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ABSTRACT

This paper investigates the resource allocation decisions in conglomerates when managers are motivated by career concerns. The output of a conglomerate division is determined by the unknown ability of corporate management, the capital employed in the division, and intangible resources that the management allocates to the division. While capital allocation across divisions is fully observable and contractible, the allocation of intangible resources is not. The divisions differ in how informative their cash flows are about managerial ability. Corporate management, influenced by career concerns, seeks to maximize perceived ability. In this set up, we show that it is in the interest of management to overallocate intangible resources to the more informative divisions in order to increase the market's perception of its ability. Anticipating this bias, it is in the firm's owners' interest to also overallocate capital to the more informative divisions. To the extent that industries with lower cash flow informativeness have higher q-ratios, this inefficiency results in a form of corporate socialism. Since the value loss due to the allocational inefficiency increases with the difference in informativeness, the model offers a rationale for corporate hedging that reduces this difference. The model highlights a cost of segment reporting and tracking stocks, namely, that they create avenues for managers to distort their perceived ability at the expense of investors.

CAREER CONCERNS AND RESOURCE ALLOCATION IN CONGLOMERATES

Evidence from recent research on corporate scope suggests that conglomerates are less efficient than comparable single-segment firms. Lang and Stulz (1994) and Berger and Ofek (1995) find that conglomerates trade at a discount of about 15% relative to a portfolio of single-segment firms in the same industries. In addition, there is some evidence (see Lamont (1997) and Shin and Stulz (1998)) that one of the causes of the value loss in conglomerates might be the inefficiency of internal capital markets which misallocate capital to the segments. Rajan, Servaes, and Zingales (2000) and Scharfstein (1998) find evidence that is consistent with misallocation of capital within conglomerates.

Several papers have attempted to explain the misallocation of capital (see Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000)). These papers argue that moral hazard and rent-seeking at the level of corporate and divisional management can cause capital to be misallocated when, for instance, it is difficult to write enforceable contracts based on capital allocation. In our paper, we argue that capital misallocation can exist even if capital allocation is contractible and there is no rent seeking by divisional managers. Specifically, we suggest that the inefficiency in *observable* capital allocation may be an optimal response to the misallocation of *unobservable* intangible resources stemming from the career concerns of the firm's senior management. In our model, management has no preference for capital per se and the amount of capital that the firm can raise is endogenously determined. Our approach indicates, therefore, that the problem of capital misallocation can arise due to factors unrelated to agency issues between chief executive officers and divisional managers or the inability to contract on capital allocation.

In our model, the output of a conglomerate division depends on the ability of the corporate manager, observable capital and unobservable intangible resources allocated to that division. The manager in our model may represent the chief executive officer or, in general, the top management team whose ability influences the performance of the divisions. The premise is that the success of a division depends not only on capital, but also on resources such as talented individuals, systems and environment that promote better interaction and communication among employees, managerial attention, and leadership, etc. By their nature, the allocation of these resources is difficult to observe and verify.

The second premise of our model is that managerial ability is unknown, and the manager, driven by career concerns, wishes to maximize his perceived ability.[1] This is because the manager's expected future wages depend on his perceived ability. Divisional cash flows are observable and are signals of the manager's unknown ability. The final premise of the model is that the signal-to-noise ratio (i.e., informativeness) of the divisional cash flows regarding managerial ability differs across divisions and is non-increasing with the scale of the divisions.

