Internal Capital Markets and Firm-Level Compensation Incentives for Division Managers

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Abstract: Do multi-divisional firms structure compensation contracts for division managers to mitigate information and incentive problems in their internal capital markets? Using Compustat Segment financial data and compensation data from a proprietary survey, I find evidence that *compensation* and *investment* incentives are substitutes: firms providing a stronger link to firm performance in incentive compensation for division managers also provide weaker investment incentives through the capital budgeting process. Specifically, as the proportion of incentive pay for division managers that is based on *firm* performance increases, division investment is less responsive to *division* profitability. While these findings may be consistent with other explanations, they are generally consistent with a model of influence activities by division managers and the implied relative weights placed on imperfect, objective signals (i.e. accounting measures) versus distortable, subjective signals (i.e. manager recommendations) in inter-divisional capital allocation decisions.

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1. Introduction

There is widespread agreement that investment decisions are the most important decisions made by firms. In fact, most large firms pay considerable attention to designing capital budgeting systems, and do so in a manner suggesting that firms recognize incentive problems in the internal allocation of capital across organizational units. For example, firms use hurdle rates that are higher than their cost of capital, possibly as a crude measure of addressing managerial attempts to overstate cash flow projections (Poterba & Summers, 1995). In addition, there is a popular trend toward ‘charging’ divisions for the cost of capital by using economic value added (EVA) as a performance measure in determining executive pay (Ittner & Larcker, 1998). Finally, capital rationing is a common practice (Taggart, 1987) and theories suggest that it is used partially to address decentralized information and incentive problems (Harris & Raviv, 1996; Holmstrom & Ricart i Costa, 1986). The purpose of the paper is to explore the use of various instruments by multi-divisional firms as a means to control information and incentive problems in the allocation of capital across divisions.

The theoretical work on the provision of incentives inside firms recognizes that firms frequently use a ‘system’ of incentive instruments and a variety of performance measures (Holmstrom & Milgrom, 1991; Baker, Gibbons & Murphy, 1994). However, the empirical work evaluating this phenomenon is limited (Cockburn, Henderson & Stern, 1999; Ichniowski, Shaw & Prennushi, 1997; Ittner, Larcker & Rajan, 1997). In this paper, I contribute to this literature by evaluating the relationship between compensation contracts for division managers and capital budgeting in multi-divisional firms as alternative instruments to address information and incentive problems in internal capital markets. Recent work in the financial literature explores ‘rent-seeking’ behavior by division managers and its effect on inter-divisional capital allocation (Scharfstein & Stein, 1996; Rajan, Servaes & Zingales, 1998). Other papers investigate the design of divisional manager compensation contracts (Bushman, Indjejekian & Smith, 1995; Jensen & Meckling, 1999). However, the relationship between the two is a topic that is largely unexplored.

Division managers in multi-divisional firms with preferences for large capital budgets have the incentive to engage in costly influence activities and distort subjective information about investment opportunities in other divisions and thereby skew capital allocations in favor of their

division (Wulf, 1999).¹ To mitigate this behavior, firms can either reduce the investment *gain* or increase the compensation *cost* to managers of engaging in influence activities. Firms incorporate ‘investment incentives’ into the capital budgeting process by specifying the optimal weights placed on two types of information in allocating capital across divisions: imperfect, objective information (i.e. accounting measures) and distortable, subjective information (i.e. managerial recommendations). To reduce the investment gain from influence activities, firms place less weight on managerial recommendations and more weight on accounting measures relative to first-best. Alternatively, to increase the compensation cost from influence activities, firms design ‘compensation incentives’ for division managers that place more weight on firm performance and less on division performance in determining incentive pay. Since influence activities distort investment and reduce firm performance, increasing the weight on firm performance increases the manager’s cost by decreasing compensation.

The principal result in this paper is that multi-divisional firms appear to use these two instruments, compensation incentives linked to firm performance and investment incentives through the capital budgeting process, as substitutes to offset incentives to distort information. I combine a panel dataset of segment (or line of business) financial data and firm organizational characteristics from Compustat’s Segment database over the period 1988-1993 with cross-sectional data from a proprietary survey about compensation contracts conducted in 1993 by a leading compensation consulting firm. The empirical methodology is based on the estimation of a segment investment equation from a standard investment model. Specifically, I measure the investment incentive by the sensitivity of segment investment to segment profitability (i.e. the weight placed on the imperfect, objective information in allocation of capital) while controlling for investment opportunities. In order to explicitly evaluate the substitutes hypothesis, the specification incorporates the structure of incentive compensation contracts (i.e. the weight placed on firm performance in determining incentive pay) while controlling for additional firm and industry characteristics.

¹ “Influence activities” is a concept developed in Milgrom (1988), Milgrom and Roberts (1990) and Meyer, Milgrom and Roberts (1992) in which lower level managers with private information and vested interests may engage in activities which influence senior manager decisions and result in reduced firm value. Influence activities in this paper take the form of signal-distortion in which players distort signals that others receive [Fudenberg and Tirole (1986) and Holmstrom (1982)]. Specifically, large division managers can take a costly action that affects the distribution of the private signal received by headquarters about small division investment opportunities.

The main empirical finding is: as the proportion of incentive pay for segment (or group) managers that is based on firm performance increases, small segment investment is less responsive to segment profitability. Moreover, this effect is present in firms with operations in industries in which objective measures (i.e. accounting profits) are less informative about investment opportunities and absent in firms with operations in industries in which accounting profits are more informative. These findings are generally consistent with a model of influence activities in which firms with compensation contracts designed to increase the manager's cost of influence can rely less on imperfect, objective signals of investment opportunities (i.e. accounting measures) and more on subjective signals (i.e. managerial recommendations) in allocating capital across divisions.²

This paper is about incentives to discourage managers from distorting information about relative investment opportunities across divisions, i.e. incentives to address negative externalities due to influence activities in internal capital markets. In the paper, I assume a division's profitability is informative about its underlying investment opportunities. However, the more common assumption in the literature on incentive compensation is that division profitability is informative about managerial effort. Hence, the evidence presented may be consistent with other, more standard explanations behind the use of incentives, i.e. incentives to address positive externalities due to productive efforts by division managers.³

It is important to note that a potential difficulty with the empirical approach pursued in the paper is that both incentive instruments are endogenous variables in the firm's problem of structuring incentives. I address this difficulty in two ways. One approach is to argue that the frequency and the level of authority involved in designing the two incentive instruments differ, and as such, I can treat one as exogenous (or predetermined). Specifically, I argue that compensation incentives for group managers are set for a longer period of time and at a higher

²In support of inefficient investment in internal capital markets, Scharfstein (1998) shows that investment of divisions of conglomerates is less sensitive to industry q than the investment of stand-alone firms. While he focuses on investment sensitivity to industry q and controls for division profitability (or cash flow), in this paper, I focus on investment sensitivity to division profitability and control for industry q .

³For example, by placing a greater weight on firm performance in determining division manager incentive compensation, firms encourage division managers to optimize for the firm instead of the division. However, this might make division profitability a noisier measure of managerial efforts. As a result, investment sensitivity to profits would decline due to different choices of productive efforts by division managers as opposed to different choices about distorting subjective information. I am in the process of evaluating alternative explanations and distinguishing between the empirical implications of more standard explanations (e.g. managers optimizing for the firm instead of the division) versus influence activities and information distortion. This is discussed further in section 6.

level of authority than budget-based incentives. With this in mind, I structure the test for substitutes by examining the short-run capital allocation decisions of senior management in setting investment incentives, conditional on the longer-term compensation incentives typically approved by the board of directors.⁴ The second approach to address the potential endogeneity problem is to use an instrumental variable for the compensation contract.⁵

In order to improve the econometric specification, I also evaluate the determinants of compensation design in the sample. This helps to ensure the inclusion of appropriate controls and identification of valid instruments. In addition, this analysis also sheds light on the common explanation for why firms link division manager incentive pay to firm performance i.e. to ‘internalize externalities’ between divisions. Similar to Bushman, et al (1995), I find that firms with operations in related businesses and firms with inter-industry and inter-geographic segment sales are more likely to link group manager bonuses to firm performance, and firms with more segments are less likely to do so. Hence, similar to the results in estimating the investment equation, these findings suggest that firms recognize interdependencies between divisions. Again, it is difficult to distinguish between positive externalities (e.g. managerial efforts that either increase the productivity of other divisions) versus negative externalities (e.g. influence activities and signal distortion in internal capital markets).

The remainder of the paper is organized into six parts. Section 2 reviews the theoretical model of incentive contracting (fully developed in Wulf, 1999) and describes the empirical implications of investment and compensation incentives. Section 3 outlines the empirical strategy and describes the data. Section 4 presents the empirical results testing the model’s implications and a discussion of the main results. Section 5 presents analyses on the determinants of division manager compensation contracts. Section 6 discusses alternative explanations for the empirical results. Section 7 concludes.

⁴This is a very similar argument to that in Cockburn, Henderson, and Stern (1999) except that they argue that promotion-based incentives are a means of rewarding researchers in pharmaceutical companies for their contribution to basic science and are fixed relative to research program capital expenditures which are a means of rewarding applied science.

⁵I have only one year of compensation data (1993) and, hence, cannot evaluate variation in compensation contracts over time. Also, it would be preferable to have the data at the beginning of the period of investigation (i.e. 1989) as opposed to the end of the period (i.e. 1993). Due to these limitations, I also use an instrument for the compensation contract in an attempt to address the endogeneity problem.

2. Review of the Influence Activity Model and Empirical Implications

Headquarters faces a fixed capital budget for new investment and wants to allocate it across divisions to maximize investment returns. Since relative investment opportunities across divisions are unknown, headquarters relies on two sources of information: past profitability of divisions and the recommendations of division managers. Historical accounting returns are a noisy, but relatively objective measure of investment opportunities. In contrast, while managerial recommendations may be more informative, they are subjective and inherently vulnerable to distortion by managers who have a preference for large capital budgets.

In the extremes, headquarters may rely either on the noisy accounting measure to allocate capital or the more subjective recommendations of managers. The profit-maximizing strategy is to use a combination of each measure and the optimal weights depend on several factors: the noise in past profitability, the ability of managers to distort information or mislead headquarters through their recommendations, and the private cost to the manager of this behavior. The focus in this paper is on the cost to the manager which is measured by the structure of the manager's compensation contract, i.e. the weight placed on firm performance in determining division manager incentive pay. Variations in the compensation instrument lead to variations in the relative weights placed on the two sources of information in equilibrium allocations of capital across divisions.

While the model is fully developed in Wulf (1999), the derivation of the substitutes hypothesis is outlined in Appendix B of this paper.⁶ As a quick overview of the formal aspects of the model, consider a situation where headquarters (H) faces a fixed capital budget for new investment and allocates it across two divisions to maximize investment returns: a large, established division (L) with known returns and a smaller, newer division (S) with unknown returns (bad and good type). L wants to maximize the capital allocated to his division and engages in costly influence activities to distort information about S's type in order to skew capital allocations. Hence, L trades off expected investment in his division against the private cost of influence. S is a passive agent. H receives two signals about S's type from a neutral party: a private, or subjective signal that can be influenced by L and may be distorted (σ); and a public, or objective signal that cannot be influenced, but is noisy (Π).

⁶ A copy of this paper is available at <http://www-management.wharton.upenn.edu/wulfresearch>.

Firms incorporate investment incentives with commitment into the capital budgeting process to prevent L from engaging in influence activities. Specifically, investment incentives determine the ‘weight’ placed on private and public signals in the capital allocation decision and are a function of the environment in which the manager operates (represented by the exogenous parameters).⁷ Intuitively, to prevent L from influencing, H reduces the expected gain from influence activities by reducing the weight on the distortable, private signal about S and increasing the weight on the noisy, public signal relative to first-best.⁸ Alternatively, H can design compensation incentives to increase L’s private cost of influence. Since influence activities distort investment and reduce firm performance, H raises the private cost to L by placing more weight on *firm* performance and less on *division* performance in determining incentive compensation. Hence, the influence activities model predicts that investment and compensation incentives are substitute instruments in mitigating influence activities by L, i.e. the greater use of one incentive instrument decreases the marginal benefit of using the other instrument.

