Executive compensation and internal capital market efficiency

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ABSTRACT

We document that chief executive officer (CEO) incentive compensation plays an important role in determining internal capital market (ICM) allocation efficiency. Our results suggest that CEO equity-based compensation can be effective in ameliorating inefficiencies in internal capital allocation decisions. We find that while stock grants play an important role in motivating CEOs to make more efficient internal capital allocation decisions, there is surprisingly no discernible influence of stock options. Our analysis supports the view that private benefits derived by managers are increasing in internal capital misallocation. We also document a strong positive link between CEO incentive compensation and excess value of diversified firms suggesting that the diversification discount can be ameliorated with CEO incentive compensation. The study contributes to the ICM literature and the literature on conglomerate diversification discount.

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1. Introduction

Optimal allocation of scarce resources is at the heart of wealth creation in a free market economy. Efficient *external* capital markets facilitate in this process by allocating capital to the most productive investments. Similarly, efficiency of the *internal* capital market is critical to value creation in a multi-segment firm. Allocation of internal capital rests at the discretion of top managers who are expected to channel funds to segments with the highest value-added projects. Therefore, the value created from

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investments in a multi-segment firm critically hinges on how effectively internal capital is allocated among various divisions by the top managers at the corporate headquarters.

These managers have control rights that allow them the discretion of "winner-picking" when it comes to allocating capital between divisions. The ability to allocate corporate resources also presents the top executives at the headquarters (we designate the chief executive officer (CEO) to represent this group) with the opportunity to extract private benefits at the cost of misallocating corporate resources leading to value destruction for the shareholders of multi-segment firms. This study examines the link between CEO incentive compensation and the efficiency of internal capital markets. Studying this linkage will contribute to the internal capital markets literature by shedding light on the importance of CEO compensation structure in internal capital allocation efficiency.

We contend that if the costs to headquarters (HQ) managers for misallocating corporate resources are made prohibitive, or at least greater than the associated private benefits, then the managers are much less likely to engage in value destroying internal capital *mis*allocation decisions. Executive compensation can be a powerful mechanism to achieve this goal of aligning HQ managers' and shareholders' interests, and hence making it costly for these managers to misallocate capital among the various divisions of the firm.[1] It therefore begs the important, yet unaddressed, question in the internal capital markets literature as well as the vast body of literature on diversification discount: what is the role of CEO compensation in reducing agency conflicts that cause internal capital misallocation and shareholder value destruction in multi-segment firms? In other words, does CEO incentive compensation improve internal capital market (ICM) efficiency? We believe that the answer to this question is important in finding a solution to improving the efficiency of internal capital markets and thereby stemming value destruction in multi-segment firms.

Given the importance of inter-divisional capital allocation efficiency in corporate value creation, the study of internal capital markets has been the focus of many prior studies in the finance literature. The question of whether there are efficiency gains from internal capital markets remains controversial. Compelling arguments are made that support both sides of the issue. Williamson (1986) makes the case that diversification and establishment of an internal capital market will allow better sharing of inside information and more efficient allocation of capital among competing investments within the firm because information asymmetry and agency costs will render financing from external capital markets either inefficient or prohibitive (see also Alchian, 1969 and Williamson, 1970). A similar line of reasoning predicting efficiency gains from internal capital markets is adopted by Weston (1970), Gertner et al. (1994), Stein (1997) and Matsusaka and Nanda (2002). Maksimovic and Phillips (2002) provide empirical evidence that diversified firms allocate resources efficiently, while Hadlock et al. (2001) conclude that diversification improves access to external capital markets.

The opposing side of the debate on efficiency gains/losses from internal capital markets allocations suggests that diversification leads to inefficient investment (capital allocation) decisions within the different segments because of managerial agency problems and this results in a decline in firm value (e.g. Lang and Stulz, 1994 and Berger and Ofek, 1995). The general theme in this literature is that conglomerate firms destroy value due to the existence of two types of agency conflicts; one between the corporate managers at headquarters and shareholders, and the other between HQ managers and rent-seeking divisional managers. In this framework, the HQ managers (i.e. the CEO) derive private benefits of control from all divisions whereas the divisional managers extract private benefits from their divisions only.

Several studies support the view that value destruction in multi-segment firms is due to misallocation of internal capital (see Meyer et al., 1992; Rajan and Zingales, 1996; Lamont, 1997; Shin and Stulz, 1998; Scharfstein, 1998; Rajan et al., 2000; and Scharfstein and Stein, 2000). Scharfstein and Stein (2000) and Rajan et al. (2000) develop theoretical models of internal capital market based on agency conflicts. Scharfstein and Stein incorporate the two types of agency conflicts in their model to explain misallocation of resources and rent-payment by the CEO to the divisional managers who receive unjustifiably more resource allocation for their divisions. Further, Shleifer and

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[1] Recent studies have documented the importance of executive compensation structure in influencing major corporate financial decisions that are value enhancing for the shareholders (see Datta et al., 2001, among others).

Vishny (1989) argue that managers can use diversification to entrench themselves by engaging in manager-specific investments.

The two types of agency conflicts discussed above manifest as "socialism" in allocation of internal capital and parochial rent-seeking/lobbying behavior by self-serving divisional managers. More specifically, CEOs can extract private benefits of control by over-investing free cash flow for empire-building (Jensen, 1986), engaging in inefficient cross-subsidization (Lamont, 1997; Shin and Stulz, 1998; and Scharfstein, 1998), funding value destroying "pet" projects (Shin and Stulz, 1998), and giving in to rent-seeking by divisional managers. It is noteworthy that rent-seeking can be more of a problem with managers of weaker divisions because they face a relatively lower opportunity cost of spending their time and effort lobbying the headquarters (see Scharfstein and Stein, 2000). In addition, internal capital markets give the CEOs the ability to avoid monitoring from external financial markets allowing diversified firms to undertake inefficient investments.[2]

While all of the aforementioned agency-based factors have been identified as causes of value destruction in multi-segment firms, previous studies are silent on the important empirical link between CEO incentive compensation that captures the degree of HQ manager-shareholder agency problem and the efficiency of internal capital markets. Executive incentive compensation, by aligning manager-shareholder interests, can influence corporate decision-making resulting in more efficient internal capital allocation.

