhibits a mean (median) of 0.15 (0.15), while the same ratio for the firm's remaining segments (*Other Segment CF / Sales*) has a mean (median) of 0.16 (0.15). The industry

Tobin's q for the segment (*Industry Tobin's q*), which corresponds to the median for focused firms operating in the same three-digit SIC code, displays a mean (median) of 1.5 (1.4) across the sample.

4.2. CEO duality and capital allocations to divisions

For an investment allocation to be efficient, internal capital must be directed toward divisions with superior investment opportunities and away from those with poorer investment prospects. To examine the relation between CEO duality and internal capital allocation, this study undertakes a segment-level analysis, in which the dependent variable is segment industry-adjusted investment, or *Segment Investment*.

To investigate the unconditional relation between CEO duality and investment allocation/efficiency, a sample of firms that changed their leadership structure (dual to non-dual or vice versa) without replacing the CEO is identified. This measure avoids a potential impact of CEO replacement on investment allocation and efficiency. The univariate analysis accounts for the time patterns of investment allocation/efficiency, for three years before and three years after the CEO duality/non-duality change. The results show that firms governed by a dual CEO regime experience lower investment allocation and efficiency. Specifically, for firms switching from the non-dual structure to a dual structure, the previous investment allocation/efficiency average is 0.45, the post-three year average is 0.11, and the *pre-post* difference of -0.34 is significant at the 1% level. For firms changing from dual to non-dual structures, the pre-three year investment allocation/efficiency average was 0.21, falling short of the three-year post-change average of 0.41. The *pre-post* difference of 0.20 is again statistically significant at the 1% level. This unconditional time pattern behaviour indicates that the dual structure is a dominant adverse factor related to firm investment misallocations and inefficiencies, in early support of Hypothesis 1.

The regression models in Table 3 validate the robustness of these unconditional patterns using segment panel data that take into account firm- and year-fixed effects. The multivariate regression analysis tests whether segment investment (*Segment Investment*) in fiscal year t relates to *CEO Duality* in fiscal year $t-1$ and if this relation differs according to whether the segment offers high or low growth opportunities, after accounting for other potential antecedents of investment efficiency. The assessment of growth opportunities is done using a dummy variable, namely Q_{dum} , that is equal to one if the segment's Tobin's q is greater than the sales-weighted average Tobin's q for the firm as a whole. The model also controls for growth opportunities using the *Industry Tobin's q* across all focused firms in the segment's three-digit SIC code industry. Absolute (*Segment Size*) and relative (*Relative Segment Size*) measures of segment size also are included in the model, because they offer important determinants of investment allocations (Shin and Stulz, 1998; Rajan *et al.*, 2000; Ozbas and Scharfstein, 2010). To control for the sensitivity of a segment's investment to its own cash flow, the model also features *Segment CF / Sales* along with the segment's investment sensitivity to *Other Segment CF / Sales* (Peyer and Shivdasani, 2001; Shin and Stulz, 2001; Ahn *et al.*, 2006). In addition to the firm-level measures, the regression controls for the CEO's formal experience with the firm, *CEO Tenure*, and for corporate governance it takes into account the stockholdings of institutional investors, *Institutional Own*. Similar to CEO duality, these variables are measured at the end of the year prior to the year for the allocation efficiency measures. The model specification includes firm fixed effects and year dummies. Including a separate dummy variable for each firm helps control for unobserved time-invariant heterogeneity. Therefore, the reported evidence is unaffected by cross-sectional differences in organizational structure or segment reporting. Standard errors are clustered at the firm level.

[Table 3 here]

Table 3, model (1), reports the results of the relation between segment investment and CEO duality. Industry-adjusted segment investment relates positively to CEO duality, implying that the dual CEO makes more investments. This evidence also might imply overinvestment by the CEO, a proposition assessed subsequently in this study. Furthermore, model (1) examines whether segment investment depends on the segment's relative growth opportunities, Q_{dum} . Although not significant, the negative sign could indicate tendencies of inefficient cross-subsidization or a mismeasurement of growth opportunities.