Note that underlying this model is the assumption that firms can provide incentives to division managers using internal capital markets in addition to using compensation. The tradeoff between the two types of incentives can be explicitly analyzed in the investment equation of the small division that is derived from the model’s optimal contracts.⁹ The general form of the equation is as follows:

$$I^S = \beta_0 + \beta_1(c, \phi, \psi, \theta)\Pi \quad (1)$$

where I^S is expected investment in S, Π is the public signal about S’s type, and β_1 is a function of the exogenous parameters of the model.¹⁰ The key parameter in the empirical test is the manager’s private cost of influence (c). The other parameters include: the manager’s ability to distort signals (ϕ), the quality of the public signal (ψ), and the probability of a bad type (θ).

⁷ Investment (or capital-budgeting) incentives would specify capital allocation to divisions as a function of the signals about investment opportunities. While not directly observable in practice, firms may offer implicit contracts that accomplish similar goals.

⁸ While firms offer ‘lower-powered’ incentives on the distortable signal to satisfy incentive compatibility for the large division manager, this translates into higher responsive to the noisy, public signal about S or a stronger ‘investment incentive’ for L.

⁹ The model also makes predictions with respect to investment in the large division. However, I choose to empirically evaluate investment in only the small division, expecting the behavior to be more pronounced.

¹⁰ Since I have a proxy for the public signal, but not the private signal, I derive expected investment conditional on the public signal by averaging over the private signal realizations. Hence, the substitutability between β and c is derived from the model having taken expectations over the private signal. This has important implications for the econometric specification of the investment equation. Specifically, a proxy for the private signal should *not* be included.

Since investment *levels* (represented by β_0) are subject to many interpretations, I focus on investment *sensitivity* to the public signal (represented by $\beta_1 = \partial I^S / \partial \Pi$).¹¹ This sensitivity or weight placed on the public signal in allocating capital to S is what I define as the ‘investment incentive’ for L.¹² The substitutes hypothesis suggests that H can reduce the weight on the public signal (i.e. reduce β_1 or the ‘investment incentive’) by increasing the private cost to L (i.e. increase c or the ‘compensation incentive’) while still satisfying incentive compatibility (i.e. $\partial \beta_1 / \partial c < 0$ or $\partial^2 I^S / \partial \Pi \partial c < 0$). This leads to the following testable implications:

Implications: Multi-divisional firms’ investment in small divisions can be characterized by:

- (i) a positive sensitivity of investment to the public signal [i.e. a positive investment incentive or $\partial I^S / \partial \Pi > 0$ in (1)].
- (ii) a decreasing relationship between investment sensitivity to the public signal and the manager’s private cost (or compensation incentive) [i.e. $\partial \beta_1 / \partial c < 0$ or $\partial^2 I^S / \partial \Pi \partial c < 0$ in (1)].

In other words, investment incentives and compensation incentives are substitute instruments in controlling influence activities by division managers to distort information.¹³

¹¹While the public signal in the model is a binary random variable, the proxy used for the public signal (lagged profits) is continuous. Differences (as opposed to derivatives) are used in the derivation of the model’s empirical implications in appendix B. However, I use derivatives to be consistent with and to simplify the notation in the empirical work.

¹²It is important to note the logic behind defining the investment incentive for L in terms of the investment sensitivity to profits for S. Since capital is fixed, the investment in L is inversely correlated with the investment in S, i.e. L receives whatever is not invested in S. Hence, by increasing the sensitivity to profits in S (and reducing the investment sensitivity to distortable, subjective measures), H increases the expected investment gain to L from *not* influencing.

¹³The model predicts substitutability between investment and compensation incentives under certain parameter restrictions which are detailed in appendix B. Specifically, the instruments should be substitutes in firms with low quality public signals and high personal costs of influence to managers. For other parameter values, the cross-partial derivative is zero. This distinction among parameter values is further explored in the empirical tests in Section 4.2 by splitting the sample into subgroups using proxies for these parameters.

3. Empirical Methodology and The Data

3.1 Empirical Methodology

This section describes the strategy to test the model's prediction that investment and compensation incentive instruments are substitutes in controlling signal distortion. As mentioned above, the model predicts a general form of an investment equation for the small division as defined by (1). However, the main empirical problem is that the instruments are endogenous variables in the problem of structuring incentives.¹⁴ Hence, it is difficult to distinguish between the presence of structural interdependence and "spurious" covariation due to unobserved heterogeneity across firms. In an attempt to address the endogeneity problem, I use two approaches. One approach argues that the frequency of designing the two incentive instruments differs and that I can treat one as exogenous. The other approach is to use an instrumental variable for the compensation incentive.

The structure of compensation incentives for managers is an important policy decision of the firm and plays a critical role in aligning incentives of management with interests of shareholders, and more specifically, with the strategic direction of the firm. Since firm and business unit strategies don't change frequently and redesigning compensation contracts can be a costly exercise, I argue that compensation incentives are relatively fixed in the short run. In fact, changes in executive compensation typically require the approval of the compensation committee of the board of directors. In contrast, capital budget decisions are more frequent and typically made by an investment committee comprised only of members internal to the firm. Hence, I treat the use of compensation-based incentives as being at least weakly exogenous (or predetermined) relative to that of investment-based incentives, allowing for an empirical test of the substitutability of the incentive instruments.

The difference in frequency in designing the two incentive instruments doesn't address the possibility that the relationship between compensation contracts and investment sensitivity is the

¹⁴The empirical implications derived in this paper assume that the private cost parameter is exogenous. However, in using compensation design as a proxy for this parameter, c cannot be considered as exogenous because it is a choice variable of the firm in addition to investment (which is the dependent variable in the regression). In particular, c is likely to depend on ϕ , θ , and ψ . While I include proxies for ϕ and ψ in the econometric specification, I don't explicitly include a proxy for θ . Hence the omission of this variable leads to correlation between the independent variable, c and the error term.

result of unobserved heterogeneity among firms.¹⁵ In a second approach to address this problem, I use an instrumental variable for the compensation incentives. I argue that the relative size of the small division is a reasonable instrument for the weight placed on firm performance in determining division manager annual incentive compensation. When small divisions are large relative to the size of the firm, compensation incentives are more effective due to larger penalties. Specifically, if pay is linked to firm performance, the cost of influence by L is greater when small divisions contribute more to firm profitability.

3.2 The Data

The model is estimated using an unbalanced panel dataset constructed from financial statistics for segments within the firm. It is comprised of 415 firm-segment-year observations covering 94 firms over the period 1989-1993. The analysis is based on financial data from the Compustat Industry Segment database in conjunction with compensation data from a proprietary survey conducted by a leading compensation consulting firm. The Compustat Industry Segment database reports segment information for approximately 6500 firms per year.¹⁶ Information includes key financial statistics and SIC codes at the segment level. While the level of aggregation of these data is typically higher than that of the division, capital allocation decisions also are made at the line of business (or segment) level.¹⁷ Hence, the paper uses the segment information to represent the division (or group). In addition, I use Compustat's Annual File for firm-level information. Finally, I merge the Compustat sample (based on the selection procedure described in detail in Appendix A) with the participant firms in the compensation survey.¹⁸ Descriptive financial statistics for this final sample are summarized in Table 1.

¹⁵The use of panel data would allow one to address this problem directly. However, at this time, only cross-sectional data on the characteristics of the compensation design are available.

¹⁶ In segment reporting data, managers define what constitutes a distinct business at their firm subject to accounting standards. FASB No. 14 and SEC Regulation S-K require firms to report financial information for segments that represent 10% or more of consolidated sales. This ruling defines an industry segment as "A component of an enterprise engaged in providing a product or service, or a group of related products or services primarily to unaffiliated customers (i.e., customers outside the enterprise) for a profit."

¹⁷For example, Bausch and Lomb report two segments in Compustat: the larger segment is Healthcare (sic 2834) and the smaller segment is Optics (sic 3851).

¹⁸ The participants in the compensation survey included 246 companies comprised of both single and multiple segment firms operating in manufacturing and service industries. When retaining manufacturing firms that operate in more than one segment (i.e. deleting single segment firms and service firms), the survey sample reduces to 131 firms. I merge the Compustat sample with this smaller compensation survey sample that results in 108 firms. However, since I don't have the relevant financial information for these firms over the entire five-year period and since several firms do not report compensation information for *group* CEOs, the final pooled sample used in the investment

The compensation data were collected by a leading compensation consulting firm in a proprietary mail survey with follow-up telephone conversations to verify accuracy. While I base the investment analysis on five years of financial data (1989-1993), the compensation data pertain to practices in effect at the time of the survey (Spring 1993). The sample includes only firms that report information about the proportion of annual bonuses based on performance measured at the corporate, group, division, plant and individual levels. The survey collected information on four management levels (chief executive officer, group CEO, division CEO, and plant manager).¹⁹ However, for the purposes of testing the substitutes hypothesis, I focus on group CEOs. This is because ‘segments’ as defined in Compustat are most analogous to ‘groups’ as defined within the survey participants.²⁰ Descriptive data on the compensation packages of group CEOs, division CEOs, and plant managers are presented in Table 2. In order to use the determinants of bonuses as a proxy for the manager’s cost of influence, the magnitude of the bonus should be significant to the manager’s salary. Since the average target bonus over salary for the group CEO is 49%, I argue that the expected bonus is large enough to be of interest to the manager (i.e. target bonus of \$155,000 is significant relative to average salary of \$315,700).

The proxy for the agent’s cost of influence in the investment analysis is the percentage of the group CEO’s annual bonus tied to firm performance (*fweight*). Unfortunately, the reported information for each managerial position is a firm-wide average. That is, each sample firm reports only one set of percentages for each managerial level, not a separate set for each manager included in the survey. As a result, the compensation data are not directly linked to a specific group or division, but instead represent the general practices of the firm. However, based on the wording in the questionnaire, it is reasonable to assume that the reported information is more likely to be representative of the compensation contract for the large division manager rather than the small division.²¹ Hence, while specific divisional information would be preferable, I believe this data limitation is not serious. These data for all managerial positions are summarized in Table 3.

analysis contains 94 firms and 415 segment-years. Refer to “Criteria Used in Sample Selection” in appendix A for additional details.

¹⁹A division CEO has the highest authority in a division (the lowest level of profit center responsibility), with responsibility for sales, marketing, engineering, and manufacturing activities. A group CEO has the responsibility for multiple divisional profit centers. A plant manager is the individual with the highest authority in the manufacturing plant.

²⁰The argument for and limitations of this assumption are discussed in detail in Section 4.3 (Robustness).

²¹ The question in the survey is worded as follows: “When determining individual awards, companies often take into account the performance of various organizational levels. For each position listed below, specify the approximate weighting given to the performance of each organizational level when determining individual awards.”