We contend that resolving the first type of agency conflict, which exists between the CEO (HQ managers) and the shareholders, lies at the heart of stemming value destruction in multi-segment firms. We reason here that if the interest alignment between the CEO and the shareholders is strong, then the cost to the CEO of misallocating corporate resources by giving in to the rent-seeking and distortionary lobbying efforts of the divisional managers will be prohibitive relative to any private benefits that may accrue to the CEO.[3] This study therefore focuses on the role of CEO incentive compensation in internal capital allocation efficiency.[4,5]

Clearly, the above logic is based on the implicit assumption that CEO's derivation of private benefits is increasing in internal capital misallocation, as suggested by the Scharfstein and Stein (2000) model. However, most other theoretical models assume that while the CEO derives private benefits from investments, these benefits are not increasing in internal capital misallocation (see Stein, 1997 and Rajan et al., 2000). These studies argue that the CEOs have an incentive to optimally allocate capital across divisions so that they can consume more in private benefits. Therefore, another important contribution of our study is that by empirically examining whether private benefits derived by HQ managers are positively linked to internal capital misallocation, we can distinguish between these alternative assumptions about the relation between private benefits and investment misallocation.

For a sample of 1311 diversified-firm years during the period 1992–2003, we document compelling evidence supporting our central hypothesis that managerial equity-based incentives play an important role in more efficient allocation of internal capital. Our results also underscore the importance of differentiating between various types of equity-based compensation because we find that they have very different effects on internal capital allocation efficiency. Our findings show that CEO stock-

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[2] However, a number of recent studies question the interpretation of the earlier researchers (see Graham et al., 2002; Campa and Kedia, 2002; and Villalonga, 2004).

[3] Meyer et al. (1992) introduce the concept of influence costs and lobbying efforts in the context of multi-divisional organizations. They conclude that the prospect of layoffs and organizational decline imposes additional influence costs that would be reduced in the absence of layoffs and would be ameliorated or eliminated in focused organizations.

[4] A separate strand of the executive compensation literature addresses the issue of why firms do not offer optimal incentives to their executives in the first place. For example, Core et al. (2003) argue that optimal contracts evolve over time. They state that firms experiment with their executive compensation where some experiments fail and others succeed. Based on this view, the company is doing its best to provide the optimal incentives; however, its attempts sometimes may not be successful. In addition, companies may differ in terms of their beliefs about what constitutes an optimal compensation contract. Another rationale provided by Shleifer and Vishny (1997) and Zingales (1998) for observing deviations from optimal contracts is the presence of transaction costs that can rule out continuous re-contracting. This could result in contracts gradually deviating from optimality.

[5] Wulf (2002) focuses on the agency problem between HQ managers and divisional managers. Using proprietary data, she examines the relationship between incentive compensation of divisional managers and the allocation of capital among segments in multi-divisional firms.

holdings have a significant influence in enhancing internal capital market efficiency, while options compensation surprisingly does not emerge as a significant determinant of internal capital market efficiency. Collectively, these findings suggest that better alignment of CEO (HQ managers) incentives with shareholders interests result in more efficient internal capital allocation. Our results also suggest that private benefits by managers at HQ are indeed positively related to internal capital misallocation and supports Scharfstein and Stein's (2000) assumption. For completeness, we also explore the relationship between CEO incentive compensation and excess value of a diversified firm. These results complete the circle by linking our main finding that CEO incentive compensation has a strong positive influence on internal capital market efficiency, which in turn manifests in higher excess firm value.

The rest of the paper is organized as follows. In Section 2 we present the sample formation process and data description. Section 3 delineates the different measures of internal capital market efficiency and various measures of CEO incentive compensation used in the analysis. The empirical findings are presented in Section 4. Conclusions follow.

2. Sample formation and data description

This section describes the sample formation process and data sources. Three sets of databases are employed to construct the sample and obtain the necessary data: firm-level financial data from Compustat database, segment-level financial data from Compustat Industrial Segment (CIS) database and executive compensation data from Standard and Poor's ExecuComp database. To identify the sample of diversified firms that we use in the study, we start with all firms with multiple industrial segments in the Compustat Industrial Segment file during the period, 1992–2003. We focus on the twelve-year period, 1992–2003, because ExecuComp data are available from 1992.

We apply the following screening criteria to obtain the final sample of diversified firms: (1) Multi-segment firms which do not have information on sales, assets or capital expenditure are deleted. (2) We exclude firms that have $20 million or less in total sales. (3) Following Berger and Ofek (1995), we eliminate firms whose sum of segment sales are not within 1% of the total firm sales and whose sum of the segments' assets are not within 25% of the firm's assets. For firms where the sum of segments' asset is less than firms' assets, we allocate the difference to the segments based on the weights of segments to ensure that the sum of segment assets adds up to total assets. (4) Firms with segments in one-digit SIC codes of 0, 6 or 9 are eliminated.[6] (5) We eliminate pseudo conglomerates, namely firms that have all their business segments in the same industry. We define diversified firms as firms with at least two segments operating in different three-digit SIC codes. This is a necessary selection criterion given the way the internal capital efficiency measures are constructed. (6) We require that we obtain a portfolio of single segment industry matches for our sample of multi-segment diversified firms. For each division of a multi-segment firm we require to have five industry-matched firms based on three-digit SIC code. (7) The multi-divisional firm has the requisite compensation data from ExecuComp database and certain firm-specific information on the Compustat database. (8) Finally, because some of the constructed variables are based on two years of firm data, this in effect restricts the sample to firms that have at least two years of complete data available. Imposing the above selection criteria produces a final sample of 1311 diversified firm years. [7,8]

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[6] We eliminate SIC 0 (agriculture firms), SIC 6 (financial firms where market-to-book ratios are difficult to interpret) and SIC 9 (non-operating divisions).

[7] To remove the effects of extreme outliers present in some of the variables, we trim them by 1 percent on either end of the tails.

[8] The criteria requiring an industry match and availability of complete data (compensation and financial data) *each* resulted in loss of over 4000 firm-year observations while the need for two years of financial data to construct some variables reduced the sample by 692 firm-year observations.

3. Measures of internal capital market efficiency and CEO incentives

3.1. Measures of internal capital market efficiency

In this section, we describe three different measures of internal capital market efficiency used in the study. For transfers to be efficient, internal capital should be allocated to divisions with better investment opportunities and away from those with poorer investment prospects. Following the internal capital market literature, segment capital expenditures is used to proxy for investments. Our first measure of internal capital market efficiency is the industry-adjusted value added, *RVIA*, defined as:

$$RVIA = \sum_{j=1}^{n} \omega_j (q_j - \bar{q}) \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right] \tag{1}$$

where ω_j is the proportion of segment j's book value of assets to firm assets, BA_j is the book value of segment j's assets, and q_j is segment j's q proxied by the mean asset-weighted Tobin's q of single segment firms operating in the same three-digit SIC industry as segment j. The variables q_j, BA_j, and ω_j are measured as of the beginning of the period. Industry q is used to proxy for investment opportunities of segments within the diversified firms. Tobin's q is the market-to-book asset ratio, where market value is the sum of the market value of common equity (Compustat item #199*#25) and book value of assets (Compustat item #6) minus book value of common equity (Compustat item #60) minus accumulated deferred taxes (Compustat item #74). $\bar{q}$ is the mean asset-weighted imputed q_j's of the multi-divisional firm. In essence, the term $(q_j - \bar{q})$ compares segment j's investment opportunities to those of the firm. Segments endowed with better investment opportunities, $(q_j - \bar{q} > 0)$, should obtain more resources if internal allocations are to be efficient while segments with negative $(q_j - \bar{q} < 0)$ should obtain less resources. $Capex_j/BA_j$, representing the investment ratio of segment j, is the ratio of capital expenditure of segment j (as of the end of the period) divided by the segment's assets (as of the beginning of the period) whereas $\frac{Capex_j^i}{BA_j^i}$ is the asset-weighted ratio of capital expenditure to assets for peer single-segment firms operating in the same three-digit SIC industry as segment j.