In model (2) of Table 3, an additional interaction term assesses whether the relation between CEO duality and segment investment varies according to growth opportunities by taking into account of whether the segment is classified as high- q or low- q . This effect is captured with the interaction of *CEO Duality* and Q_{dum} . The model shows that CEO duality maintains a positive sign, conveying an even more significant relation to segment investment and again implying overinvestment tendencies due to CEO duality. The results on the interaction term also suggest that the impact of CEO duality on segment investment is significantly weaker for high growth segments (high- q) than for low growth segments (low- q). The economically significant differences show that CEO duality fails to give priority to its firm's high- q segments in its capital allocation process. As posited in Hypothesis 1, it appears that dual CEOs disproportionately allocate investments to segments. They prefer to allocate the firm's resources to options that underperform the first-best alternative investment but whose value is greater under these CEOs than under the best alternative. Such behaviour gives birth to managerial agency problems and could have detrimental impacts on overall value added from the firm's allocation policy. This finding is contrary to efficient internal market paradigms (e.g., Stein, 1997; Shin and Stulz, 1998) that predict that diversified firms channel funds to divisions with good growth opportunities. The findings also have implications for literature examining investment policy in diversified firms (Rajan *et al.*,

2000; Scharfstein & Stein, 2000; Wulf, 2009; Duchin and Sosyura, 2013), in that they suggest that part of the recorded investment inefficiency stems from the increased power concentrated in the hands of the CEO.

The main analysis of this study relates to the impact of CEO duality on investment allocation, so an issue that arises is whether the relation tested in the regression might be endogenous (Yang and Zhao, 2014). Hermalin and Weisbach (1998) argue that the decision about the structure and composition of a board of directors represents the firm's answer to organizational design issues or problems. For Kang and Zardkoohi (2005), CEO duality can have various institutional, power, social reciprocity, reward, and organizational antecedents, so a firm's choice of leadership structure is not random but rather represents a response to a constrained optimization process. However, Iyengar and Zampelli (2009) find no evidence that CEO duality is a structure intentionally chosen to optimize performance; if the firm is choosing a dual leadership regime, the reason for this choice is not performance.

Still, to account for the possibility of endogenous CEO duality and its effects on investment efficiency, we use an instrumental variable (IV) approach to estimate the main regression equation using two-stage least squares. The instrumentation of CEO duality uses CEO age, computed as a natural logarithm, and 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. The choice of an appropriate instrument requires two conditions: the correlation with the instrumented regressor should be strong, and there must be orthogonality with the error term. It is highly probable that CEO duality is significantly and positively related to CEO age (Linck *et al.*, 2008; Yang and Zhao, 2014); there is no evidence that CEO age directly affects investment efficiency.

Models (3) and (4) in Table 3 contain the results from the second-stage IV estimation, with CEO age and the CEO age dummy as instruments, respectively. Consistent with

expectations, in both models, the positive and significant relation of CEO duality persists. The misallocation of investment to segments by CEO duality is confirmed; therefore causality appears to run from CEO duality to investment efficiency, and not in the other direction. The IV approach lends credence to the notion that CEO duality is a negative determinant of internal capital markets, in that it adversely affects the allocation and efficiency of investments.

4.3. CEO duality and value added by the firm's allocation policy

For a further assessment of Hypothesis 1, and most importantly, to examine the overall value consequences of the firm's transfers of capital to its various investment opportunities, we first use a firm-level measure of relative value added, *RVA*, as proposed by Rajan *et al.* (2000), and a second measure of the relative investment ratio, *RINV*, as proposed by Ahn and Denis (2004). A positive (negative) value for *RVA* indicates that the internal capital market is efficient (inefficient), thus increasing (decreasing) the value added by investment allocation. The measure of *RVA* is of particular interest in this study since it directly captures the valuation impact resulting from the firm's investment allocation. As aforementioned, rather than inheriting generic measures which do not particularly examine the investment consequences of CEO duality, we instead use a metric that can be regarded as a measure of the overall value added (subtracted) by the firm's investment allocation. *RINV* is an overall firm measure of investment efficiency; a positive (negative) value designates that the firm is investing relatively more (less) in its high-*q* segments (Ahn and Dennis, 2004).

Table 4 reports estimates for two additional regression models of added value by allocation (*RVA*) and overall investment efficiency (*RINV*). For both models, a set of control variables accounts for relevant firm characteristics in the context of the internal capital market efficiency of diversified firms. Specifically, the models include the industry-adjusted ratio of research and development to sales, *R&D*, which controls for the variation in

information asymmetry across sample firms. According to Datta *et al.* (2009) high information asymmetry can give self-interested managers an opportunity to pursue their private benefits, to the detriment of shareholders, by hiding misallocation actions from the market. Moreover, Ataullah *et al.* (2014) acknowledge a value-related information gap between insiders and stockholder for diversified firms. Therefore, the models also control for the *Number of Segments*, to capture the breadth of diversification. Also, *Firm Size* is a proxy for the overall effect of other firm characteristics. Other control variables include industry-adjusted firm investments (*Investment*), *CEO Tenure* as a proxy for formal experience, and institutional ownership (*Institutional Own*) as a control for corporate governance. Consistent with Rajan *et al.* (2000) and Datta *et al.* (2009), the models include the sample firm's industry-adjusted *Tobin's q* to control for growth opportunities. As with the previous specifications, firm- and year-fixed effects provide further controls in the models and the standard errors are clustered at the firm level.