3.3 Econometric Specification

In the econometric specification as outlined in general in (1), I regress expected investment in the small segment on lagged profits of the small segment (proxy for the public signal), while specifying the regression coefficient as a function of firm and industry characteristics (proxies for the exogenous parameters). Specifically, I assume the coefficient on Π to be a linear function of the manager's private cost of influence (c), the manager's ability to distort signals (ϕ), the quality of the public signal (ψ), and the probability of a bad type (θ). The parameter of interest is the private cost of influence (c) and is proxied by the weight placed on firm performance in determining division manager incentive compensation (*fweight*). Hence, the empirical test is to evaluate whether the investment sensitivity to lagged profits for small divisions (i.e. $\partial I / \partial \Pi$) decreases as the weight placed on firm performance in determining manager bonuses increases (i.e. $\partial^2 I^S / \partial \Pi \partial fweight < 0$). To complete the empirical specification, I introduce additional controls that may be included in the information set about segment investment opportunities. Specifically, I control for investment opportunity of the segment by using an industry measure for Tobin's q . In addition, I include firm profitability and firm sales growth relative to the industry as measures of firm (or other segment) investment opportunities. Also, I include firm, industry and year fixed effects. The estimating investment equation is the following:

$$I_i^S = \beta_i^F + \beta_1(\gamma_o + \gamma_1 fweight + \gamma_2 related + \gamma_3 numseg + \gamma_4 capconst + \gamma_5 sigqual) \Pi_{-1i}^S + \beta_2 Q_i + \beta_3 \Pi_{-1i}^F + \beta_4 X_i^F + \alpha_i + \delta_t + \varepsilon_i \quad (2)$$

where I_i^S is the i th segment's net capital expenditures (capital expenditures less depreciation) in period t divided by the book value of the i th segment's assets in that period; Π_{-1i}^S is the i th segment's operating income in period $t-1$ divided by the book value of the i th segment's assets in that period; Q_i is Tobin's q for the median of standalone firms in the i th segment's industry defined at the 2-digit SIC level; Π_{-1i}^F is identical to Π_{-1i}^S except calculated for the firm containing the i th segment, and X_i^F is the deviation of the firm sales growth in period t from the

firm's industry sales growth in that period (i.e. for the firm containing the i th segment); β_i^F is a firm dummy variable for the i th segment, α_i is an industry dummy variable for the i th segment's business defined at the 2-digit SIC level, δ_t is a year dummy variable, ε_i is a disturbance term. Lastly, *fweight*, *related*, *numseg*, *capconst*, *sigqual* are firm and industry variables proxying for the exogenous parameters (and are defined in detail below). Expanding the expression in (2) and redefining the coefficients results in the following specification:

$$I_i^S = \beta_i^F + \beta_{10}\Pi_{-1i}^S + \beta_{11}fweight\Pi_{-1i}^S + \beta_{12}related\Pi_{-1i}^S + \beta_{13}numseg\Pi_{-1i}^S + \beta_{14}capconst\Pi_{-1i}^S + \beta_{15}sigqual\Pi_{-1i}^S + \beta_2Q_i + \beta_3\Pi_{-1i}^F + \beta_4X_i^F + \alpha_i + \delta_t + \varepsilon_i \quad (3)$$

where $\beta_{10} = \beta_1\gamma_0$; $\beta_{11} = \beta_1\gamma_1$; $\beta_{12} = \beta_1\gamma_2$; $\beta_{13} = \beta_1\gamma_3$; $\beta_{14} = \beta_1\gamma_4$; and $\beta_{15} = \beta_1\gamma_5$ from (2)

To test the empirical hypotheses, first I evaluate the use of investment incentives or whether the segment's investment sensitivity to profitability is greater than zero (i.e. $\beta_{10} = \partial I^S / \partial \Pi^S > 0$). Next, I evaluate whether the weight placed on firm performance in the compensation incentives has an effect on the investment incentives (i.e. $\partial \beta_{11} / \partial fweight = \partial^2 I^S / \partial \Pi^S \partial fweight \neq 0$). Finally, I evaluate the substitutes hypothesis: the investment incentive declines with an increase in the weight placed on firm performance in the compensation incentive (i.e. $\partial \beta_{11} / \partial fweight = \partial^2 I^S / \partial \Pi^S \partial fweight < 0$). The results from the estimating this regression appear in Table 6 and are discussed in Section 4.

3.4 Construction of Variables

I use lagged segment profits (operating income/assets) as a proxy for the public signal and include Tobin's q for standalone firms in the segment's industry as a control for segment investment opportunity. There are two reasons for using segment profits as a proxy: (i) Tobin's q for the segment cannot be calculated and industry q's do not reflect segment-specific investment opportunities and (ii) due to persistence in profits, current profits are generally a reasonable

predictor of future profits.²² I also include other elements of the information set that are informative about the small segment's investment opportunities. Specifically, I include both lagged firm profitability and firm sales growth relative to the industry as measures of firm or other segment investment opportunities.²³

To proxy for the agent's cost of influence, I use the percentage weight placed on firm performance in determining the group CEO's annual bonus (*fweight*). The performance measures used to determine annual bonuses can be any combination of the following measures of hierarchical performance: corporate, group, division, plant or individual (illustrated in Table 3). The higher the weight placed on corporate performance in determining the group CEO's (or large division manager's) bonus, the higher the private cost of influencing. In contrast, if the group CEO's bonus is based solely on own division performance (or if his salary is determined by size of division), he has more incentive (or it is less costly) to influence signals.

While *fweight* is the variable of interest, I control for two of the three exogenous variables in the analysis: ψ , the quality of the public signal and ϕ , the ability of L to distort the private signal. The proxy for the quality of the public signal (ψ) is an industry characteristic--the informativeness of profits in predicting firm value for the segment's industry. Roughly speaking, earnings measures are a good signal about firm value (and firm investment prospects) in industries where accounting measurements of firm value are closely related to the market value of the firm. For example, a firm's profitability is a good predictor of firm value in stable and more predictable industries (e.g. textile industry). In contrast, profitability is a poor predictor in rapidly changing industries (e.g. pharmaceutical and computer industries). In the accounting literature, this concept is referred to as the value relevance of earnings and is defined as the inverse of the variation of the log of firm value measured by accounting measures divided by firm market value. Using a large sample of firms from Compustat over the period 1953-1996, Chang (1998) measures the value relevance of earnings in 37 industry groups based on a technique used in Fama & French (1997)

²² The finance literature that evaluates "socialism" in the internal capital markets [Scharfstein and Stein (1996), Shin and Stulz (1997), and Rajan, Servaes and Zingales (1998)] (or inefficient cross-subsidization) generally uses the median value of Tobin's q for standalone firms operating in the segment's industry as a measure of the segment's investment opportunity. However, both Whited (1999) and Chevalier (2000) discuss the limitations in using this measure as a proxy for segment investment opportunities. For a discussion of current profits (or cash flow) as a good predictor of future profits, refer to Gilchrist and Himmelberg (1998).

²³ The empirical results are generally robust to including Tobin's q for the firm instead of firm growth relative to the industry.

and ranks industries based on this measure. As one might expect, utility firms have the highest value relevance of earnings, while pharmaceutical firms have the lowest. I collapse these industry groups into five categories and define these groups by the variable *sigqual*. This variable is further described in Table 4. In the tables of results, I use the dummy variable *sigqualdum* which equals 1 if the segment operates in an industry in which profits are informative about firm market value (*sigqual* greater than or equal to two) and zero otherwise.

Next, I turn to describing the proxies for the ability of the manager to distort information. Proxies for ϕ are based upon three firm characteristics: relatedness of segment operations (*related*), number of segments (*numseg*), and degree of capital constraints (*capconst*). Descriptive statistics for these three variables are summarized in Table 5. The arguments for why these are reasonable proxies for the manager's ability to distort signals are described in detail in Wulf (1999). Briefly, the ability of L to distort the private signal that headquarters receives should be a function of the degree of focus (or diversification) of the firm. One could argue that if the firm is more focused (or less diversified) and the businesses of the divisions are closely related, the large division manager should be perceived as being better informed about the small division's investment prospects and more credible in distorting the signal. Alternatively, if the businesses are more related, headquarters might not be as easily influenced. Relatedness of segment operations is measured by a simple comparison of SIC codes for small and large segments.²⁴ If the segment SIC codes are different at the 1-digit level, the firm is highly unrelated. If the segment SIC codes are the same at this level, the businesses are slightly related. Firms are highly related if the segment SIC codes are the same at the 4-digit level. The variable *related* is defined by five relatedness categories representing increasing levels of relatedness of businesses between small and large segments, where each category is assigned an integer value from 0 to 4 (i.e. assumes a linear relationship). In the tables of results, I use the dummy variable *relatedum* which equals 1 if the segments are related at the 2, 3, or 4 digit level and zero otherwise.

In addition to business relatedness, if the firm has more divisions, it is argued that the CEO has broader responsibilities and may be less discerning in evaluating S's investment prospects. This will increase L's ability to distort private signals. The variable *numseg* is defined by five

²⁴ This definition is a somewhat crude, but standard approach used to designate increasing levels of relatedness. Other empirical work uses different techniques, some of which try to identify both horizontal and vertical linkages between segments [e.g. Scharfstein (1998)]. In this paper, small and large segments are defined as the manufacturing segments with the smallest and largest sales in a given year.

categories including two, three, four, five through seven, and greater than seven segments, where each category is assigned an integer value from 0 to 4. In the tables of results, I use the dummy variable *numsegdum* which equals 1 if the number of segments are greater than or equal to three and zero otherwise. Finally, the large division manager has the incentive to influence capital allocation decisions only if capital is constrained. Hence, capital constrained firms should be more vulnerable to influence activities. The variable *capconst* is a dummy variable measuring a firm's access to the public debt markets: it equals zero if the firm has an S&P debt rating (unconstrained) and one otherwise (constrained).²⁵

4. Empirical Results

4.1 Test for Substitutes

The main results are presented in Tables 6 and 7. Based on (2), the main specification is a regression of the investment ratio of the small segment on profitability of the small segment and interactions between the small segment profitability and the key compensation variable *fweight*. In Table 6, the first two specifications are estimated using OLS, while the latter two include firm fixed effects. The principal results center around two coefficients: the coefficient on Π_{-1}^S (segment profitability) and the coefficient on the interactive term $\Pi_{-1}^S * fweight$ (segment profitability times weight on firm performance). The coefficient on Π_{-1}^S is a measure of the model's investment incentive (i.e. $\partial I / \partial \Pi$) and this coefficient is positive and significant in three of the four specifications. Firms allocate more capital to small segments when the segments are more profitable. Specifically, for a 1% increase in segment profitability, the segment investment ratio increases by approximately .14% [specification (3)]. More importantly, the coefficient on the interactive term (i.e. the measure of the substitutability between investment and compensation incentives) is negative and significant across all specifications. Not only is the sign consistent with the substitutes hypothesis (i.e. $\partial^2 I^S / \partial \Pi \partial fweight$), but the magnitude of the coefficient is

²⁵The issue of whether a firm is capital constrained or not has been extensively discussed in the corporate finance literature. I evaluated several measures of financial constraints including leverage, dividend payout ratios, size of firm defined by sales and assets, and access to public debt markets. I decided to use access to public debt markets measured by whether the firm has a S&P bond rating because it is a simple measure that is the least controversial (and similar to the approach used in Kashyap, Lamont and Stein (1994)). While it is possible to delineate several categories of capital constraints analogous to the two other firm characteristics, this level of refinement is difficult to justify given the current controversy over identifying capital constrained firms.

surprisingly large. Focusing on specification (3), the coefficient on the interactive term (-.122) is almost as large as the coefficient on Π_{-1}^S (.136). This suggests that firms that place 100% weight on firm performance in determining group CEOs annual incentives (controlling for other characteristics), place (almost) no weight on segment profitability in allocating capital.²⁶

One plausible explanation for the above results is the following. Firms with well-designed compensation incentives allocate capital to small segments based less on historical accounting measures (objective, but noisy) and more on other, more informative measures about future investment opportunities (subjective). In contrast, in firms with incentives not tied to firm performance, the more subjective measures might be vulnerable to distortion, forcing firms to rely on noisy accounting measures.

In addition to this core result, the estimates also suggest that the industry measure of Tobin's q is not important in determining investment, however firm profitability is important. This latter result is consistent with the finding in other empirical work that firms make investment decisions within the hierarchy and actively allocate capital across segments.²⁷ The other significant coefficient is that on the interaction of profitability and relatedness. In firms with more related businesses, capital allocation decisions are based less on accounting measures. If it is more difficult for managers to distort information when businesses are related, then firms can rely less on accounting measures and more on subjective measures.²⁸ The remaining control variables enter the model less importantly.

Finally, the variable that I use as an instrument for the compensation contract is *relsize* which is a measure of the relative size of the small division to that of the firm. It is defined as the log of the ratio of small segment sales to firm sales.²⁹ If the small segment represents a larger proportion of firm profits, then investment distortion leads to a larger decline in firm performance and a more severe penalty to division managers. Since the 'effectiveness' of the compensation contract is in

²⁶ To improve upon specification (3), I correct the standard errors to allow for the specification of the correlation structure among observations within firms. Specifically, I allow for the estimation of the correlation matrix within firms placing no constraints on the matrix other than it being symmetric and that the same correlation structure applies to all firms. The results hold in this robust specification.

²⁷ Related empirical work uses several techniques to evaluate whether capital is actively allocated across divisions. Shin and Stulz (1997) find that small segment investment is a function of other segment's cash flow. The significance of firm profitability in the above regression is consistent with their finding.

²⁸ However, an alternative explanation might be that accounting measures in firms that operate in related businesses are noisier, possibly due to limitations in transfer pricing mechanisms.