The expression $[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i}]$ is intended to capture the deviation of the investment ratio of segment j from that of the corresponding asset-weighted ratio of single segment peer firms in the same industry. This differential serves to proxy for "abnormal" investment ratio of the segment when compared to the industry, i.e., transfer of resources.

Efficient transfers occur when a segment with an above average q has a greater-than-average investment and a below average q segment receives below average investment. In these cases, *RVIA* is positive. Likewise, inefficient transfers occur when an above average q segment receives less than average investment ratio and a below average q segment receives a greater than average investment ratio and *RVIA* will be negative.

Our second measure of efficiency is the relative value added from internal capital allocation, *RVA*, as devised by Rajan et al. (2000) which incorporates both firm and industry adjustments.

$$RVA = \sum_{j=1}^{n} \omega_j (q_j - \bar{q}) \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} - \sum_{j=1}^{n} \omega_j \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right] \right] \tag{2}$$

where ω_j, BA_j, $\frac{Capex_j^i}{BA_j^i}$, q_j, and $\bar{q}$ are as defined earlier. Again, the variables q_j, BA_j, and ω_j are measured as of the beginning of the period while *Capex* is measured as of the end of the period. While the expression $[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i}]$ captures the deviation of the investment ratio of segment j from that of single segment peer firm in the same industry (i.e., an industry-adjusted investment ratio), the expression $\sum_{j=1}^{n} \omega_j [\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i}]$ adjusts for differences in capital availability for the sample firm

vis-à-vis the single segment counterparts. The implications from the above *RVA* measure is that segments with above (below) average investment opportunities which are allocated more (less) resources on an industry and firm adjusted basis constitute efficient internal transfers.

Finally, our third measure of internal capital market efficiency is the absolute value added (*AVA*) measure as devised by Rajan et al. (2000). The only difference between this measure and our *RVIA* measure is in the way we capture the relative investment opportunities of a segment. In the *RVIA* measure, we use the mean asset-weighted imputed q_j's of the diversified firm as the benchmark, while the corresponding benchmark is 1 for the *AVA* measure.

$$AVA = \sum_{j=1}^{n} \omega_j (q_j - 1) \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} - \sum_{j=1}^{n} \omega_j \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right] \right]. \tag{3}$$

3.2. Measure of CEO incentives

To capture CEO incentives we use *Total Compensation Sensitivity* defined as the sum of the CEO's share ownership and the product of the CEO's option delta and option ownership, scaled by the number of shares outstanding.[9] This composite measure is also decomposed into two components: *Stock Compensation Sensitivity* and *Option Compensation Sensitivity*. The first component, *Stock Compensation Sensitivity*, is computed as the CEO's ownership, including restricted shareholdings, as a fraction of total firm shares outstanding. To calculate *Option Compensation Sensitivity* we multiply the respective option delta by the corresponding options held by the CEO and scale this product by the total number of shares outstanding.

Options Delta is measured as the change in value of all stock options held by the CEO with respect to a one percent change in the stock price. To compute the option delta for current grants, we use the partial derivative of the option's value with respect to stock price. Option value is calculated using the modified Black–Scholes (1973) model which adjusts for dividend payments.[10] For previously granted options, ExecuComp does not provide the parameters of the option grant. To compute the value and the option delta of such grants, we follow Core and Guay's (1999) one-year approximation method to estimate option maturity and the stock price.[11] We use monthly stock returns over the previous 60 months to estimate the standard deviation of equity returns. The dividend yield is estimated based on the most recent three years' dividend yield.

All incentive metrics are measured as of the year-end prior to the year of the efficiency measures because we argue that equity incentives in the preceding year are expected to influence the internal capital allocation in the current year.

4. Empirical findings

4.1. Descriptive statistics

Table 1 presents a summary of the descriptive statistics of firm characteristics, ICM efficiency measures and CEO compensation characteristics for 1311 firm-years of diversified firms. The firms have a mean (median) book value of assets of \$4.78 (\$1.85) billion. We include three measures of diversification in the study: the number of discrete segments reported in the Compustat segment tapes,

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[9] We thank the referee for suggesting this composite incentive measure instead of capturing the effects of stock and options compensations separately.

[10] The partial derivative of the modified Black–Scholes option value with respect to the stock price is $e^{-yT} N(d_1)$ where $d_1 = \{[\text{Ln}(S/X) + (r - y + \sigma^2/2)T]/\sigma \sqrt{T}\}$, X is the strike price, r is the risk-free rate as measured by the yield on Treasury matching the option's time to maturity, y is the dividend yield over the preceding three years, T is the number of years to option expiration and σ is the annualized standard deviation of stock return over the past 60 months. The sensitivity of option value to stock price is the partial derivative multiplied by the stock price/100.

[11] We thank John Core and Wayne Guay for sharing their computer programs that utilize their methodology to estimate stock options related sensitivities. See Appendix A for a summary of their one-year approximation method to estimate option delta for previously granted options.

Table 1

Descriptive statistics of firm characteristics, internal capital market efficiency measures and CEO compensation for diversified firms

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
	Firm Characteristics				
Book value of assets ($ bil)	$4.78	$1.85	$.09	$113.00	$7.78
Capex/Total assets	6.59	5.36	0.35	39.34	5.02
R&D/Sales (%)	1.74	0.00	0.00	53.81	3.64
Inverse of Herfindahl Index	2.03	1.92	1.02	6.70	0.74
Diversity ratio	0.83	0.84	0.28	1.40	0.11
Number of segments	2.84	3.00	2.00	10.00	1.01
	ICM Efficiency Measures				
RVIA	−0.00135	0.00000	−0.1138	0.1118	0.0135
RVA	−0.00154	0.00000	−0.1327	0.1115	0.0150
AVA	−0.00284	−0.00215	−0.4928	1.2283	0.0628
	Compensation Characteristics				
Total Compensation Sensitivity (%)	22.65	4.57	0.00	376.36	53.00
Total compensation ('000)	$3343.09	$1831.59	$205.10	$202,190.00	$8096.00
Value of stock options granted in current year ('000)	$2033.64	$456.32	$0.00	$229,870.00	$9921.00
Value of all options ('000)	$13,079.13	$3462.81	$0.00	$1,145,040.00	$50,154.00
Value of stocks plus options ('000)	$49,394.70	$10,196.26	$0.00	$3,914,646	$187,350
Options delta ('000)	$211.79	$65.21	$0.00	$13,444.30	$699.46
Stock ownership (%)	2.22	0.22	0.00	56.98	6.01
Restricted stock ownership (%)	0.04	0.00	0.00	2.24	0.14

This table provides summary statistics for 1311 firm-years of diversified firms for the period 1992–2003. All variables are defined in Appendix B. CEO stock ownership and restricted stock ownership are reported as a percentage of total shares outstanding. Data are obtained from Compustat tapes and Standard and Poor's ExecuComp database.

the diversity ratio, and the inverse of the sales-based Herfindahl Index $(1/H)$. All three variables are measured as of the end of the year.