[Table 4 here]

In Table 4, *CEO Duality* has negative and significant effect in model (1) on *RVA*. Together with the results in the main analysis related to investment allocations, this finding confirms that CEO duality is a significantly negative determinant of internal capital market efficiency. In the sample firms, CEO duality thus leads to the allocation of relatively more capital to segments with lower growth opportunities, which incrementally reduces firm value, as captured by the *RVA* variable. This evidence confirms Hypothesis 2 and answers the question inherent to Hypothesis 1, that is, whether the dual CEO overinvests. The answer is demonstrated in Table 3, by the segment-level regressions with the tendency exhibited by the dual CEO toward increased investments. This increase reflects overinvestment actions by the dual CEO as it is clear that this increase in investment does not lead to a corresponding increase in firm value. It seems that the ability to allocate corporate resources provides the

CEO with an opportunity to extract private benefits, at the cost of misallocating corporate resources, such that he or she incrementally makes investment decisions that deteriorate shareholder value. The results of regression model (2) for the alternative measure of firm investment efficiency, *RINV* are aligned with the results for *RVA* and for the segment level allocation, confirming that dual CEOs invest relatively more in low *q* segments and relatively less in high *q* segments. This investment pattern lines up with the predictions of rent-seeking models by Rajan *et al.* (2000) and Scharfstein and Stein (2000), implying that capital is inefficiently allocated across the segments of diversified firms and this has a negative effect on the value added to the firm by allocations.

Regarding the control variables, a similar tendency arises in both models, such that the coefficient of the *Number of Segments* is insignificant, in weak support of Rajan *et al.*'s (2000) prediction that greater diversity of segment *q* leads to the misallocation of capital to investments and increased investment inefficiency. Firm size is positive and significant only in the estimation in which the dependent variable is *RINV*, indicating a strong relation between larger firms and relative investment. The industry-adjusted *R&D* is positive and significant in both models. That is, high information asymmetry does constitute a cover for CEO duality, enabling the misallocation of capital to gain private benefits. The coefficients for *Tobin's q* and *Investment* in both models emerge as insignificant, and thus do not provide any inferences with regards to the impact of greater investment opportunities or larger investments on efficient allocations. Finally, *CEO Tenure* and *Institutional Own* emerge as insignificant throughout. It appears that the firm fixed effects absorb much of the variation across many of the controls variables, yet the strong statistical relation for *CEO Duality* conveys a clear message regarding the negative impact of CEO duality on the (marginal) firm value driven by capital allocations.

4.4. Impact of agency risk factors

If CEO duality leads to investment misallocation and inefficiency, are there also factors that can mitigate its impact? Do firms with key elements designed to mitigate agency risk, such as executive compensation, alleviate the documented negative relations? Table 5 presents the results of the tests of Hypotheses 3 and 4, which examine the potential moderating effects of three agency risk factors: (1) CEO *Incentive Ratio* that captures the share of a hypothetical CEO's total compensation that would come from a 1% increase in the value of the equity of his or her company (Bergstresser and Philippon, 2006), (2) a CEO's portfolio price sensitivity, *Delta*, 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 (Core and Guay, 2002), and (3) the level of free cash flows, *FCF*. Table 5 reports the regression results for the segment-level sample, divided into two sub-samples, whereby each sub-sample includes observations above or below the yearly median values of CEO *Incentive Ratio*, *Delta*, and *FCF*, respectively. Because the distribution of Delta is right-skewed, the natural logarithm transformation of the variable serves to break up the full sample. All agency risk factors are measured as of the year-end, prior to the year of the allocation measures ($t-1$), because their occurrence in the former year likely influences the internal capital allocation in the current year (t). If a CEO's lagged *Incentive Ratio* and lagged *Delta* are greater than the yearly median, the CEO is considered highly incentivized and sensitive to compensation. If these variables fall below the respective yearly median values, the CEO has low compensation incentives and sensitivities. Likewise, if a firm's lagged *FCF* is greater than the yearly median, the firm has a high level of free cash flows and low levels if the lagged *FCF* falls below the yearly median. High agency environments are those with low compensation incentives but high free cash flows.