²⁹ The simple ratio of small segment sales to firm sales has a median and standard deviation of .17 and .13, respectively.

part determined by the relative size of the small segment, I argue that it can be used as an instrument for the compensation contract.³⁰ Specification (4) of Table 6, is a 2SLS regression using *relsize* as an instrument for the weight placed on firm performance in determining the annual bonus for the group manager. While the power of the tests in the 2SLS specification is slightly reduced, the signs of the coefficients and the relative magnitudes are approximately the same.

4.2 Effect of Signal Quality & Private Costs

By splitting the sample using select control variables, I investigate further whether the result supporting the substitutes hypothesis is more or less pronounced in certain types of firms. I analyze subgroups of the sample using three variables: *sigqual*, *fweight* and *relsize*. In the first two columns of Table 7, the sample is split into two groups based on the informativeness of profits in predicting firm value for the segment's industry: low and high quality signal samples. The results in specification (1) indicate that the substitutes hypothesis only holds in firms with small segment's that operate in businesses in which accounting returns are not very informative (i.e. positive and significant coefficient on profitability and negative and significant coefficient on the interaction between profitability and *fweight*, i.e. $\partial^2 I^S / \partial \Pi \partial fweight < 0$). Again, this is consistent with firms with well-designed incentives relying on accounting measures less (and other subjective measures more) in allocating capital to small segments (i.e. firms satisfy incentive compatibility and the incentives are substitutes). In contrast, when accounting measures are informative (1'), firms rely on profits in allocating capital (positive, significant and larger coefficient on profitability), but compensation incentives no longer have an effect on investment incentives (negative, but insignificant coefficient on the interactive term, i.e. $\partial^2 I^S / \partial \Pi \partial fweight = 0$). While there may be several possible explanations for this result, it is consistent with influence activities and signal distortion in internal capital markets. Specifically, when accounting measures are good signals about investment opportunities, firms don't need to link compensation to firm performance to increase the manager's cost of influence activities (i.e. firms don't satisfy incentive compatibility and the incentives are not substitutes). Hence, investment sensitivity to profits is not affected by the design of the compensation incentives.

³⁰One might argue that *relsize* also measures the potential investment gain from influence activities or managerial ability to successfully distort information. This and additional limitations of this instrument are considered in detail in Section 5.

Next, in the second two columns of Table 7, the sample is split into two groups based on the weight placed on firm performance in determining group manager annual bonuses (*fweight* or the manager's personal cost of influence): low and high cost samples. Firms with managers that face high personal costs of influence can place more weight on subjective measures (and less weight on accounting measures) by increasing the compensation incentive (i.e. firms satisfy incentive compatibility and the incentives are substitutes). In contrast, when managers face low personal costs, it is too costly for the firms to satisfy incentive compatibility and firms choose to allow influence activities. In this case, investment sensitivity to profits is no longer a function of the private costs of the manager (i.e. $\partial^2 I^S / \partial \Pi \partial fweight = 0$). The results in specifications (2) and (2') (weakly) indicate that the substitutes hypothesis only holds in firms with high private costs of influence (i.e. positive coefficient on profitability and negative coefficient on the interaction between profitability and *fweight*). However, the coefficients are only significant in a one-sided test.

Finally, I split the sample into two groups based on the relative size of the small segment to the firm (*relsize*). Earlier I used *relsize* as an instrument for the compensation contract based on the argument that it measured the 'effectiveness' or penalty associated with compensation incentives: signal distortion about larger, small segments reduces both firm performance and incentive compensation by a greater amount. However, *relsize* could also measure either the potential investment gains to managers from signal distortion or the ability of managers to successfully distort signals. To distinguish between these effects and to further evaluate the validity of the instrument, I do two things: (i) include *relsize* as an independent variable in the main specification (3) in Table 6, and (ii) use it to split the sample in the last two columns of Table 7. Importantly, the coefficient on *relsize* is insignificant when it's included in (3) (t-stat of -.761) and the other coefficients remain stable (unreported). This supports the validity of *relsize* as an instrument for the compensation contract (i.e. while it is correlated with *fweight*, it is uncorrelated with the error in the investment equation). In addition, the results in specifications (3) and (3') in Table 7 suggest that the substitutes hypothesis holds in firms where small segments are smaller relative to firm size (i.e. $\partial^2 I^S / \partial \Pi \partial fweight < 0$ in (3)), and doesn't hold in firms where small segments are larger relative to firm size (i.e. $\partial^2 I^S / \partial \Pi \partial fweight = 0$ in (3')). This result suggests that information and distortion problems may be more prevalent in firms where the

size distribution of segments is more dispersed and that the degree of the dispersion might be related to the large division manager's ability to distort information about small division investments.

4.3 Robustness

While the key variable of interest (*fweight*) is included as a continuous variable in all specifications in Tables 6 and 7, the other control variables are included as dichotomous variables (*relateddum*, *numsegdum*, and *sigqualdum*). The results in Table 6 are generally robust in specifications that relax this dichotomous restriction and instead impose a linear relationship among categories of the control variables. Specifically, in assigning integer values ranging from 0 to 4 to represent the five categories as defined earlier in section 3 (i.e. using *related*, *numseg*, and *sigqual*), the two key coefficients in specifications (3) and (4) in Table 6 remain significant (i.e. .150** and .376** on Π_{-1}^S and -.096* and -.322* on $\Pi_{-1}^S * fweight$, respectively). In relaxing these restrictions further by assigning dummy variables to each of the five categories of these three control variables (and allowing non-linear relationships), the results suggest that the dichotomous and linear functional form assumptions are too restrictive. Tests of the joint restrictions imposed in specification (3) can be rejected in favor of a more general specification. In the most general specification with five dummies for each of the three control variables, the coefficient on the interaction term between profitability and *fweight* is no longer significant.³¹

One obvious limitation that may bias the empirical results is the exclusion of other forms of compensation that are linked to firm performance, e.g. stock options.³² Since stock option grants for group managers are not included in the compensation survey, I partially address this omission by using firm fixed effects. In comparing specification (2) to (3) in Table 6, the inclusion of firm

³¹Additional work might include analyzing different measures that combine the notions of business heterogeneity, number of divisions, and dispersion in size of divisions as both independent variables in the investment equation and instruments for the compensation contract. Refer to Rose and Shephard (1997) for definitions of diversification based on Herfindahl indices.

³²Specifically, in the design of compensation plans, firms may use *fweight* and stock options as substitute instruments to align group manager incentives with those of the firm and this could lead to a misclassification in the empirical analysis. For example, a firm that doesn't link annual bonuses to firm performance (i.e. low *fweight*) would be classified as one with 'low-powered' firm incentives. But this same firm may grant many options and, in fact, should be classified as a firm with 'high-powered' firm incentives. I am unaware of any empirical studies that shed light on whether firms use these instruments as substitutes or complements.

fixed effects (jointly significant) increases the magnitudes of the coefficients, but doesn't change the signs.

Due to data limitations in the compensation survey and the inability to match compensation design variables directly to segments as reported in Compustat, I assume that the organizational concept of a group is analogous to that of a segment. This matching seems appropriate based on a comparison of average group and division sales as reported by the compensation survey to that of the average size of the segment for the firm reported in Compustat. The average difference between group sales (reported in the compensation survey) and segment sales (reported in Compustat) for the firms in the sample in 1992 is significantly lower than the comparable measure for the divisions. Moreover, the results in specification (3) of Table 6 are robust when matching divisions (as opposed to groups) to segments. Specifically, when defining *fweight* as the weight placed on firm performance in determining *division CEO* annual bonuses, the coefficients on Π_{-1}^S (segment profitability) and the interactive term $\Pi_{-1}^S * fweight$ (segment profitability times weight placed on firm performance) are of similar magnitudes as reported in Table 6 and are significant at higher levels [182 (.065)*** and -.173 (.049)***, respectively].³³

The results supporting the substitutes hypothesis may depend on the size of the firm, or more specifically, the size of the firm's capital budget. Including the log of firm sales as an independent variable has essentially no effect on the results in specifications (3) and (4) in Table 6 and its coefficient is insignificant. Moreover, including the firm's investment ratio as an independent variable (defined as current firm net investment divided by firm assets), the two key coefficients in both (3) and (4) remain stable while several others change: the coefficient on *numsegdum* and *sigqualdum* remain positive and become significant (10% level); the coefficient on firm profitability (Π_{-1}^F) is no longer significant; the coefficient on relative firm sales growth (X^F) remains negative and becomes significant (5% level); and the coefficient on the firm's investment ratio is large, positive and significant (1% level).

One important assumption in the model is the larger, established division manager's ability to distort private signals about the smaller, newer division's investment prospects. Empirically, I use relative division sales size to represent these two types of divisions and then focus only on small

³³ When defining *fweight* as the sum of the weight placed on firm performance *and* the weight placed on group performance in determining the *division* CEOs annual bonus, the respective coefficients (and standard errors) are .191 (.065)*** and -.182 (.049)***.

segment investment behavior in the analysis. While relative tenure of the division managers might be a better measure of the ability of L to distort information and persuade H, this measure generally is not available. The use of division sales to represent the division manager's informal power within the organization seems to be a reasonable proxy.³⁴ This assumption is further supported by the results in specification (3) and (3') in table 7. The substitutes hypothesis holds in firms in which L should be more influential (i.e. firms with low-share small segments) and absent in firms in which L should be less influential (i.e. firms with large-share small segments).

Another possible limitation is the assumption that the returns of large divisions are known, or at least, more predictable than the returns of small divisions. Since small divisions do not necessarily operate in developing, less predictable businesses, this asymmetry assumption may not be reasonable. I evaluate the reasonableness of this assumption by eliminating small divisions operating in declining, more predictable businesses and focusing on those in growing, less predictable businesses. I redefine small, newer divisions as those segments that operate in developing, high-growth industries and find that the results are only partially robust in this smaller sample.³⁵ While the magnitude and sign of the two key coefficients are stable, the coefficient on the interactive term is only significant in a one-tail test (i.e. t-stat of -1.38 with number of observations declining to 207).

Another limitation is that I treat the organization structure as exogenous and model influence between two divisions only, yet the sample contains firms that have more than two divisions.³⁶ I argue that in the short run, it is more costly for the firm to reorganize than to incur costs from offering second-best investment or compensation incentive contracts. It is true that by modeling the influence activities between only two divisions, I ignore potential influence between other

³⁴ While determining CEO tenure may be possible using proxy statements, determining division manager tenure is significantly more difficult (however, I do have length of tenure for the typical group manager). Usually a division's size is correlated with the amount of resources controlled by division managers (e.g. size of capital budgets and number of employees) and hence is a reasonable measure of division manager 'power' within the firm.

³⁵ Include select 2-digit SIC codes: 28 (Chemicals and Allied Products), 35 (Industrial and Commercial Machinery and Computer Equipment), 36 (Electronic and Other Electrical Equipment and Components), and 38 (Measuring, Analyzing and Controlling Instruments). Refer to Griliches and Mairesse (1984).

³⁶ The limitation of treating the organization structure as exogenous is related to the evidence presented in Chevalier (2000) that suggests that some of the cross-subsidization results in the finance literature may be attributable to selection bias because divisions of diversified firms are not randomly allocated to their corporate parents. However, a large part of the criticism in the Chevalier paper has to do with the use of Tobin's q for the division's industry and the underlying assumption that the investment opportunities facing conglomerate divisions are identical to those of stand-alone firms in their industries. The empirical results in this paper are subject to the former criticism, but not as much to the latter because I primarily focus on segment investment sensitivity to segment profits using Tobin's q of stand-alone firms in the industry only as a control for segment investment opportunities.

divisions. To evaluate whether this simplifying assumption has any effect on the empirical analyses, I complete the analysis using only firms with two segments. In the sample of firms with only two segments, there are only 104 observations and 27 firms and the empirical results are no longer robust. Specifically, none of the explanatory variables are significant due to the reduced power of the tests.