The first and the simplest metric is the *Number of segments* in the firm; the second measure, *Diversity*, proposed by Rajan et al. (2000), captures the disparity among asset-weighted opportunities within the firm and is calculated as the coefficient of variation of segment qs weighted by the fraction of individual segment's asset to total firm asset.

$$Diversity = \frac{\sqrt{\sum_{j=1}^{n} \frac{(\omega_j q_j - \varpi q)^2}{n-1}}}{\frac{\sum_{j=1}^{n} q_j}{n}} \tag{4}$$

where q_j is market-to-book ratio of the segment proxied by the asset-weighted q of single segment firms in the same industry as the firm; ω_j is the weight in terms of assets of segment j; and n is number of the segments of the diversified firm.

Our third diversity measure is the inverse of the sales-based Herfindahl Index $(1/HI)$, where the Herfindahl Index is defined as follows:

$$HI = \sum_{j=1}^{n} \left(\frac{Sales_j}{\sum_{j=1}^{n} Sales_j} \right)^2 \tag{5}$$

where n is the total number of firm segments and j indicates segment j.

Our median sample firm is composed of three distinct segments similar to the results reported by Berger and Ofek (1995), Rajan et al. (2000), and Aggarwal and Samwick (2003). We compute the mean (median) industry-adjusted relative value added (*RVIA*) to be 0.00135 (0.00), while the comparable figures for industry and firm adjusted relative value added (*RVA*) and absolute value added (*AVA*) due to internal capital allocation are −0.00154 (0.00) and −0.00284 (−0.00215) respectively. We note that the reported negative sample mean measures of efficiency suggest inefficient internal capital allocation, on average.

Due to the skewness in the compensation characteristics we focus our discussion on the median values. The median CEO annual total compensation package of $1.83 million, $456,320 of which is the value of currently granted options. The median total compensation package for our sample firms is comparable to that reported by Anderson et al. (2000) of $1.53 million for multi-segment firms for an earlier sample period.

The median Black–Scholes value of all stock option grants is $3.463 million. The mean (median) *Total Compensation Sensitivity* for our sample is 2.266 (0.236) percent. Table 1 also reveals that the median dollar value of options delta is $65,210 while portfolio (unreported in the table) capturing all of the equity-based incentives (including all options plus restricted and unrestricted stockholdings) has a median value of $140,340 indicating that CEO's total wealth changes by $140,340 for each one percent change in the stock price. This is somewhat higher than that reported by Core and Guay (1999) for an earlier sample period of 1992–1997. This difference suggests that the sensitivity of CEO incentive compensation to stock price has increased during the 1998–2003 period. This increase underscores the fact that there is also growth in the proportion of CEO equity compensation during this period. For example, during our sample period, the mean (median) fraction of current option grants to total compensation has increased steadily from 29.37% (17.22%) in 1992 to 43.64% (39.97%) in 2003. Collectively, these figures suggest that ignoring previously granted options and CEO stockholdings underestimate the size of equity based incentives.

Our univariate results solidify our motivation to study the link between CEO incentive compensation and the allocation of internal capital in multi-segment firms. Prior studies that are empirically silent on the influence of managerial equity compensation on internal capital allocation efficiency are ignoring an important part of their analysis of value-destruction in multi-segment firms.

4.2. Multivariate analysis

4.2.1. Executive equity compensation and internal capital market efficiency

In this section, we test our central hypothesis that CEO incentive compensation plays a pivotal role in internal capital market allocation efficiency and the associated value-creation (or destruction) in multi-segment firms. In Table 2 we report estimates for nine regression models, with three of different model specifications for each of the three measures of internal capital market efficiency (*RVIA*, *RVA* and *AVA*) as the dependent variable. All regression models are estimated with calendar year dummy variables (not reported) and firm fixed effects. The fixed effects regressions are estimated by subtracting the firm-specific time-series mean for each variable from the observation. This is equivalent to adding a dummy variable for each sample firm (see Barclay and Smith, 1995).

As argued in Section 3.2, the CEO incentive compensation variable *Total Compensation Sensitivity* used in the regressions are measured asynchronously as of the year-end preceding the year for which the internal capital market efficiency metrics (*RVIA*, *RVA* and *AVA*) are computed. As suggested in Scharfstein and Stein (2000) model, if private benefits derived by managers are increasing in internal capital misallocation, we expect a positive relation between our incentive compensation variable and internal capital market efficiency measures. Other theoretical treatments of diversified firms do not necessarily assume any link between private benefits derived by headquarters managers and internal capital misallocation.

In all regression models presented in Table 2, our focus variable *Total Compensation Sensitivity* is positive and highly significant. This result implies that a 10% increase in this variable from its mean increases internal capital market efficiency measured by *RVIA* by 13.42%. Based on this result, we conclude that CEO incentive compensation is a significant determinant of internal capital market efficiency. The significant relation between managerial equity compensation and internal capital market efficiency measures also implies that private benefits by managers at HQ are indeed positively related to internal capital misallocation and supports Scharfstein and Stein (2000).