[Table 5 here]

Models (1), (3), and (5) in Table 5 show that in low agency risk environments, the adverse impact of CEO duality on investment allocation and efficiency disappears. High levels of CEO *Incentive Ratio* and *Delta* and low *FCF*, associated with low agency risk environments, significantly moderate the negative relation between CEO duality and investment allocation. These results are consistent with literature on executive equity-based compensation, in which not only the slope but also the convexity of the equity-based payoff function is central to mitigating CEOs' self-interest (Guay, 1999). The result for *Delta* is intriguing; high levels of *Delta* appear to encourage managers to take risks and work toward reducing inefficiencies, presumably to increase firm value. This result sheds light on the risk-value trade-off that executives face, and it confirms that dual CEOs are willing to increase firms' idiosyncratic risk when faced with high *Delta* levels, for the sake of investing in projects with better net present value, even though this risk cannot be hedged.

For low levels of CEO *Incentive Ratio* and *Delta* but high levels of *FCF*, the results in models (2), (4) and (6) support Hypothesis 1; they confirm the positive, significant relation between CEO duality and industry-adjusted segment investment. That is, dual CEOs exhibit overinvestment tendencies in high agency risk environments. The results for the interaction term of CEO duality and Q_{dum} also offer evidence of (sub-optimal) cross-subsidization across divisions. There is compelling evidence that conditions of high agency risk allow dual CEOs to manifest agency behaviours that erode the firm's investment efficiency at the segment level and negative responses in terms of allocating capital expenditures to the firm's investment opportunities. Collectively, these results support the notion that an adverse impact of CEO duality on capital allocations and investment efficiency happens only in high agency environments characterized by poor compensation schemes or high levels of free cash flows.

To examine whether agency risk factors alleviate the negative impact of CEO duality on the overall value added from allocations and also to confirm the validity of the results in Table 5 at the firm level, the same analysis is repeated, using *RVA* and *RINV*. Panels A and B of Table 6 present the results for the moderating effects of CEO *Incentive Ratio*, *Delta*, and *FCF* on the relation between investment efficiency (*RVA* and *RINV*) and *CEO Duality*. The same baseline regressions for the results in Table 4 are applied here. Both tables show a consistent pattern: in low agency risk environments, particularly models (1), (3), and (5), the negative and significant relation of CEO duality with *RVA* and *RINV* disappears. Dual CEOs do not cede to inefficient investments that lower overall firm value in low agency environments. A consistent pattern also arises for high agency environments, as shown in models (2), (4), and (6). That is, the relation between CEO duality and relative value added by allocations and investment efficiency is negative and significant when CEO *Incentive Ratio* and *Delta* sensitivities are low but *FCFs* are high. Overall, the evidence from the second sub-sample analysis in Table 6 substantiates the inferences about agency risk moderators in Table 5; it also comprehensively affirms that conditions cultivating or prohibiting agency risk can have a determinant role in ameliorating the value-destroying inefficient investment decisions that result from CEO duality.

[Table 6 here]

5. Conclusion

Building on evidence from agency theory and strategic leadership literature, this study shows empirically that CEO duality produces a governance context that may encourage CEOs to direct investment resources inefficiently, to the “wrong” segments, ultimately causing a loss in firm value. 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 is the first to show the channel through which CEO duality exerts an adverse effect on investment decisions that lead to an incremental loss of overall firm value.

In particular, 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, in the form of risk reduction and managerial entrenchment, manifest to the detriment of the firm's shareholders. Two important points arise from this study. First, low agency risk regimes can help eliminate investment misallocation and inefficiency. Such regimes can be cultivated by high compensation incentives and sensitivities linked to firm market performance. Second, unlike prior literature that focuses mainly on direct relations with performance metrics, this study provides an investment perspective on CEO duality behaviour, and produces the valuation consequences of this investment behaviour. These results add to both strategic leadership literature and internal capital markets literature, while also illustrating that agency risk factors are significant determinants and moderate the adverse effects that arise from CEO duality.