As mentioned earlier, there is information about segment investment opportunities in firm measures (i.e. firm profits and Tobin's q) in addition to segment measures (segment profits and Tobin's q for standalone firms in the segment's industry). In Table 9, I estimate more general model specifications to evaluate the robustness of the negative sign on the interactive term $\Pi_{-1}^S * fweight$. Specifically, I interact firm and industry characteristics with the other elements of the information set about segment investment opportunities and find that the sign, relative magnitude and significance of the two key coefficients are robust in these more general specifications. Some specific results in Table 9 deserve mention. First, specification (1) in Table 9 is the same as the main specification (3) in Table 6. In specification (2) in Table 9, the interactive terms $\Pi_{-1}^S * sigqualdum$ and $\Pi_{-1}^F * sigqualdum$ become significant and opposite in sign. In firms that operate in small segments in which accounting returns are good predictors of investment opportunities, more weight is placed on small segment profitability and less on firm profitability in allocating capital to small segments. In specification (3) and (4) in Table 9, the relatedness variable is no longer significant when interacted with segment profits, but is significant when interacted with Tobin's q of the segment's industry in both specifications. In firms that operate in related businesses, less weight is placed on the median q of stand-alone firms that operate in the segment's industry in allocating capital to small segments.

Finally, since there is persistence in profits over time, and because lagged profits are used as a proxy for the public signal, the investment pattern may be a result of a relationship between persistence in profits and firm characteristics.³⁷ This is difficult to resolve because in order to estimate first-order autoregressive profit equations as a function of firm characteristics, a panel of at least three years is required. Again, as mentioned earlier, this is problematic due to frequent firm reorganizations of segments and the small sample size and is beyond the scope of this paper.

³⁷Refer to Gilchrist and Himmelberg (1995) for a discussion of this problem and techniques to resolve it.

5. Determinants of Incentive Compensation

Multi-divisional firms may link division manager incentive pay to firm performance for several reasons, one being to ensure that managers ‘internalize productive externalities’ between divisions. This form of incentive contract is beneficial when efforts by one division manager positively affect the performance of other divisions. For example, the quality of service that the IBM mainframe division provides to its customers may have a positive effect on the reputation and performance of IBM’s personal computer division. In support of this argument, Bushman, et al (1995) find that the weight placed on higher levels of organizational hierarchy in determining division manager incentive pay is positively correlated with interdependencies between divisions. However, the same type of incentive contract could address negative externalities such as those arising from information problems in the internal mechanisms of the firm, e.g. in transfer prices between divisions or in the allocation of human and capital resources across divisions.

In this section, I empirically explore the relationship between group manager compensation contracts and firm and industry characteristics to ensure that I have included the appropriate controls in the econometric specification in (3) and to evaluate the validity of *resize* as an instrument. The analysis also sheds light on the common explanation for why firms link division manager incentive pay to firm performance i.e. to ‘internalize externalities’ between divisions. Based on a probit specification, I evaluate whether group CEO compensation contracts can be explained by firm and industry characteristics.³⁸ In this regression, the dependent variable is defined as whether or not the annual bonus for the group CEO is based on firm performance (i.e. either 0% or greater than 0%). The estimating equation for the probit regression is as follows:

$$pr(fweightdum = 1) = \Phi(\tau_o + \tau_1 related + \tau_2 capconst + \tau_3 segnum + \tau_4 sigqual + \tau_5 indseg + \tau_6 geoseg) + \varepsilon \quad (4)$$

where *fweightdum* equals 0 if the weight placed on firm performance in determining group manager annual bonus is zero and *fweightdum* equals 1 otherwise (i.e. the weight is greater than zero); *related* delineates five relatedness categories representing increasing levels of relatedness of

³⁸Bushman, et al (1995) find similar results using *fweight* defined as a continuous variable. In the smaller sample used in this paper, while the results of the continuous model are similar qualitatively, the power of the tests is reduced.

businesses between small and large segments (measured by SIC code) and where each category is assigned an integer value from 0 to 4; *capconst* equals 1 if firms have limited access to the public debt markets measured by no S&P debt rating (financially constrained) and zero otherwise (unconstrained); *segnum* delineates five categories representing increasing numbers of segments (2, 3, 4, 5-7, 8+) where each category is assigned an integer value ranging from 0 to 4; *sigqual* is defined by five categories representing the ability of earnings to predict firm value, where each category is assigned an integer value from 0 to 4 (see footnote to Table 4); *indseg* equals one if the firm reports inter-industry segment sales (sales between business segments) and zero otherwise; and *geoseg* equals one if the firm reports inter-geographic segment sales (sales between geographic segments) and zero otherwise.³⁹

The results are presented in Table 8 and suggest that firms with operations in related businesses and firms with inter-industry and inter-geographic segment sales are more likely to link group CEO bonuses to firm performance, while firms that are more capital constrained and firms with more divisions are less likely to do so. The positive sign on the coefficient for the relatedness variable is consistent with firms designing compensation plans in order to recognize interdependencies between divisions. These interdependencies may lead to positive spillovers in which a manager's effort in one division increases the performance of another division (Bushman, et al, 1995) or negative spillovers in which influence activities by one division manager distorts signals about another division's investment opportunities (Wulf, 1999).

The results also suggest that capital constrained firms are less likely to link group CEO annual bonuses to firm performance (negative and significant coefficient on *capconst*). This appears to be at odds with influence activities in the internal capital market. Specifically, if firms were completely unconstrained, there would be no incentive for managers to skew capital away from other divisions. Hence, we would expect capital constrained firms to be more likely to use firm performance to determine division manager bonuses. However, this result may be questionable because of the limited number of capital constrained firms in the sample (approximately one-tenth of the sample don't have S&P bond ratings and hence are considered capital constrained).

³⁹In addition to the above probit regressions, I have estimated various 2-sided tobit regressions that are more consistent with the distribution of the dependent variable (relatively large number of observations with the value of 0 and 100). In these specifications (unreported), I use both integer values assigned to categories (assumes a linear relationship) and categories of dummy variables (allows non-linear relationships) as independent variables. While the results are qualitatively similar, the power of the tests is not as strong as the probit specification.

Finally, it is important to note that while *indseg* and *geoseg* appear to be significant determinants in the design of the compensation contract (i.e. both positive and significant coefficients in specification (5) of Table 8), they have no explanatory power when they are interacted with profitability and included in the investment equation in specification (3) of Table 6 (unreported). Also, while the coefficient on *relsize* is insignificant when included in specification (5) in Table 8, it does have explanatory power when interacted with profitability in the first stage regression of the 2SLS regression of specification (4) in Table 6. Specifically, in the regression of *fweight* (interacted with profitability) on the exogenous variables (interacted with profitability, including the instrument *relsize*), the coefficient on the instrument is positive and significant (unreported).⁴⁰

6. Explanations for Results and Additional Discussion

While there may be several explanations for the empirical results in section 4, they are generally consistent with the predictions of the influence and signal distortion model. Firms that increase the private cost of influencing by large division managers through firm-level compensation incentives prevent managers from distorting subjective information about investment opportunities. As a result, firms place less weight on noisy, objective signals (e.g. accounting measures) in allocating capital to small segments and more weight on accurate, subjective signals (e.g. managerial recommendations). Moreover, this tradeoff between investment and compensation incentives holds in firms that operate in businesses where accounting measures are less informative about investment opportunities, but is absent in firms that operate in businesses in which accounting measures are more informative. This suggests that as the quality of accounting measures improve, the firm relies less on firm-level compensation incentives to keep the manager from distorting information.

As mentioned earlier, the results may also be consistent with firms trying to structure compensation to ensure that managers pursue tasks that internalize positive externalities between divisions (instead of negative externalities i.e. influence activities). For example, in order to ensure that managers select optimal actions for the firm, firms may increase *fweight* in the *small* division manager's compensation contract. In turn, small division managers take actions that

⁴⁰ Note that due to the non-linear functional form of the investment equation (i.e. the interactions between firm and industry variables and lagged profitability), the instrument is defined by the interaction between *relsize* and lagged

optimize firm value and these actions lead to lower profits for their division. As a result, firms rely less on small division profits to allocate capital because they are a noisy measure of the small division's investment opportunities (or a noisy measure of the small division manager's efforts).⁴¹

Differentiating between these two alternative explanations is problematic. One approach would be to evaluate variation in firm performance levels or market valuations with variation in compensation contracts while controlling for firm and industry characteristics. Higher performance or valuations of firms with a stronger link between firm performance and group manager bonuses might support the positive externality explanation, while lower performance or valuations would support negative externalities. However, this assumes that compensation contracts that place higher weight on firm performance are effective. In fact, the opposite might occur. Specifically, small division managers might choose to free ride when their bonuses are determined by firm performance thereby lowering firm performance and market valuations.

Putting aside the difficulties in distinguishing between positive and negative externalities, another argument that might explain the results is simply due to variation in firms' capital budgeting thresholds. For example, firms generally allow division manager discretion in capital spending below a certain threshold. Higher thresholds might translate into lower sensitivity to profits and hence thresholds may explain variation in investment sensitivity to profits (i.e. $\partial I^S / \partial \Pi^S > 0$). However, given this explanation, it is not clear why the design of incentive compensation should affect sensitivity to profits (i.e. $\partial^2 I^S / \partial \Pi^S \partial fweight < 0$).

More generally (and outside of the scope of this paper), these results might be explained by variation in the role of decision-making authority in capital budgeting and the degree to which capital is actively allocated in internal capital markets. Based on preliminary empirical results (unreported), the relationship between investment and compensation incentives varies across firms by the tenure of the chief executive officer and the size of the corporate staff. Specifically, firms with less experienced CEOs appear to rely less on accounting returns (and more on subjective

profits, not just *re)size*.

⁴¹A counterfactual to this argument might be the following: finding that the substitutability still holds in firms that use high *fweight* for large division manager bonuses and low *fweight* for small division manager bonuses. However, even in this case, high *fweight* for large division manager bonuses may increase small division profits because the large division manager is now optimizing for the firm (with positive benefits for the small division) instead of just the large division. Again, firms may rely less on small division profits in allocating capital because profits may overstate investment opportunity and managerial effort.

measures) when firm-level compensation incentives are in place (i.e. substitutes). One possible explanation is that firm-level compensation incentives discourage division managers from distorting subjective information thereby allowing inexperienced CEOs to rely more on recommendations and less on accounting returns in allocating capital. Interestingly, firms with larger corporate staffs appear to use the incentive instruments as substitutes, while those with smaller corporate staffs appear to use them as complements. That is, firms with smaller corporate staffs rely more on accounting measures when firm-level compensation incentives are in place. This latter finding might suggest that firms with small staffs are less able to monitor reporting of segment performance and compensation incentives reduce the distortion or noise in the ‘objective’ accounting measures.

7. Conclusions and Further Research

The contributions in this paper are important for several reasons. To date, there is little empirical work evaluating the relationship between compensation incentives for division managers and the allocation of capital among divisions within multi-divisional firms. Recent papers find evidence suggesting that rent-seeking behavior and influence activities in the internal capital market lead to inefficient investment and lower firm values. While these papers describe the problem, they do not discuss or evaluate the possible solutions available to the firm. In contrast, this paper analyzes whether firms’ decisions in allocating capital across segments are related to the structure of incentive compensation for group (or segment) managers. I find evidence that compensation and investment incentives are substitutes: firms providing stronger links to firm performance in compensation incentives for group managers also provide weaker investment incentives through the capital budgeting process. Specifically, as the proportion of incentive pay for group managers that is based on *firm* performance increases, small segment investment is less responsive to *segment* profitability (i.e. imperfect accounting measures). While there may be several explanations for the results presented in this paper, they are generally consistent with a model of influence activities by division managers and the implied relative weights placed on noisy, objective signals versus distortable, subjective signals in inter-divisional capital allocation decisions. Firms that increase the private cost of influencing through firm-level compensation incentives discourage managers from distorting subjective information about investment opportunities thereby allowing headquarters to place less weight on noisy, objective signals (e.g.

accounting measures) and more weight on accurate, subjective signals (e.g. managerial recommendations) in allocating capital across divisions.

Evidence of the substitutability of incentive instruments suggests that firms may design incentives in light of the organizational structure of the firm. Or, more specifically, firms recognize interdependencies between divisions in allocating capital and in designing division manager compensation programs. However, it is difficult to determine whether the incentive instruments are addressing negative interdependencies (e.g. deterring influence activities in the internal capital markets) or positive interdependencies (e.g. encouraging managerial efforts that increase firm value). A more general model would allow managers to allocate their time between both types of tasks: productive effort versus unproductive influence activities. Short of generalizing the model, one way to distinguish between these alternative hypotheses is to compare performance and market valuations of firms controlling for firm and industry characteristics. Specifically, one approach would evaluate whether firms using certain types of compensation contracts (controlling for other characteristics) trade at a premium relative to other comparable (or possibly single segment) firms.