In the regressions presented in Table 2, we include a set of *control variables* to account for relevant firm characteristics in the context of studying internal capital market efficiency of multi-segment firms. We include the number of discrete segments reported in the Compustat segment tapes, the diversity ratio and the inverse of the sales-based Herfindahl Index ($1/H$) to proxy for the diversity

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Table 2
The role of CEO equity-based incentives on internal capital market efficiency

Independent variables	RVIA			RVA			AVA		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Total Compensation Sensitivity	0.0080	0.0081	0.0080	0.0077	0.0078	0.0077	0.0027	0.0026	0.0026
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Number of segments	0.0004			0.0003			0.0051		
	(0.64)			(0.67)			(0.12)		
Diversity		0.0133			0.0102			−0.0173	
		(0.05)			(0.09)			(0.49)	
1/HI			−0.0007			−0.0005			−0.0069
			(0.68)			(0.71)			(0.17)
R&D/Sales	0.0272	0.0307	0.0265	0.0204	0.0231	0.0199	0.1401	0.1314	0.1315
	(0.54)	(0.49)	(0.55)	(0.61)	(0.56)	(0.62)	(0.40)	(0.43)	(0.43)
Firm size	0.0019	0.0015	0.0020	0.0009	0.0006	0.0010	0.0260	0.0274	0.0271
	(0.31)	(0.43)	(0.19)	(0.61)	(0.75)	(0.57)	(0.00)	(0.00)	(0.00)
Capex/Total assets	−0.0282	−0.0267	−0.0288	−0.0471	−0.0460	−0.0476	0.4868	0.4794	0.4798
	(0.08)	(0.10)	(0.08)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tobin's q	0.0004	0.0002	0.0004	0.0003	0.0002	0.0003	0.0020	0.0022	0.0023
	(0.76)	(0.84)	(0.74)	(0.79)	(0.86)	(0.77)	(0.65)	(0.61)	(0.59)
CEO Change Dummy	−0.0012	−0.0013	−0.0011	−0.0006	−0.0007	−0.0006	−0.0013	−0.0014	−0.0014
	(0.40)	(0.33)	(0.39)	(0.64)	(0.57)	(0.64)	(0.79)	(0.78)	(0.79)
Intercept	−0.0302	−0.0343	−0.0286	−0.0161	−0.0193	0.0149	−0.4448	−0.4334	−0.4494
	(0.35)	(0.28)	(0.37)	(0.57)	(0.50)	(0.61)	(0.00)	(0.00)	(0.00)
R^2	47.46%	47.79%	47.55%	50.02%	50.19%	50.02%	61.60	61.57	61.67

This table presents regression estimates with three measures of internal capital market efficiency, RVIA, RVA, and AVA as the dependent variable and CEO equity-based compensation variable, *Total Compensation Sensitivity*, as the focus variable. The dependent variables (*RVIA*, *RVA*, and *AVA*), the focus variable (*Total Compensation Sensitivity*) and the control variables (*Number of segments*, *Diversity*, 1/*HI*, *R&D/Sales*, *Firm size*, *Capex/Total assets*, *Tobin's q*, and *CEO Change Dummy*) are as defined in Appendix B. All regressions are estimated using calendar year dummy variables (not reported) and firm fixed effects based on a sample of 1311 diversified firm-year observations during the period 19920–2003. *P*-values are reported in parentheses below the coefficient estimates.

of investment opportunities in the firm. Appendix B provides detailed definitions of all the variables used in the regression analysis.

Rajan et al. (2000) predict that an increase in the diversity of segment qs will lead to an increase in inefficient transfers, i.e. from segments with above average asset-weighted investment opportunities to segments with below the firm's average investment opportunities. Thus, the greater segment diversity provides more opportunities for the CEO to misallocate internal capital and reap private benefits. The coefficients of the *Number of segments* variable in Models 1, 4 and 7 are statistically insignificant, The *Diversity* variable is significantly positive in Models 2 and 5 when *RVIA* and *RVA* are used as the dependent variable, while the coefficients of 1/*HI* (in Models 3, 6 and 9), although consistently negative, are statistically insignificant in all three panels. Our results do not find support for the notion that greater diversity necessarily leads to misallocation of internal capital after controlling for CEO incentive alignment.

We also control for variation in information asymmetry between the sample firms by including research and development to sales ratio (*R&D/Sales*). We reason that high information asymmetry can provide cover for managers to misallocate internal capital to gain private benefits to the detriment of the shareholders. In this context, we must also recognize that firms with high information asymmetry also typically have high managerial incentive compensation to alleviate the problem of opacity of managerial decisions and difficulty to externally monitor such firms (see Smith and Watts, 1992). The *R&D/sales* ratio emerges as insignificant in all three panels of Table 2. We also use intangible assets to total assets as another proxy for information asymmetry. The findings are similar to those obtained using *R&D/sales* ratio. We do not report these results in the interest of brevity.

Our model specification also includes the control variables *Firm size*, defined as the log of book value of total assets, and *Capex/Total assets*, defined as capital expenditures to book value of total assets, as control variables. Following previous studies, we use *Firm size* as a "catchall" control variable. *Firm size* is positive in all the models perhaps because it is capturing firm transparency (opposite of

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information asymmetry). However, this variable's coefficients are statistically significant only in the *AVA* regressions. The coefficients of *Capex/total assets* are significantly negative in the *RVIA* and *RVA* models indicating that larger investments can lead to less efficient allocations.

Following Rajan et al. (2000), we also include the sample firm's *Tobin's q* as an additional control variable but find it to be insignificant in all regressions.[12] This finding suggests that the firm's investment opportunities, that may be influenced by past stock price performance, do not affect the relationship between incentive compensation and internal capital market allocation efficiency documented in this analysis. To avoid relating investment efficiency to incentives of the previous CEO, in the case of a CEO change, we include a *CEO Change Dummy* that assumes a value of one for a CEO change and zero otherwise. The coefficients of this variable are statistically insignificant in all regression models presented in Table 2. The regression models presented in Table 2 have *R*-squared values ranging from 47.46% to 61.67%.

In summary, we find compelling empirical evidence supporting our central hypothesis that managerial incentives play an important role in more efficient allocation of internal capital.[13] Put differently, our results suggest that CEO equity-based compensation can be effective in ameliorating the distortionary (value destroying) internal capital allocation decisions that can result from the existence of the two types of agency problems described earlier. This finding is robust to different model specifications.[14]

Further, to check the robustness of our results presented in Table 2, we re-estimate our regressions including only firms with no change in CEO relative to the previous year to circumvent the mismatching of CEO compensation with the internal capital market efficiency measures. The sample size for this analysis is 1044 diversified firm-year observations. Our results are highly robust to this selection criterion. We present the results of this analysis in Table 3. As an additional robustness check, we also re-estimate the regressions presented in Table 2 by selecting firms whose segments stay exactly the same from one year to the next. This selection criterion yields 759 firm-year observations. The results of this analysis indicate that our results are highly robust to this restriction. We do not report the results of this analysis for the sake of brevity.

4.2.2. Equity-based compensation sensitivities and internal capital allocation efficiency

Guay (1999) argues that not only the slope but also the convexity in the incentive scheme is important in effectively controlling agency conflicts between managers and shareholders. His evidence suggests that the convexity in the CEO's equity-based payoff function is important in influencing CEO investment behavior. In Table 4 we explore the differential effects of *Options Compensation Sensitivity* and *Stock Compensation Sensitivity*, the two components that make up our *Total Compensation Sensitivity* measure. We present three regression models in Table 4 with *Options Compensation Sensitivity* and *Stock Compensation Sensitivity* as the focus variables where the dependent variable is *RVIA* in Model 1, *RVA* in Model 2, and *AVA* in Models 3. We define *Options Compensation Sensitivity* and *Stock Compensation Sensitivity* in Appendix B. The same control variables used in Table 2, such as *Number of segments*, *R&D/Sales*, *Firm size*, *Capex/Total assets*, *Tobin's q*, and *CEO Change Dummy*, are included in the regressions.