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Appendix

Definitions of the Variables

Variables	Definitions
Dependent Variables	
Segment Investment	Industry-adjusted segment investment, defined as the difference between the investment for the segment and that of the median focused firm operating in the same three-digit SIC industry
RVA	Relative value added, calculated when firm- and industry-adjusted segment investment are weighted by the difference between the industry median Tobin's q for that segment and the sales-weighted average Tobin's q for the firm. RVA is multiplied by 100.
RINV	Relative investment is the sales-weighted sum of firm- and industry-adjusted investment in high Tobin's q segments minus the sales-weighted sum of firm- and industry-adjusted investment in low Tobin's q segments. RINV is multiplied by 100.
Main Independent Variable	
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.
Control Variables	
Segment Size	Segment size is 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 / Sales	It is the segment's industry-adjusted ratio of cash flows (i.e., operating income) to sales.
Other Segment CF / Sales	It is the segment's industry-adjusted ratio of cash flows (i.e., operating income) to sales for the firm's remaining segments.
Industry Tobin's q	It is the Tobin's q of the median focused firm in the segment's three-digit SIC code industry.
Q _{dum}	A dummy variable equal to one if the Tobin's q of the median focused firm in the segment's industry is

greater than the sales-weighted average Tobin's q for the firm as a whole.

Firm Size	The natural logarithm of total sales.
Number of Segments	The number of the firm's segments (measured at the three-digit SIC level).
R&D	The firm's industry-adjusted ratio of R&D expenditures divided by sales.
Investment	The firm's industry-adjusted investment that is equal to firm's capital expenditure divided by sales.
Tobin's q	The firm's industry-adjusted Tobin's q that is equal to the market value of assets divided by the book value of assets.
CEO Tenure	The natural logarithm of the length of time between the date when the person became the CEO and the current fiscal year end.
Institutional Own	Institutional ownership, defined as the ratio of the number of common shares held by institutional investors to the total shares outstanding of the firm.

Moderating Variables

Incentive Ratio

CEO equity-based incentives ratio estimated as in Bergstresser and Philippon (2006). This measure of incentives is normalized in a way that captures the share of a hypothetical CEO's total compensation that would come from a 1% increase in the value of the equity of his or her company, as shown below:

$$Incentive\ Ratio = \frac{ONEPCT}{ONEPCT + SALARY + BONUS}$$

with:

$$ONEPCT = 0.01 * PRICE \times (SHARES + OPTIONS)$$

where *PRICE* is the company 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 portfolio price sensitivity 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 parameters of the Black and Scholes formula follow the definitions as in Core and Guay (2002).

FCF

Free cash flows calculated as income before extraordinary items plus depreciation expense scaled by total assets

Table 1. Correlation Matrix
Panel A. Firm Level

Variable	1	2	3	4	5	6	7	8	9
1. CEO Duality									
2. Relative Value Added (RVA)	-0.032**								
3. Relative Investment (RINV)	-0.029**	0.760***							
4. Firm Size	0.213***	0.011	0.012						
5. Number of Segments	-0.008	0.019**	0.026***	0.308***					
6. R&D	-0.042***	0.042***	0.004	-0.025***	-0.016***				
7. Investment	-0.012	0.023***	0.027***	0.013*	0.017**	0.037***			
8. Tobin's q	0.025**	-0.014	-0.008	0.369***	0.109***	0.089***	0.042***		
9. CEO Tenure	0.226***	-0.008	0.012	-0.095***	-0.002	-0.065***	0.011	0.061***	
10. Institutional Own	0.015	0.013	0.001	-0.112***	-0.040***	0.014**	0.016*	0.012*	-0.001

Panel B. Segment Level

Variable	1	2	3	4	5	6	7	8
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/ Sales	0.021***	-0.012**	0.252***	0.047***				
6. Other Segment CF/ Sales	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. CEO Tenure	0.210***	0.004	-0.083***	-0.001	-0.036***	-0.024***	0.041***	
9. Institutional Own	0.023***	0.016***	-0.119***	0.020***	-0.046***	-0.045***	-0.028***	0.001

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

*Table 2. Descriptive Statistics
Panel A. Firm Level*

Variable	Mean	Minimum	Median	Maximum	St. Deviation
Relative Value Added (RVA)	-0.037	-3.947	-0.005	4.236	0.803
Relative Investment (RINV)	-0.148	-16.204	-0.046	16.090	3.561
Firm Size	7.614	2.848	7.597	10.882	1.445
Number of Segments	3.037	2.000	3.000	7.000	1.076
R&D	-0.058	-1.394	-0.003	0.399	0.204
Investment	0.005	-0.402	-0.001	0.495	0.093
Tobin's q	0.071	-3.416	0.017	4.073	0.858
CEO Tenure	7.529	0.496	5.240	37.996	7.373
Institutional Own	0.366	0.000	0.351	0.982	0.179