Appendix A-Tables of Descriptive Statistics and Empirical Results

Table 1
Descriptive financial statistics for sample of multi-segment firms

Sample Characteristics	Multi-segment Firms		Smallest Segments	
	<u>Median</u>	<u>Standard Deviation</u>	<u>Median</u>	<u>Standard Deviation</u>
Sales (\$millions)	4650	15108	795	1332
Assets (\$millions)	4400	20116	595	1540
Net Invest. / Assets (I)	.0141	.0290	.0093	.0532
Oper. Inc. / Assets (Π_{t-1})	.1572	.0766	.1305	.1728
Sales Growth	.0432	.0984	.0288	.2571
Tobin's q	1.380	1.062	1.509	.5700
Relative size of segment			.17	.13
Observations	415		415	
Number of Firms	94		94	

Note: Descriptive statistics for the sample of observations of multi-segment firms. Included are the small manufacturing segments (SIC codes between 2000 and 4000) during the 1989-93 period. Small segments are defined as the manufacturing segment in the firm with the smallest sales. Net investment is defined as the firm's or segment's net capital expenditures in period t divided by the book value of the firm's or segment's assets in that period. Operating income/assets is defined as the firm's or segment's operating income in period t-1 divided by the book value of the firm's or segment's assets in that period. Sales growth is defined as the firm's or segment's sales growth in period t. Tobin's q for the firm is measured as firm market value divided by book value of assets. Similar to Scharfstein (1998), market value is defined as the book value of assets plus the market value of common equity minus the sum of the book value of common equity and balance sheet deferred taxes. Tobin's q for the segment is defined as the median q for single segment firms in the industry (defined at the 2 digit SIC). Relative size of segment is the ratio of segment sales to firm sales. Refer to "Criteria Used for Sample Selection" at the end of this appendix (A) for additional details. Source: Compustat

Table 2

Descriptive statistics of compensation programs for sample of multi-segment firms

Compensation Component	Number of Firms	Mean	Std . Dev.	1st Quartile	Median	3rd Quartile
Salary (\$000)						
Group CEO	164	315.7	107.7	243	300	367
Division CEO	203	202.8	78.4	150	192	232
Plant Manager	105	109.8	31.4	90	104	122
Target Bonus over Salary (%)						
Group CEO	142	49	12.8	40	49	55
Division CEO	172	39.7	12.3	32	38	45
Plant Manager	84	24	11.4	20	23	27

Note: Compustat 'segments' are analogous to 'groups' as defined in the compensation survey. Refer to the second paragraph in Section 4.3 for a discussion about this matching. The statistics in this table represent a larger sample than that used in the investment analysis [i.e. the statistics describe the same sample as that used in Bushman, Indjejikian, Smith (1995)]. For each sample firm, salary and target bonus are computed as an average for each managerial level based on data reported in the 1993 survey.

Table 3

Basis for Determining 1993 Annual Bonus: Percentage of Managers' Annual Bonuses Based on Organizational Level Performance

(*fweight* designated in bold type--proxy for manager's cost of influence, c)

Manager	Number of Firms	Performance of Organizational Level				Individual
		Corporate	Group	Division	Plant	
		Mean Median	Mean Median	Mean Median	Mean Median	Mean Median
Corporate CEO	106	86.0 100	.5 0	0 0	0 0	13.5 0
Group CEO	94	35.2 30	44.5 50	1.3 0	0 0	18.9 0
Division CEO	106	22.3 2.5	7.7 0	51.8 50	0 0	18.2 0
Plant Managers	84	18.6 0	5.4 0	32.0 25	22.6 0	21.4 17.5

Note: The sample in this table consists of 106 domestic public companies drawn from a proprietary compensation survey that forms the basis for determining annual bonuses for at least one of the following organizational levels: plant managers, division CEOs, or group CEOs. The table reports the percentage of the annual bonus based on performance at each organizational level. The key variable used in the empirical analysis, *fweight* (designated in bold type), is defined as the weight placed on firm performance in determining *group* CEOs annual bonuses.

Table 4

Categories of Quality of Public Signal (*sigqual*)
Informativeness of Earnings in Predicting Firm Market Value
(measured by the value relevance of earnings across industries)

[proxy for quality of the public signal (ψ)]

Category	Industries Included	Number and Percent of Small Segment-Year Observations
<i>sigqual</i> =0 (low)	Trading, Wholesale, Measuring Equipment, Pharmaceutical Products, Consumer Goods, Computers, Medical Equipment, Business Service	62 15%
<i>sigqual</i> =1	Construction, Rubber Products, Fabricated Products, Printing and Publishing, Petroleum and Coal	33 8%
<i>sigqual</i> =2	Machinery, Electronic Equipment, Food Products, Alcoholic Beverages, Recreational Products	120 29%
<i>sigqual</i> =3	Electric Equipment, Construction Materials, Business Supplies, Chemicals	157 38%
<i>sigqual</i> =4 (high)	Shipping Containers, Automobiles, Aircraft, Steel Works, Apparel, Textiles	43 10%
Total		415

Note: In the accounting literature, this concept is referred to as the value relevance of earnings and is defined as the inverse of the variation of the log of firm value measured by accounting measures divided by firm market value. Specifically, the inverse of the variance of $\log(V/P)$ where P is the market value of the firm and V is firm value estimated from the accounting-based valuation model. Using a large sample of firms from Compustat over the period 1953-1996, Chang (1998) measures the value relevance of earnings in 37 industry groups based on a technique used in Fama & French (1997) and ranks industries based on this measure. As expected, utility firms have the highest value relevance of earnings, while pharmaceutical firms have the lowest. These 37 industry groups are categorized into five groups increasing from *sigqual*=0 to *sigqual*=4.

Table 5

**Number of Firm-Year Observations with Different Attributes in
Multi-segment Sample (*related* vs. *numseg*)**

Relatedness of small and large segment businesses (*related*)

Number of Segments (<i>numseg</i>)	Different at 1-digit SIC (<i>related</i> =0)	Same at 1-digit SIC (<i>related</i> =1)	Same at 2-digit SIC (<i>related</i> =2)	Same at 3-digit SIC (<i>related</i> =3)	Same at 4-digit SIC (<i>related</i> =4)	Total
2	0	63	16	0	25	104
3	26	38	34	16	9	123
4	24	37	24	9	11	105
5+	20	45	14	4	0	83
Total	70	183	88	29	45	415

Variable Definitions: *related* is defined by five relatedness categories representing increasing levels of relatedness of businesses between small and large segments (defined by SIC code) in a multi-segment firm, where each category is assigned an integer value from 0 to 4 [small (large) segments are those with the smallest (largest) sales in a firm in a year]; *numseg* is defined by five categories representing increasing numbers of segments (2, 3, 4, 5-7 and 8-10) where each category is assigned an integer value ranging from 0 to 4; *capconst* is a dummy variable measuring a firm's access to the public debt markets: it equals zero if the firm has an S&P debt rating (unconstrained) and one otherwise (constrained). The split in the sample for the capital constraint characteristic (*capconst*) is approximately one-tenth more constrained firm observations (firms without S&P bond ratings) and nine-tenths less constrained firms (firms with S&P bond ratings). Not surprisingly, less constrained firms have more segments than more constrained firms do.

Table 6
**Small Segment Investment Sensitivity to Profits as a Function of Firm
Characteristics--Modeled by Investment Equation**

Dependent Variable is Small Segment Investment Divided by
Book Value of Segment Assets(I^S)

Independent Variables	(1)	(2)	(3)	(4)
	OLS	OLS	Firm Fixed Effects	IV-Firm Fixed Effects
Π_{-1}^S (segment oper. inc./assets)	-.012 (.021)	.084*** (.032)	.136*** (.047)	.214* (.113)
Π_{-1}^S *fweight	--	-.087*** (.034)	-.122** (.050)	-.215* (.130)
Π_{-1}^S *relateddum	--	-.120*** (.027)	-.111** (.046)	-.129** (.052)
Π_{-1}^S *numsegdum	--	-.005 (.030)	.034 (.052)	.033 (.053)
Π_{-1}^S *capconst	--	-.087** (.044)	.013 (.063)	-.012 (.071)
Π_{-1}^S *sigqualdum	--	.015 (.035)	.076 (.053)	.054 (.060)
Tobin's q (industry of segment)	.005 (.017)	.008 (.016)	.014 (.011)	.014 (.011)
<hr/>				
Π_{-1}^F (firm oper. inc./ assets)	.048 (.032)	.044 (.033)	.149** (.072)	.140* (.073)
X^F (relative firm sales growth)	.025 (.027)	.019 (.024)	-.022 (.023)	-.029 (.025)
<hr/>				
Observations	415	415	415	415
No. of firms	94	94	94	94
R-sq.	.12	.19	.26	--

Notes: All regressions include industry (2 digit sic) and year fixed effects and standard errors adjust for heteroskedasticity of the error terms. Observations on the smallest manufacturing segment in a firm in a year resulting in unbalanced panel with 94 firms and 415 firm-segment-years. Variable definitions: (i) *fweight* is the percentage weight placed on firm performance in determining annual bonuses for group CEOs (see Table3) (ii) *relateddum* is a dummy variable measuring the relatedness of businesses between small and large segments (defined by SIC code): it equals 1 if they are related at the 2, 3, or 4 digit level and zero otherwise. (see Table 5) (iii) *numsegdum* is dummy variable measuring the number of segments: it equals 1 if the firm has greater than 3 segments and zero otherwise. (see Table 5) (iii) *capconst* is a dummy variable measuring a firm's access to the public debt markets: it equals zero if the firm has an S&P debt rating (unconstrained) and one otherwise (constrained) (iv) *sigqualdum* is a dummy variable measuring the informativeness of profits in predicting firm value in the segment's industry; it equals one if *sigqual* is greater than or equal to 2 (i.e.informative) and zero otherwise (i.e. not informative) (see Table 4). Tobin's q is measured as the median market-to-book ratio for standalone firms in the segment's industry (2-digit SIC). Relative firm sales growth is defined as the deviation of the firm sales growth from the firm's industry sales growth (2-digit SIC). The results in specification (3) are robust to corrections in the standard errors for heteroskedestacity across firms and to allowing for the specification of the correlation structure among observations within firms (see footnote 26 in the text). The instrument used in specification (4) is the variable *relsize* which is defined as the log of the ratio of small segment sales to firm sales. *** (**/*) significant at 1% (5/10%) level.

Table 7
**Small Segment Investment Sensitivity to Profits as a Function of Firm
Characteristics--Modeled by Investment Equation**

Dependent Variable is Small Segment Investment Divided by
Book Value of Segment Assets(I^S)

Criterion Used to Split Sample	Quality of Segment Profitability as Signal (<i>sigqual</i>)		Cost to Manager of Signal Distortion (<i>fweight</i>)		Relative Size of Small Segment (<i>relsize</i>)	
Independent Variables	(1) Low Quality Signal	(1') High Quality Signal	(2) Low Private Cost	(2') High Private Cost	(3) Small, Small Segment	(3') Large, Small Segment
Π_{-1}^S (seg. oper. inc./assets)	.168*** (.048)	.228*** (.104)	.169*** (.065)	.239 (.168)	.218*** (.065)	.033 (.112)
Π_{-1}^S * <i>fweight</i>	-.170*** (.051)	-.087 (.113)	-.017 (.418)	-.239 (.169)	-.220*** (.068)	.189 (.129)
Π_{-1}^S *relateddum	-.011 (.053)	-.099 (.102)	-.105 (.076)	-.002 (.086)	-.108 (.091)	.021 (.086)
Π_{-1}^S *numsegdum	.026 (.065)	-.069 (.092)	.024 (.087)	-.050 (.073)	.010 (.075)	-.175* (.094)
Π_{-1}^S *capconst	-.008 (.052)	-.624 (.446)	-.013 (.069)	-.155 (.225)	-.101 (.086)	.100 (.121)
Π_{-1}^S *sigqualdum	--	--	.009 (.094)	.185** (.072)	.050 (.094)	.040 (.108)
Tobin's q (industry of seg.)	-.005 (.016)	.019 (.016)	.022 (.017)	-.001 (.015)	.018 (.017)	.016 (.014)
Π_{-1}^F (firm oper. inc./assets)	.004 (.082)	.262* (.140)	.157 (.107)	.054 (.105)	.152 (.105)	.047 (.103)
X^F (rel. firm sales growth)	-.025 (.025)	-.009 (.044)	-.038 (.032)	.025 (.035)	-.058 (.038)	-.004 (.032)
Observations	214	201	217	198	208	207
R-sq.	.22	.35	.39	.26	.28	.27

Note: For variable definitions and model specifications, refer to the footnote in Table 6. The low quality signal sample includes those firms with *sigqual* less than or equal to two; while the high quality signal sample includes the remaining firms. The low private cost sample includes those firms with *fweight* less than or equal to 30%; while the high cost sample includes the remaining firms. The small (large), small segment sample includes those firms with *relsize* less (greater) than the median for the whole sample. *** (**/*) significant at 1% (5/10%) level.