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[12] We get qualitatively similar results when the reciprocal of Tobin's *q* is used in the regression models.

[13] Our results are robust to other measures of incentive compensation. Specifically, we include (a) the delta of the CEO's portfolio of stockholdings and options holdings scaled by total annual CEO compensation and (b) total equity-based compensation as a fraction of total CEO compensation. We also obtain qualitatively similar results when we estimate OLS regressions for the models presented in Table 2.

[14] Scharfstein (1998) reports that "socialism" in capital allocation is related to agency problems between headquarters and investors. Using a sample of 136 conglomerates (with available management ownership information) for the year 1979, he studies capital expenditures and focuses on management's ownership stake in the firm rather than executive compensation to measure manager-shareholder interest alignment. In contrast, our analysis examines the link between executive compensation (differentiating between the various components of the compensation package) and the efficiency of internal capital allocation. Given that the importance of executive compensation structure, especially the stock option component of the package, has grown significantly since 1979, it is essential to broaden the measure of interest alignment between managers and shareholders and examine the role executive compensation in internal capital allocation efficiency.

Table 3
The role of CEO equity-based incentives on internal capital market efficiency for firm-years with no CEO changes

Independent variables	RVIA	RVIA	RVA	RVA	AVA	AVA
Total Compensation Sensitivity	0.0083	0.0083	0.0084	0.0084	0.0031	0.0031
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Number of segments	−0.0002		−0.0002		0.0050	
	(0.83)		(0.77)		(0.17)	
Diversity		0.78		0.0060		−0.0267
		(0.26)		(0.35)		(0.36)
R&D/Sales	0.0262	0.0284	0.0097	0.0115	0.0990	0.0880
	(0.57)	(0.54)	(0.82)	(0.79)	(0.61)	(0.65)
Firm size	0.0035	0.0031	0.0024	0.0021	0.0306	0.0329
	(0.07)	(0.10)	(0.18)	(0.24)	(< 0.01)	(< 0.01)
Capex/Total assets	−0.0327	−0.0312	−0.0552	−0.0539	0.5420	0.5314
	(0.06)	(0.08)	(0.00)	(0.00)	(< 0.01)	(< 0.01)
Tobin's q	0.0001	0.0001	0.0001	0.0001	0.0027	0.0031
	(0.91)	(0.96)	(0.96)	(0.92)	(0.61)	(0.56)
Intercept	−0.0535	−0.0557	−0.0359	−0.0376	−0.5155	−0.5078
	(0.10)	(0.09)	(0.23)	(0.09)	(< 0.01)	(< 0.01)
R^2	50.06%	50.14%	52.34%	52.39%	61.53%	61.47%

This table presents regression estimates with three measures of internal capital market efficiency, RVIA, RVA, and AVA as the dependent variables. We use *Total Compensation Sensitivity* as the focus variables. The dependent variables (*RVIA, RVA,* and *AVA*), the focus variable (*Total Compensation Sensitivity*) and the control variables (*Number of segments, Diversity, R&D/Sales, Firm size, Capex/Total assets,* and *Tobin's q*) are as defined in Appendix B of the paper. All results are estimated using fixed-effect regressions based on a sample of 1044 diversified firm-year observations during the period 1992–2003 for which there were no changes in CEO relative to the previous year. *P*-values (for two-tailed test) are reported in parentheses below the coefficient estimates.

Table 4
CEO options and stock compensation sensitivities and internal capital allocation efficiency

Independent variables	RVIA Model 1	RVA Model 2	AVA Model 3
Options Compensation Sensitivity	−0.0026	−0.0024	0.0012
	(0.17)	(0.17)	(0.86)
Shares Compensation Sensitivity	0.0088	0.0085	0.0027
	(0.00)	(0.00)	(0.01)
Number of segments	0.0006	0.0005	0.0054
	(0.49)	(0.54)	(0.11)
R&D/Sales	0.0466	0.0379	0.1482
	(0.31)	(0.36)	(0.39)
Firm size	0.0022	0.0011	0.0261
	(0.25)	(0.51)	(0.00)
Capex/Total assets	−0.0278	−0.0468	0.4872
	(0.09)	(0.00)	(0.00)
Tobin's q	0.0010	0.0009	0.0023
	(0.40)	(0.43)	(0.61)
CEO Change Dummy	−0.0012	−0.0006	−0.0014
	(0.38)	(0.63)	(0.79)
Intercept	−0.0393	−0.0243	−0.4494
	(0.22)	(0.40)	(0.00)
R^2	47.88	50.34	61.60

This table presents regression estimates with three measures of internal capital market efficiency, RVIA, RVA, and AVA as the dependent variable and CEO stock option sensitivities (*Options Compensation Sensitivity* and *Stock Compensation Sensitivity*) as the independent (focus) variables. The dependent variables (*RVIA, RVA* and *AVA*), the focus variables (*Options Compensation Sensitivity* and *Stock Compensation Sensitivity*) and the control variables (*Number of segments, R&D/Sales, Firm size, Capex/Total assets, Tobin's q,* and *CEO Change Dummy*) are as defined in Appendix B. All regressions are estimated using calendar year dummy variables (not reported) and firm fixed effects based on a sample of 1311 diversified firm-year observations during the period 1992–2003. *P*-values (for two-tailed test) are reported in parentheses below the coefficient estimates.

The results in Table 4 show that *Stock Compensation Sensitivity* is positive and highly significant in all three regression models, while the *Options Compensation Sensitivity* coefficients emerge insignificant in all models. Our results imply that while stock grants play an important role in motivating CEOs to

make more efficient internal capital allocation decisions, there is no discernible influence of stock options, as captured by the *Options Compensation Sensitivity* measure, on internal capital allocation efficiency. We conduct the *F*-test for the difference in coefficients for the two components of equity-based compensation and find that the difference to be significant. That is, stock compensation has a greater impact on improving internal capital market efficiency. Our finding that stock options are not significant in determining the efficiency of internal capital allocation is puzzling. We check the robustness of the results of Table 4 by re-estimating the regressions utilizing firms with no changes in the number of segments. The empirical findings are qualitatively unchanged. We do not tabulate the results of this robustness check for the sake of brevity.