Panel B. Segment Level

Variable	Mean	Minimum	Median	Maximum	St. Deviation
Segment Investment	0.005	-0.402	-0.001	0.495	0.090
Segment Size	6.111	-1.269	6.161	9.707	1.743
Relative Segment Size	0.341	0.000	0.276	0.998	0.256
Segment CF/ Sales	0.154	-1.185	0.145	0.836	0.192
Other Segment CF/ Sales	0.161	-0.975	0.150	0.673	0.131
Industry Tobin's q	1.535	0.851	1.382	4.860	0.555

Notes. This table reports summary statistics for the sample of diversified companies included in Compustat at any time during 1992–2013 that operate in at least two business segments in different three-digit SIC codes. All variable definitions are provided in the appendix.

Table 3. Segment investment and CEO duality

Name	Model 1	Model 2	Model 3 IV	Model 4 IV
Intercept	0.281 ^{***} (0.035)	0.281 ^{***} (0.035)	0.272 ^{***} (0.035)	0.274 ^{***} (0.036)
CEO Duality _{t-1}	0.006 ^{**} (0.003)	0.010 ^{***} (0.003)	0.050 ^{**} (0.024)	0.057 ^{**} (0.029)
Segment Size	-0.016 ^{***} (0.004)	-0.016 ^{***} (0.004)	-0.019 ^{**} (0.005)	-0.019 ^{***} (0.005)
Relative Segment Size	0.044 ^{***} (0.013)	0.044 ^{***} (0.013)	0.052 ^{**} (0.014)	0.054 ^{***} (0.015)
Segment CF / Sales	-0.019 (0.020)	-0.020 (0.020)	-0.019 (0.020)	-0.020 (0.020)
Other Segment CF / Sales	-0.010 (0.023)	-0.010 (0.023)	-0.009 (0.021)	-0.009 (0.021)
Industry Tobin's q	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
Q _{dum}	-0.004 (0.003)	0.003 (0.004)	0.011 (0.009)	0.011 (0.009)
CEO Tenure _{t-1}	0.001 (0.001)	0.001 (0.001)	-0.005 (0.003)	-0.005 (0.004)
Institutional Own _{t-1}	0.004 (0.008)	0.004 (0.008)	0.009 (0.008)	0.011 (0.008)
CEO Duality _{t-1} * Q _{dum}		-0.010 ^{**} (0.005)	-0.023 ^{**} (0.011)	-0.023 ^{**} (0.011)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
N	11,403	11,403	11,296	11,296
R ²	0.239	0.240	0.239	0.238

Notes. This table reports segment investment regressions for the years 1992-2013. The dependent variable is the industry-adjusted segment investment in all specifications, corresponding to the difference between the investment for the segment and that of the median focused firm operating in the same three-digit standard industrial classification industry. Models 3 and 4 present the results from the second-stage estimation of the IV approach to analyse the impact of CEO duality on industry-adjusted segment investment. The analysis instruments CEO duality using the natural logarithm of CEO age (model 3) and a dummy variable that takes a value of one if the age of the CEO is higher than industry mean age, and zero otherwise (model 4) in the same three-digit SIC industry in a given year. All other variable definitions are given in appendix. Standard errors are clustered at the firm level, and are reported in parenthesis. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 4. Investment efficiency and CEO duality

	Model 1 RVA	Model 2 RINV
Intercept	-0.058 (0.144)	-0.916 (0.581)
CEO Duality _{t-1}	-0.063* (0.036)	-0.332** (0.157)
Firm Size	0.014 (0.013)	0.111** (0.0482)
Number of Segments	0.016 (0.019)	0.014 (0.082)
R&D	0.272** (0.129)	0.735* (0.437)
Investment	-0.484 (0.449)	-2.741 (2.410)
Tobin's q	-0.044 (0.028)	-0.030 (0.068)
CEO Tenure _{t-1}	0.001 (0.002)	0.015 (0.010)
Institutional Own _{t-1}	-0.005 (0.101)	-0.245 (0.452)
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
N	4,404	4,368
R ²	0.378	0.307

Notes. This table reports investment efficiency regressions for the years 1992-2013. The measure of investment efficiency is RVA in model 1 and RINV in model 2. To calculate RVA, firm- and industry-adjusted segment investment are weighted by the difference between the industry median Tobin's q for that segment and the sales-weighted average Tobin's q for the firm. RINV is the sales-weighted sum of firm- and industry-adjusted investment in high Tobin's q segments minus the sales-weighted sum of firm- and industry-adjusted investment in low Tobin's q segments. Both RVA and RINV are multiplied by 100. All variable definitions are given in appendix. Regression models are estimated with calendar year dummy variables and firm fixed effects. Standard errors are clustered at the firm level, and are reported in parenthesis. *, ** and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 5. Segment investment and CEO duality: High versus low agency risk