Table 8
Determinants of Group CEO Incentive Compensation Design
Modeled as a Probit Specification (1992)

Dependent Variable is the % Weight Placed on Firm Performance in Determining Group CEO Incentive Compensation (defined as a dummy variable)

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
<i>fweightdum</i> (weight on firm perf.)					
Independent Variables:					
<i>related</i> (relatedness of seg. ops.)	.281** (.133)	--	.270* (.139)	.243* (.145)	.279* (.163)
<i>capconst</i> (capital constrained)	--	-.729** (.331)	-.671** (.332)	-.744** (.343)	-.814** (.370)
<i>numseg</i> (number of segments)	--	--	--	-.150 (.145)	-.381** (.174)
<i>sigqual</i> (signal quality of small seg. profits)	--	--	--	-.067 (.137)	-.134 (.144)
<i>indseg</i> (presence of inter- industry segment sales)	--	--	--	--	.722* (.390)
<i>geoseg</i> (presence of inter- geographic segment sales)	--	--	--	--	.879** (.352)
Pseudo R-sqd	.04	.04	.08	.09	.20
Observations	94	94	94	94	94

Notes: Coefficients represent marginal effects calculated at the mean for each variable (except for *capconst*, *indseg*, and *geoseg*). Variable definitions: (i) *fweightdum* equals 0 if the weight placed on corporate performance in determining group CEO annual bonus is zero and *fweightdum* equals 1 otherwise (i.e. the weight is greater than zero) (ii) *related* is defined by five relatedness categories representing increasing levels of relatedness of businesses between small and large segments (defined by SIC code), where each category is assigned an integer value from 0 to 4. (iii) *numseg* is defined by five categories representing increasing numbers of segments (2, 3, 4, 5-7 and 8-10) where each category is assigned an integer value ranging from 0 to 4; (iii) *capconst* is a dummy variable measuring a firm's access to the public debt markets: it equals zero if the firm has an S&P debt rating (unconstrained) and one otherwise (constrained); (iv) *sigqual* is defined by five categories representing the ability of earnings to predict firm value, where each category is assigned an integer value from 0 to 4 (see footnote to Table 4); (v) *indseg* equals one if the firm has any inter-industry segment sales and zero otherwise; and (vi) *geoseg* equals one if the firm has any inter-geographic segment sales and zero otherwise. *** (**/*) significant at 1% (5/10%) level.

Table 9
**Small Segment Investment Sensitivity to Profits as a Function of Firm
Characteristics--Modeled by Investment Equation**

Dependent Variable is Small Segment Investment Divided by
Book Value of Segment Assets(I^S)

Independent Variables	(1) Spec. (3) in Table 6	(2) Firm Fixed Effects	(3) Firm Fixed Effects	(4) Firm Fixed Effects
Π_{-1}^S (segment oper. inc./assets)	.136 (.047)***	.169 (.053)***	.143 (.048)***	.181 (.053)***
Π_{-1}^S *fweight	-.122 (.050)**	-.151 (.055)***	-.124 (.051)***	-.164 (.056)***
Π_{-1}^S *relateddum	-.111 (.046)**	-.019 (.046)	-.025 (.052)	.035 (.057)
Π_{-1}^S *numsegdum	.034 (.052)	-.038 (.057)	-.003 (.055)	.038 (.057)
Π_{-1}^S *capconst	.013 (.063)	-.094 (.088)	-.069 (.075)	-.121 (.088)
Π_{-1}^S *sigqualdum	.076 (.053)	.112 (.056)***	.087 (.055)	.103 (.056)*
Tobin's q (industry of segment)	.014 (.011)	.018 (.011)	.028 (.019)	.037 (.021)*
q * fweight			.016 (.800)	.016 (.021)
q * relateddum			-.008 (.002)***	-.009 (.004)**
q * numsegdum			-.002 (.004)	-.007 (.004)
q * capconst			.026 (.016)	.013 (.024)
q * sigqualdum			-.002 (.004)	.001 (.005)
<hr/>				
Π_{-1}^F (firm oper. inc./ assets)	.137 (.072)*	.232 (.192)	.142 (.074)*	.069 (.251)
Π_{-1}^F *fweight		.173 (.225)		.166 (.236)
Π_{-1}^F *relateddum		-.083 (.034)**		.017 (.058)
Π_{-1}^F *numsegdum		.068 (.050)		.111 (.057)*
Π_{-1}^F *capconst		.169 (.119)		.163 (.173)
Π_{-1}^F *sigqualdum		-.085 (.052)*		-.093 (.063)
X^F (relative firm sales growth)	-.029 (.023)	-.018 (.024)	-.025 (.024)	-.017 (.024)
<hr/>				
Observations	415	415	415	415
No. of firms	94	94	94	94
R-sq.	.24	.32	.32	.34

All regressions include firm, industry (2 digit sic), and year fixed effects and standard errors adjust for heteroskedasticity of the error terms. Observations on the smallest manufacturing segment in a firm in a year resulting in unbalanced panel with 94 firms and 415 firm-segment-years. Variable definitions: (i) *fweight* is the percentage weight placed on firm performance in determining annual bonuses for group CEOs (ii) *relateddum* is a dummy variable measuring the relatedness of businesses between small and large segments (defined by SIC code): it equals 1 if they are related at the 2, 3, or 4 digit level and zero otherwise. (iii) *numsegdum* is dummy variable measuring the number of segments: it equals 1 if the firm has greater than 3 segments and zero otherwise. (iii) *capconst* is a dummy variable measuring a firm's access to the public debt markets: it equals zero if the firm has an S&P debt rating (unconstrained) and one otherwise (constrained) (iv) *sigqualdum* is a dummy variable measuring the informativeness of profits in predicting firm value in the segment's industry; it equals one if *sigqual* is greater than or equal to 2 (i.e.informative) and zero otherwise (i.e. not informative) (see Table 4). Tobin's q is measured as the median market-to-book ratio for standalone firms in the segment's industry (2-digit SIC). Relative firm sales growth is defined as the deviation of the firm sales growth from the firm's industry sales growth (2-digit SIC). *** (**/*) significant at 1% (5/10%) level.

Criteria Used for Sample Selection

The analyses include financial data for the five-year period from 1989 through 1993 for multi-segment firms with at least two segments that operate in manufacturing industries (i.e., SIC codes from 2000 to 4000). Since investment is defined as capital expenditures net of depreciation (the only measure of investment reported at the segment level), I focus only on manufacturing segments. Using capital expenditures as a definition of investment in non-manufacturing businesses ignores the importance of other investments such as R&D, advertising, etc. The model distinguishes between two types of divisions within the firm: (i) large, established divisions with known returns and (ii) smaller, newer divisions with unknown returns. In order to identify the extremes in investment behavior and maintain consistency with the model, only the largest and smallest segments in manufacturing industries are included in the analysis. I use the manufacturing segment with the smallest sales in each year to represent the division with the least influential (or passive) manager and the least predictable returns (smaller, newer division). I only estimate the investment equation of the smallest segments. I use the manufacturing segment with the largest sales in each year to represent the division with the most influential manager and the most predictable returns (larger, established division). The largest segments and the associated SIC codes are used only to determine the relatedness of the businesses of the small and large manufacturing segments (measured by the variable *related*).

Firms reorganize their segments over time leading to a potential selection problem in creating a balanced panel. Since firm reorganization is common, there is a significant attrition problem when matching segments (i.e. matching segment identification numbers) from year-to-year. Approximately 10% of the segments did not match between 1992 and 1993 and an additional 10% did not match when adding 1991. In light of this reorganization problem and to ensure that the regression of current investment on lagged profits uses data for the same segment, I include only segments with identical identification numbers for the two periods being compared. Observations have been pooled over the 5-year period resulting in an unbalanced panel of small segments with 94 firms and 415 segment-years. For each segment, the following variables have been used to calculate financial ratios: net sales, operating profit (loss), depreciation, capital expenditures, identifiable total assets and primary SIC code. From the Compustat Annual File, net sales, operating profit (loss), total assets, S&P bond ratings, stock price and common shares outstanding were used to calculate firm variables such as sales growth, profitability, market-to-book ratios and degree of capital constraints.

The participants in the compensation survey included 246 companies comprised of both single and multiple segment firms operating in manufacturing and service industries. When retaining manufacturing firms that operate in more than one segment (i.e. deleting single segment firms and service firms), the

survey sample reduces to 131 firms. I merge the Compustat sample with this smaller compensation survey sample that results in 108 firms. However, since I don't have the relevant financial information for these firms over the entire five-year period and since several firms do not report compensation information for group CEOs, the final pooled sample used in the investment analysis has 94 firms and 415 firm-segment-year observations.

The firms and segments that remain in the multi-segment sample used for investment analysis meet the following criteria: firms with at least two segments in manufacturing industries, segments that have the same identification number for the two consecutive years of comparison, segments for which SIC codes and key financial statistics are available, and firms that are participants in the compensation survey and report information for group CEOs.

Appendix B—Model: Review and Derivation of Empirical Implications

A. Firm's Problem and Solution

Headquarters has a choice between *detering* or *allowing* (i.e. inducing) influence activities by the large division manager. The optimal choice (i.e. the one that maximizes returns from investment) depends on the environment within which the firm operates. This environment is characterized by four attributes (exogenous parameters): the ability of the manager to distort signals (ϕ), the quality of the public signal (ψ), the private cost to the division manager from influencing private information (c), and the probability of a bad type (θ). Hence, the situation is a standard moral hazard problem in which the agent chooses to take a costly action. Headquarters (principal) determines the value-maximizing investment rules (analogous to cost-minimizing wage schedules) to induce each action (influencing or not) by the division manager (agent). These rules specify divisional investment (payoff to the agent) as a function of a private and public signal (what the principal observes). Subsequently, headquarters determines whether deterring or allowing influence activities is optimal and offers the contract that results in the preferred action. The optimal contract and preferred action depend upon the firm's environment (i.e. the four attributes mentioned above).

Headquarters represents shareholders and maximizes shareholder wealth defined as the sum of expected returns net of investment in each division. L's utility function is the sum of the linear utility from investment in L [$I^L(\sigma, \Pi)$] and the disutility from the private costs of influence (c), i.e. $U^L = I^L(\sigma, \Pi) - c$. The investment incentives reduce the manager's *gain* from signal distortion [i.e. lower $I^L(\sigma, \Pi)$], while the compensation incentives increase the manager's *cost* of signal distortion [i.e. increase c]. Headquarters offers an investment rule that either *deters* or *allows* influence activities. The timing occurs as follows: H offers an investment contract to S and L; L chooses whether to engage in influence activities and if so, incurs a personal cost; both signals are transmitted to H; H allocates capital between S and L.

The game is solved recursively in two steps--a standard solution in a moral hazard model. First, I solve for the value-maximizing investment rule under each regime. Let the value-maximizing investment rule for the 'deter influence' regime and 'allow influence' regime be denoted by $\{I_D^S(\sigma, \Pi), I_D^L(\sigma, \Pi)\}$ and $\{I_A^S(\sigma, \Pi), I_A^L(\sigma, \Pi)\}$, respectively. The *optimal contract* (or the preferred regime) is determined by a comparison of the investment distortion under each regime relative to first-best. In this paper, I evaluate the comparative statics with respect to the agent's private cost parameter.