4.2.3. Subperiod analysis—a further robustness check

In 1977, the Statement of Financial Accounting Standards 14 (SFAS 14) required publicly traded firms to report information for industry segments that account for more than 10% of consolidated profits, sales or assets. SFAS 14 gave firms the discretion to categorize its segments depending on its particular circumstance. In 1997, SFAS 131 began requiring firms to disclose and report segments based on the breakdown used internally by management to define its segments. The principal intent of SFAS 131 is to ensure that management's reporting of segment financial information is in accord with internal organization of business activity.

Our sample period overlaps the two regimes, i.e. business segments defined according to SFAS 14 (1992–May 1997) and to SFAS 131 (June 1997–2003). Rajan et al. (2000) examine the correspondence between segment and division categorization for a number of firms in their sample which was strictly before SFAS 131. They find that only for one out of ten firms the reported segment structure does not bear resemblance to the organizational structure. This evidence would suggest that the differences between the pre- and post-SFAS 131 periods would be minimal. Thus the impact of the change in segment reporting requirements on our results would depend on the extent to which the new reporting requirements are more in accord with internal organizations compared to SFAS 14. To test the robustness of our results presented in Tables 3 and 5, we partition our sample into two subperiods (pre- and post-SFAS 131). Our results pertaining to CEO incentive variables and their impact on internal allocations are stable and robust to the partitioning of our sample period into pre- and post-SFAS 131.[15]

4.2.4. CEO equity compensation and firm excess value

While several prior studies attribute the diversification discount in multi-segment firms to inefficient internal capital market (Berger and Ofek, 1995; Lamont, 1997; Shin and Stulz, 1998; Scharfstein and Stein, 2000; Rajan et al., 2000; among others), a number of recent studies question the interpretation of the earlier researchers (see Graham et al., 2002; Campa and Kedia, 2002; and Villalonga, 2004).

Since we find in this study that CEO equity-based compensation has the potential to reduce inefficient resource allocations, we extend our analysis by exploring the link between CEO incentive compensation and firm excess value. Although not the initial and primary focus of this study, we explore this relationship for completeness, leaving a more detailed analysis of this linkage and its implications for the diversification discount literature to future research.

In Table 5, we present firm fixed effects regression estimates to examine the relation between excess value and CEO's equity-based incentive compensation. Berger and Ofek's (1995) technique is employed to estimate the excess value of multi-segment firms using capital-to-sales multiple. We prefer the sales multiple to the capital-to-earnings multiple, because it is less likely to be influenced

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[15] To be certain that the segment reporting requirement due to the SFAS 131 did not affect our beginning-of-period asset calculation, we also use an alternate method of calculating this item where we use end-of-period asset adjusted for capital expenditure and depreciation. Our results are unchanged.

Table 5
Firm excess value and CEO equity compensation

Independent variables	Model 1	Model 2	Model 3
Total Compensation Sensitivity	0.4679	0.4711	0.4688
	(0.01)	(0.01)	(0.01)
Diversity	−0.4210		
	(0.30)		
Number of segments		−0.0092	
		(0.86)	
1/HI			−0.0763
			(0.35)
Firm size	0.3620	0.3474	0.3495
	(0.00)	(0.00)	(0.00)
Intercept	−7.1150	−7.2321	−7.092
	(0.00)	(0.00)	(0.00)
R^2	72.98%	72.95%	72.98%

This table presents regression estimates explaining multi-segment firm excess value as a function of *Total Compensation Sensitivity* based on a sample of 1311 diversified firm-year observations during the period 1992–2003. All the independent variables are as defined in Appendix B. We compute firm excess value (*EV*) using Berger and Ofek (1995) methodology as follows:

$$EV = \ln\left(\frac{MV}{I(MV)}\right)$$

where, $I(MV)$ is defined as $\sum_{i=1}^{n} Sales_i * (Ind_i(\frac{Capital}{Sales})_{mf})$, *MV* is the firm's market value defined as book value of assets plus the difference between market value and book value of equity, $I(MV)$ is the imputed value of the firm calculated as the sum of the stand-alone market values of the firm's business segments, $Sales_i$ is segment *i*'s sales value, $Ind_i(\frac{Capital}{Sales})_{mf}$ is the multiple of the matched firm's total capital to sales, where matched firm is defined as the median firm in the industry with the same 3-digit SIC code, *n* is the number of segments. All regressions are estimated using calendar year dummy variables (not reported) and firm fixed effects based on a sample of 1311 diversified firm-year observations during the period 1992–2003. *P*-values are reported in parentheses below the coefficient estimates.

by strategic reporting and income smoothing. Excess value (*EV*) is computed using Berger and Ofek (1995) methodology as follows:

$$EV = \ln\left(\frac{MV}{I(MV)}\right) \tag{6}$$

where, *MV* is the firm's market value defined as book value of assets plus the difference between market value and book value of equity, $I(MV)$ is the imputed value of the firm calculated as the sum of the stand-alone market values of the firm's business segments and is defined as $\sum_{i=1}^{n} Sales_i * (Ind_i(\frac{Capital}{Sales})_{mf})$. $Sales_i$ is segment *i*'s sales value and $Ind_i(\frac{Capital}{Sales})_{mf}$ is the multiple of the matched firm's total capital to sales, where matched firm is defined as the median firm in the industry with the same 3-digit SIC code, *n* is the number of segments. Our results are robust to the alternative calculations of $I(MV)$ using book assets as opposed to sales in computing the segment weights.

Table 5 presents three different configurations of the firm fixed effects regression model explaining *EV* with our focus variable *Total Compensation Sensitivity*. We incorporate three relevant control variables, *Diversity*, *Number of segments*, and *Firm Size*, in the model to capture firm characteristics that can influence firm excess value. *Total Compensation Sensitivity* is positive and highly significant in all three models. This result indicates that the sensitivity of the value of the CEO's equity-based compensation is an important determinant of excess value of multi-segment firms. This finding supports our logic that if higher CEO incentives lead to more efficient capital allocation decisions (as documented in this study), then better internal capital market efficiency in turn should manifest in larger excess value. Overall, the results presented in Table 5 suggest a positive link between CEO incentive compensation and excess value of diversified firms. These results help us complete the circle linking the main finding of our study, that CEO incentive compensation has a strong positive influence on internal capital market efficiency, to higher excess value. Our findings support Mehran (1995) who documents a positive relation between equity-based compensation and firm value (for all types of firms, diversified and focused).

5. Summary and conclusions

This study examines the link between CEO incentive compensation and internal capital market efficiency. We document compelling empirical evidence supporting our central hypothesis that equity-based incentives of headquarters manager (CEO) play an important role in more efficient allocation of internal capital. Thus, the "dark side" of internal capital markets casts its shadow on firms where the CEOs have little equity based incentives. Another facet of this study is that it enables us to discriminate between different theoretical models of internal capital allocation in multi-segment firms. Specifically, our analysis suggests that private benefits derived by CEOs are increasing in internal capital misallocation as depicted in Scharfstein and Stein (2000) model.