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Managerial Incentive Type:	High Incentive Ratio _{t-1}	Low Incentive Ratio _{t-1}	High Log(Delta) _{t-1}	Low Log(Delta) _{t-1}	Low FCF _{t-1}	High FCF _{t-1}
Agency Risk Level:	Low	High	Low	High	Low	High
Intercept	0.284*** (0.049)	0.073*** (0.028)	0.149*** (0.024)	0.321*** (0.051)	0.140*** (0.034)	0.276*** (0.043)
CEO Duality _{t-1}	0.003 (0.005)	0.014*** (0.005)	0.005 (0.004)	0.016*** (0.005)	0.004 (0.006)	0.014*** (0.004)
Segment Size	-0.014** (0.007)	-0.020*** (0.006)	-0.013*** (0.004)	-0.020** (0.006)	-0.016** (0.007)	-0.018** (0.006)
Segment Relative Size	0.043** (0.018)	0.051*** (0.018)	0.037** (0.015)	0.053*** (0.019)	0.031 (0.021)	0.058*** (0.017)
Segment CF / Sales	-0.035 (0.022)	-0.011 (0.029)	-0.046*** (0.017)	-0.004 (0.031)	-0.008 (0.028)	-0.029 (0.024)
Other Segment CF / Sales	-0.042 (0.046)	0.015 (0.020)	-0.008 (0.035)	-0.016 (0.023)	-0.035** (0.019)	0.001 (0.042)
Industry Tobin's q	0.001 (0.003)	0.002 (0.004)	0.001 (0.003)	0.001 (0.003)	0.002 (0.005)	0.001 (0.003)
Q _{dum}	0.003 (0.007)	0.002 (0.005)	0.001 (0.005)	0.003 (0.005)	0.002 (0.007)	0.004 (0.005)
CEO Tenure _{t-1}	0.0001 (0.002)	-0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)	-0.001 (0.002)
Institutional Own _{t-1}	0.005 (0.013)	0.004 (0.010)	0.018 (0.012)	-0.002 (0.010)	-0.002 (0.018)	0.008 (0.010)
Duality _{t-1} * Q _{dum}	-0.007 (0.007)	-0.013** (0.006)	-0.005 (0.005)	-0.013* (0.007)	-0.009 (0.008)	-0.012** (0.006)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	5,551	5,852	5,772	5,531	4,189	7,214
R ²	0.273	0.270	0.285	0.255	0.235	0.301

Notes. This table reports segment investment regressions for the years 1992-2013. Models 1, 3, and 5 use the subsample of firms with low agency risk, and models 2, 4, and 6 the subsample of firms with high agency risk. The dependent variable is the industry-adjusted segment investment in all specifications. High agency risk environments are found in firms with low lagged CEO *Incentive Ratio*, lagged CEO *log(Delta)* and high lagged *FCF*. Low agency risk environments are found in firms with high lagged CEO *Incentive Ratio*, lagged CEO *log(Delta)* for their CEOs and low lagged *FCF*. All variable definitions are given in appendix. Subsample is formed based on the yearly median values of each variable. Regression models are estimated with calendar year dummy variables and firm fixed effects. Standard errors are clustered at the firm level, and are reported in parenthesis. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

Table 6. Investment efficiency (RVA) and CEO duality: High versus low agency risk
 Panel A. RVA as a proxy for investment efficiency