B. Value-Maximizing Investment Rules

In a first-best world, H receives an undistorted private signal from S and hence knows S's type. The fixed capital budget (I) is allocated efficiently between L (I^L) and S (I^S). All (no) capital is allocated to S if it is a good (bad) type. However, in a second-best world, capital allocation across divisions will be inefficient relative to first-best. In order to *deter* influence activities, H commits to allocate capital to S even when it's bad. By penalizing L in the event of a bad private signal, H mitigates the incentive for L to distort the private signal.⁴² However, since deterrence is costly to the firm, it is not always optimal for firms to design contracts with that as a goal. Some firms design contracts to induce or *allow* influence.⁴³ In this regime, inefficiencies arise because investment decisions may be made based on distorted private signals. The value-maximizing investment rules appear in Table 10.

Since I have a proxy for the public signal, but not the private signal, the analyses focus on investment sensitivity to the public signal. I derive expected investment conditional on the public signal by averaging over the private signal realizations [represented by $E(I^S | \Pi)$ or simply I^S as defined in (1) in the text]. Subsequently, I consider investment sensitivity to the public signal or the 'investment incentive' [represented by $S_\Pi = \Delta E(I^S | \Pi) / \Delta \Pi$ or $\beta_1 = \partial I^S / \partial \Pi$ as defined in the text].⁴⁴ Finally, I consider how this sensitivity changes as the private cost to the agent changes [represented by $\Delta S_\Pi / \Delta c = \Delta^2 E(I^S | \Pi) / \Delta \Pi \Delta c$ or $\partial^2 I^S / \partial \Pi \partial c$ as defined in the text].

In a first-best world, H offers the first-best contract and investment sensitivity to the public signal ($S_{\Pi FB}$) depends on the signal-to-noise ratio of the public signal [$x = \psi / (1 - \psi)$] and the odds ratio of a bad type [$y = \theta / (1 - \theta)$], but *not* on the cost parameter (c).⁴⁵ However, in the 'deter' regime (i.e. second-best),

⁴²Moreover, an important point that is central to the empirical work is that the magnitudes of the investment distortion (Σ_1 and Σ_2 in Table 10) decrease in c .

⁴³In the 'allow' equilibrium, the incentive compatibility constraint is not binding, hence, without loss of generality, it can be ignored.

⁴⁴For example, in the 'deter regime', expected investment in S conditional on a bad public signal is:

$$E(I_D^S | \Pi_b) = \Pr_D(\sigma_b / \Pi_b) \cdot I_D^S(\sigma_b, \Pi_b) + \Pr_D(\sigma_g / \Pi_b) \cdot I_D^S(\sigma_g, \Pi_b) \text{ and } S_{\Pi D} = \frac{\Delta E(I_D^S | \Pi)}{\Delta \Pi} = \frac{E(I_D^S | \Pi_g) - E(I_D^S | \Pi_b)}{\Pi_g - \Pi_b}.$$

Intuitively, S_Π represents the change in the capital allocated to S as the public signal changes from bad to good. This derivation is necessary for an explicit mapping to the observables.

⁴⁵ $S_{\Pi FB} = \left[\frac{1}{1 + y/x} - \frac{1}{1 + y \cdot x} \right] \cdot \bar{I}$ where $x = \psi / (1 - \psi)$ (the signal-to-noise ratio for the public signal since ψ equals

the probability of a good public signal conditional on a good type) and $y = \theta / (1 - \theta)$ (the probability ratio of bad to good types). An analogous measure for the investment sensitivity to the *private* signal is $S_\sigma = \frac{\Delta E(I^S | \sigma)}{\Delta \sigma}$ where

investment sensitivity to the public signal ($S_{\Pi D}$) is a *decreasing* function of the cost parameter (or $\Delta S_{\Pi D} / \Delta c = \Delta^2 E(I^S | \Pi) / \Delta \Pi \Delta c < 0$) as depicted in Figure 1). The reasoning is as follows. The model predicts that, in order to deter influence activities, firms distort investment by making division investment *less* sensitive to the *private* signal (the one that can be influenced) and *more* sensitive to the *public* signal (the noisy signal that cannot be influenced) relative to first-best. In firms with low personal costs, greater weight is given to the public signal in a way that is ex post inefficient (i.e. $S_{\Pi D}$ is ‘too high’ relative to first-best). In contrast, in the ‘allow’ regime, the cost parameter is irrelevant to the investment sensitivity to the public signal ($S_{\Pi A}$) because the incentive compatibility constraint is slack (or $\Delta S_{\Pi A} / \Delta c = \Delta^2 E(I^S | \Pi) / \Delta \Pi \Delta c = 0$ as in Figure 2).

C. Optimal Investment Contract (or Preferred Regime)

The value-maximizing investment rules (Table 10) determine L’s choice and lead to implications for investment behavior for each regime (Figure 1 and 2). However, these rules say nothing about which regime is *optimal* for H. By comparing the degree of investment distortion under each regime, I determine the *optimal contract* (or preferred regime) as a function of the exogenous parameters. As mentioned earlier, since the relevant comparative statics for the empirical part of this paper primarily concern the private cost parameter, I focus on the optimal regime as a function of c and identify under what conditions the optimal regime depends on the relative quality of private and public signals.⁴⁶ Depending on parameter values, the precise solutions vary. However, for empirical purposes there are two distinct cases, one of which is presented in Figure 3. In this case, investment sensitivity to the public signal is a constant and then decreasing function of c and always greater than first-best. In addition, investment distortion (measured as the difference in the weight placed on the public signal between the optimal and first-best contract) decreases as the private cost to the agent increases.

$S_{\sigma FB} = \bar{I}$ (i.e. in first-best, investment in S changes from 0 to $\bar{I}$ when the private signal changes from bad to good).

Note that $S_{\Pi FB} \rightarrow S_{\sigma FB} = \bar{I}$ as $\psi \rightarrow 1$ or $x \rightarrow \infty$ (i.e. in first-best, investment sensitivity to the public signal converges to that of the perfect, private signal as noise in the public signal goes to zero).

⁴⁶The optimal contract (i.e. deter or allow) is determined by comparing the absolute value of the difference between the investment sensitivity function for each regime and first-best for all values of the private cost parameter i.e. $\text{Min} \{ |S_{\Pi D} - S_{\Pi FB}|, |S_{\Pi A} - S_{\Pi FB}| \}, \forall c$

Table 10

First-Best Contract and**Value-Maximizing Investment Rules—[Deter (D) and Allow (A) Influence Regimes]**[pairs represent small and large division investment (I^S , I^L)]

Cases	Signal Realizations			
	(σ_b, Π_b)	(σ_b, Π_g)	(σ_g, Π_b)	(σ_g, Π_g)
1. First-Best Contract (I_{FB}^S, I_{FB}^L)	$(0, \bar{I})$	$(0, \bar{I})$	$(\bar{I}, 0)$	$(\bar{I}, 0)$
2. Second-Best Contracts				
(based on parameters-- ϕ, ψ, c, θ)				
2.1 Deter Influence (I_D^S, I_D^L)				
i.Low distortion-to-cost	$(0, \bar{I})$	$(\Sigma_1, \bar{I} - \Sigma_1)^1$	$(\bar{I}, 0)$	$(\bar{I}, 0)$
ii.High distortion-to-cost	$(0, \bar{I})$	$(\bar{I}, 0)$	$(\Sigma_2, \bar{I} - \Sigma_2)^2$	$(\bar{I}, 0)$
2.2 Allow Influence (I_A^S, I_A^L)				
i.Low distortion-to-noise	$(0, \bar{I})$	$(0, \bar{I})$	$(\bar{I}, 0)$	$(\bar{I}, 0)$
ii. High distortion-to-noise	$(0, \bar{I})$	$(\bar{I}, 0)$	$(\bar{I}, 0)$	$(\bar{I}, 0)$

Note: The table presents the four possible combinations of private and public signal realizations; e.g. (σ_b, Π_b) represents a bad private signal and a bad public signal. Since the signals are both binary random variables, I^S and I^L are four-tuples. The four exogenous parameters include: θ =probability of a bad type; ϕ =probability of distortion of the private signal given the manager chooses to influence; ψ =probability that the public signal reveals the type; c =manager's personal cost of influence. ¹ $\Sigma_1 = \bar{I}/\psi - c/[\phi(1-\theta)\psi]$ where $\Sigma_1 < \bar{I}$ and ² $\Sigma_2 = c/[\phi(1-\theta)(1-\psi)]$ where $\Sigma_2 < \bar{I}$. Low distortion-to-cost ratio is defined by $1/[(1-\theta)\psi\bar{I}] < \phi/c < 1/[(1-\theta)(1-\psi)\bar{I}]$ and high distortion-to-cost ratio is defined by $\phi/c > 1/[(1-\theta)(1-\psi)\bar{I}]$. Note there is a minimum value for ϕ/c , below which the manager has no incentive to distort the private signal. Low distortion-to-noise ratio is defined by $\phi/(1-\psi) < 1/\psi$ and high distortion-to-noise ratio is defined by $\phi/(1-\psi) > 1/\psi$.

Figure 1
**Small Division Investment Sensitivity to the Public Signal—
 First-Best versus Deter Regime***

In the deter regime, the investment sensitivity function is a downward sloping, piece-wise linear function of c with a kink at $c = c_D^ = \phi[(1-\theta)(1-\psi)\bar{I}]$:

$$S_{\Pi D} = S_{\Pi FB} + \frac{y}{x} \cdot \frac{1}{\psi} \left[\frac{\bar{I}}{1 + \frac{x}{y}} - \frac{c}{\phi} \cdot \frac{1/(1-\theta)}{1 + \frac{y}{x}} \right] \text{ where } \phi[(1-\theta)(1-\psi)]\bar{I} < c < \phi[(1-\theta)\psi\bar{I}] \text{ (or low distortion-to-cost ratio)}$$

and where $x = \psi/(1-\psi)$ (the signal-to-noise ratio for the public signal) and $y = \theta/(1-\theta)$ (the probability ratio of bad to good types). Note that $S_{\Pi D} \rightarrow S_{\Pi FB}$ as $\psi \rightarrow 1$ or $x \rightarrow \infty$.

$$S_{\Pi D} = \bar{I} - c / \{\phi[\theta\psi + (1-\theta)(1-\psi)]\} \text{ where } 0 < c < \phi[(1-\theta)(1-\psi)]\bar{I} \text{ (or high distortion-to-cost ratio).}$$

Figure 2

**Small Division Investment Sensitivity to the Public Signal—
First-Best versus Allow Regime***

*In the allow regime, the investment sensitivity function is not a function of c , but always lies either below [where $0 \leq \phi \leq (1-\psi)/\psi$] or above first-best [where $(1-\psi)/\psi < \phi \leq 1$]. $S_{\Pi A} = (1-\phi)S_{\Pi FB}$ (for low distortion-to-noise ratio). Note that $S_{\Pi A} \rightarrow \bar{I}$ as $\psi \rightarrow 1$ and that $S_{\Pi A} \rightarrow S_{\Pi FB}$ as $\phi \rightarrow 0$.

Also, $S_{\Pi A} = \left[1 - \frac{(1-\phi)}{1+x \cdot y} \right] \cdot \bar{I}$ (for high distortion-to-noise ratio) and where $x = \psi/(1-\psi)$ (the signal-to-noise ratio for the public signal) and $y = \theta/(1-\theta)$ (the probability ratio of bad to good types). Note that $S_{\Pi A} \rightarrow \bar{I}$ as $\psi \rightarrow 1$ or $\phi \rightarrow 1$.

Figure 3

**Small Division Investment Sensitivity to the Public Signal-
First-Best versus Optimal Regime***

*This figure is a result of placing restrictions on parameter values, specifically $(1-\psi)/\psi < \phi \leq 1$. Intuitively, when the distortion-to-noise ratio is high (i.e. the probability of a distorted private signal is greater than the noise-to-signal ratio of the public signal) and the private cost is high, it is optimal to offer the contract that deters influence activities.

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