Examining effects of the sensitivities of stock and options that make up the CEO's total equity-based compensation package, we find that the CEO's stock ownership sensitivity is a significant factor that enhances internal capital allocation in a multi-segment firm. However, surprisingly we do not find that the stock option sensitivity has any influence on internal capital allocation efficiency.

We also document a positive link between CEO incentive compensation and excess value of diversified firms. These results are consistent with our findings linking CEO incentive compensation and ICM efficiency. Overall, our study contributes to the ICM literature and the literature on diversification discount in multi-segment firms.

Appendix A. Summary of Core and Guay's (1999) one-year approximation method

For the current year's option grant which have readily available information on all relevant parameters from ExecuComp, no approximation is need. The Black–Scholes sensitivity to the stock price (as of year-end) is calculated based on available data. For previously granted options which lack information on the maturity and the exercise price of the option, the procedure to estimate these variables is as follows.
For unexercisable options:

(a) Time to maturity is set equal to time to maturity of most recent year's grant minus one.
(b) If there are no new grants made, we set time to maturity to nine years.

For exercisable options:

(a) Time to maturity is set equal to that of unexercisable options minus three years.
(b) If there are no new grants made, we set time to maturity equal to six years.

To estimate the average exercise price of exercisable and unexercisable options previously granted, we subtract the realizable value per option from the year-end stock price. We refer the reader to a more detailed explanation of this procedure in Core and Guay (1999).

Appendix B. Variable definitions

B.1. Firm characteristics

Capex/Total assets   capital expenditure (Compustat data item # 128) to book value of total assets (Compustat data item # 6).
R&D/Sales   research and development expenditures (Compustat data item # 46) divided by sales revenues (Compustat data item # 12).
Firm size   logarithm of book value of total assets (Compustat data item # 6).
Number of segments   a number of distinct segments reported by the firm and available in Compustat segment tapes.
Tobin's q   the market-to-book asset ratio, where market value is the sum of the market value of common equity and book value of assets minus book value of common equity minus accumulated deferred taxes.

CEO Change Dummy   a binary variable that assumes a value of 1 if there is a change in the CEO.

1/*HI* the inverse of the Herfindahl Index (HI),

$$HI = \sum_{j=1}^{n} \left(\frac{Sales_j}{\sum_{j=1}^{n} Sales_j} \right)^2,$$

where n is the total number of segments and j indicates segment j. Calculated as of the beginning of the year.

Diversity

$$\frac{\sqrt{\sum_{j=1}^{n} \frac{(\omega_j q_j - \varpi q)^2}{n-1}}}{\frac{\sum_{j=1}^{n} q_j}{n}},$$

where q_j is market-to-book ratio of the segment proxied by the asset-weighted q of single segment firms in the same industry as the firm; ω_j is the weight in terms of assets of segment j; n is a number of the segments of the diversified firm; ω_j and q_j are beginning of year values.

B.2. ICM efficiency measures

B.2.1. Relative value added industry adjusted RVIA

$$\sum_{j=1}^{n} \omega_j (q_j - \bar{q}) \left\{ \frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right\}$$

where ω_j is the proportion of segment j's book value of assets to firm assets, BA_j is the book value of segment j's assets, q_j is segment j's q imputed by the asset-weighted Tobin's q of all single segment firms operating in the same three-digit SIC industry as that of segment j. $\bar{q}$ is the imputed segment asset-weighted q_j's of the multi-divisional firm. $Capex_j/BA_j$ is the capital expenditure (Compustat data item # 128) of segment j to the segment's assets representing the investment ratio of segment j whereas $Capex_j^i/BA_j^i$ is the asset-weighted average capital expenditure to assets ratio for peer single-segment firms operating in the same three-digit SIC industry as segment j. The variables q_j and ω_j are measured as of the beginning of the period.

B.2.2. Relative value added industry and firm adjusted RVA

$$\sum_{j=1}^{n} \omega_j (q_j - \bar{q}) \left\{ \frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} - \sum_{j=1}^{n} \omega_j \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right] \right\}$$

where ω_j is the proportion of segment j's book value of assets to firm assets, BA_j is the book value of segment j's assets, $\frac{Capex_j^i}{BA_j^i}$ is the asset-weighted average capital expenditure to assets ratio for peer single-segment firms operating in the same three-digit SIC industry as segment j, and q_j, $\bar{q}$ and $Capex_j$ are as defined earlier. The variables q_j and ω_j are measured as of the beginning of the period.

B.2.3. Absolute value added AVA

$$\sum_{j=1}^{n} \omega_j (q_j - 1) \left\{ \frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} - \sum_{j=1}^{n} \omega_j \left[\frac{Capex_j}{BA_j} - \frac{Capex_j^i}{BA_j^i} \right] \right\}$$

where ω_j is the proportion of segment j's book value of assets to firm assets, BA_j is the book value of segment j's assets, $\frac{Capex_j^i}{BA_j^i}$ is the asset-weighted average capital expenditure to assets ratio for peer single-segment firms operating in the same three-digit SIC industry as segment j, and q_j and $Capex_j$ are as defined earlier. The variables q_j and ω_j are measured as of the beginning of the period. The efficiency measures are computed as of the end of the current year.

B.3. Compensation variables

Total Compensation Sensitivity	measured as (CEO's share ownership + option delta ∗ CEO's option ownership) scaled by total firm shares outstanding. This measure is then multiplied by 100.
Options Compensation Sensitivity	measured as option delta ∗ CEO's option ownership scaled by total firm shares outstanding. This measure is then multiplied by 100.
Stock Compensation Sensitivity	measured as CEO's share ownership as a fraction of total firm shares outstanding. This measure is then multiplied by 100.
Value of all options	is calculated using the modified Black–Scholes model. The value of previous options grants (not granted in the current year) are valued using the approximation method of Core and Guay (1999).
Options delta	is the dollar change in CEO's portfolio of all options given one percent change in stock price.

All compensation variables are measured as of the end of the preceding year (beginning of the current year).

B.4. Excess value measure

We compute excess value (*EV*) using Berger and Ofek (1995) methodology as follows:

$$EV = \ln\left(\frac{MV}{I(MV)}\right)$$

where, *MV* is the firm's market value defined as book value of assets plus the difference between market value and book value of equity, $I(MV)$, defined as $\sum_{i=1}^{n} Sales_i * (Ind_i(\frac{Capital}{Sales})_{mf})$, is the imputed value of the firm calculated as the sum of the stand-alone market values of the firm's business segments. $Sales_i$ is segment *i*'s sales value, $Ind_i(\frac{Capital}{Sales})_{mf}$ is the multiple of the matched firm's total capital to sales, where matched firm is defined as the median firm in the industry with the same 3-digit SIC code, *n* is the number of segments.

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