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	High Incentive Ratio	Low Incentive Ratio	High Log(Delta) _{t-1}	Low Log(Delta) _{t-1}	Low FCF _{t-1}	High FCF _{t-1}
	Low	High	Low	High	Low	High
Intercept	0.450 (0.645)	0.798 (0.502)	-0.046 (0.260)	-0.098 (0.162)	-0.170 (0.232)	0.002 (0.171)
CEO Duality _{t-1}	-0.075 (0.057)	-0.116** (0.056)	-0.027 (0.049)	-0.085* (0.049)	-0.009 (0.050)	-0.095** (0.045)
Firm Size	0.027 (0.076)	-0.052 (0.075)	0.013 (0.022)	0.017 (0.015)	0.048** (0.019)	-0.007 (0.016)
Number of Segments	0.020 (0.031)	0.040 (0.042)	0.016 (0.021)	0.016 (0.028)	-0.025 (0.032)	0.041* (0.021)
R&D	0.143 (0.245)	0.139 (0.238)	0.372** (0.158)	0.064 (0.166)	0.351 (0.243)	0.235* (0.139)
Investment	-1.001 (0.630)	-0.324 (0.796)	-0.081 (0.597)	-0.950 (0.620)	-0.260 (0.591)	-0.706 (0.533)
Tobin's q	-0.023 (0.058)	-0.086 (0.063)	-0.062 (0.039)	-0.011 (0.034)	-0.073 (0.049)	-0.039 (0.033)
CEO Tenure _{t-1}	0.001 (0.004)	0.009 (0.006)	0.001 (0.003)	0.002 (0.003)	-0.002 (0.004)	0.003 (0.003)
Institutional Own _{t-1}	0.284 (0.214)	0.014 (0.162)	0.103 (0.164)	-0.096 (0.117)	-0.050 (0.149)	0.029 (0.130)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	2,134	2,270	2,183	2,221	1,643	2,761
R ²	0.471	0.457	0.417	0.470	0.489	0.443

Panel B. RINV as a proxy for investment efficiency

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Managerial Incentive Type:	High Incentive Ratio	Low Incentive Ratio	High $\text{Log}(\Delta)_{t-1}$	Low $\text{Log}(\Delta)_{t-1}$	Low FCF_{t-1}	High FCF_{t-1}
Agency Risk Level:	Low	High	Low	High	Low	High
Intercept	0.975 (2.670)	2.339 (2.707)	-0.893 (0.921)	-0.810 (0.775)	-1.189 (1.043)	-0.749 (0.693)
CEO Duality _{t-1}	-0.325 (0.231)	-0.591** (0.288)	-0.207 (0.201)	-0.443** (0.226)	-0.106 (0.242)	-0.494** (0.199)
Firm Size	0.094 (0.327)	-0.056 (0.398)	0.131* (0.070)	0.073 (0.077)	0.205** (0.088)	0.052 (0.055)
Number of Segments	0.123 (0.113)	0.180 (0.181)	0.023 (0.086)	0.003 (0.131)	-0.146 (0.165)	0.110 (0.076)
R&D	0.887 (0.924)	0.133 (0.758)	0.961* (0.581)	0.312 (0.517)	0.197 (0.805)	0.922* (0.509)
Investment	-7.056** (3.598)	-0.494 (4.840)	-0.643 (3.191)	-5.121 (3.512)	-0.609 (3.110)	-4.535 (3.096)
Tobin's q	-0.031 (0.146)	0.084 (0.223)	-0.059 (0.095)	0.017 (0.096)	-0.050 (0.120)	-0.024 (0.079)
CEO Tenure _{t-1}	0.006 (0.016)	0.073* (0.039)	0.008 (0.012)	0.023 (0.019)	-0.002 (0.015)	0.026** (0.012)
Institutional Own _{t-1}	-0.145 (0.815)	-0.087 (0.920)	-0.211 (0.707)	-0.339 (0.532)	0.078 (0.746)	-0.455 (0.571)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	2120	2248	2176	2192	1633	2735
R ²	0.412	0.419	0.343	0.448	0.456	0.342

Notes. This table reports investment efficiency regressions for the years 1992-2013. Panel A (Panel B) uses RVA (RINV) as a proxy for investment efficiency. Models 1, 3, and 5 use the subsample of firms with low agency risk, and models 2, 4, and 6 the subsample of firms with high agency risk. The dependent variable is RVA for the years 1992-2013. To calculate RVA, firm- and industry-adjusted segment investment are weighted by the difference between the industry median Tobin's q for that segment and the sales-weighted average Tobin's q for the firm. RINV is the sales-weighted sum of firm- and industry-adjusted investment in high Tobin's q segments minus the sales-weighted sum of firm- and industry-adjusted investment in low q segments. RVA and RINV is multiplied by 100. High agency risk environments are found in firms with low lagged CEO *Incentive Ratio*, low lagged CEO *log(Delta)* and high lagged *FCF*. Low agency risk environments are found in firms with high lagged CEO *Incentive Ratio*, lagged CEO *log(Delta)* for their CEOs and low lagged *FCF*. All variable definitions are given in appendix. Subsample is formed based on the yearly median values of each variable. Regression models are estimated with calendar year dummy variables and firm fixed effects.

Standard errors are clustered at the firm level, and are reported in parenthesis. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.