In this set up, investors choose the capital allocated to each division and the intangible resources available to the firm while the manager allocates the available intangible resources to each division to maximize his perceived ability. In the resulting equilibrium, divisions with more informative cash flows about the manager's ability receive more than the optimal (first-best) allocation of capital. There are two related reasons why it is in the investors' interest to allocate more capital to the more informative divisions. The first, and more direct, reason derives from the manager's incentive to allocate more intangible resources to the more informative divisions to increase investors' perception of his ability. The preferential allocation of intangible resources to the more informative divisions increases the marginal productivity of capital in these divisions and, hence, it is in the interests of investors to direct more capital to these divisions. However, an increase of capital to the more informative divisions also affects the manager's incentive to allocate intangible resources, which brings us to the second reason. The increased allocation of capital to the more informative divisions creates two opposing incentives for the manager. First, since the marginal productivity of intangible resources in the more informative divisions increases due to increased allocation of capital, the manager has the incentive to allocate yet more intangible resources to such divisions ("productivity effect"). Second, the more informative divisions grow in size due to greater capital and intangible resources, the informativeness of the cash flows of these divisions declines, lowering the manager's inclination to supply intangible resources to such divisions (the "precision effect"). Whenever the precision effect dominates, the manager will reduce the supply of intangible resources to the more informative divisions as more capital is allocated to such divisions. This brings the allocation of intangible resources closer to the first-best, increasing firm value and investor welfare. Thus, for both reasons, investors benefit from allocating more capital to the more informative divisions. It is also shown that the more informative divisions receive more than the first-best allocation of intangible resources in equilibrium.

Because of the misallocation of both capital and intangible resources, the more informative divisions will be subsidized at the expense of the less informative ones. To the extent that the more informative divisions are in more mature industries with fewer investment opportunities, this allocational inefficiency emerges as a form of corporate socialism. It is shown that the value loss due to misallocation increases monotonically with the difference in informativeness among the divisions. The reason is that as the difference in informativeness increases, the manager's incentive to misallocate intangible resources increases. The misallocation of intangible resources destroys value and also exacerbates the misallocation of capital across divisions.

Our model allows for correlated divisional cash flows. We show that, as the correlation between the divisional cash flows increases, the misallocation of capital and intangible resources becomes worse, increasing the value loss. As the correlation between two divisional cash flows increases, the cash flow of one division becomes a better proxy of the other. Therefore, as the correlation increases, it is optimal to increase the weight on the cash flows of the more informative division in revising the estimate of the manager's ability. Knowing this, the manager favors the more informative division, which exacerbates the misallocation of both capital and intangible resources, increasing the value loss. This result suggests that diversification (within the manager's areas of expertise) reduces both capital and intangible resource misallocation.

The rationale we provide for the misallocation of resources in conglomerates also highlights a cost to segment reporting. Segment reporting provides managers an avenue to boost their perceived abilities by misallocating resources even though, in equilibrium, investors recognize this incentive. In our model, if no segment data was available, the manager will be evaluated according to the total output of the firm. This aligns the manager's interests to that of the investors. The agency problem created by segment reporting introduces an internal cost to segment reporting. This cost is in addition to the external cost arising from providing more information to competitors which has been the focus of many studies (see Hayes and Lundholm (1996) for example).

The intangible resource allocation problem of the manager in our model is similar to multi-tasking. Holmstrom and Milgrom (1991) analyze the impact of multi-tasking on incentive contract design. Our model, on the other hand, proposes that career concerns outweigh incentives provided by wage contracts and shows how career concerns affect capital and intangible resource allocation decisions in conglomerates. The main result of Holmstrom and Milgrom (1991), that incentive contracts are less valuable in a multi-tasking environment, is consistent with our premise that career concerns might be more important than wage contracts in determining managerial behavior.

There are several papers that offer explanations for the misallocation of capital in conglomerates. Scharfstein and Stein (2000) argue that capital allocation might be the least costly way to bribe divisional managers to dissuade them from engaging in value-decreasing activities. Rajan, Servaes, and Zingales (2000) provide a theory based on divisional managers' incentive to prefer investments that increase their market value at the expense of shareholder value. The power of headquarters is limited to resource allocation and it is unable to enforce optimal rules for sharing the divisional surplus. In their model, there will be suboptimal investment if divisions have very diverse resources; therefore, headquarters tries to improve shareholder value by making resource allocation less diverse.

Aron (1988) considers the effect of diversification in a setting of managerial moral hazard and argues that, by providing multiple signals of the managerial ability, it improves welfare with better risk sharing. In her model, managerial effort is a common factor of production for all divisions and there is no allocation being done between divisions. In contrast, in our model, the allocation of intangible resources (equivalent to effort in Aron (1988)) between divisions provides the manager an avenue to potentially improve his perceived ability at the expense of shareholder value.

The empirical evidence regarding capital misallocation in conglomerates is somewhat mixed. Lamont (1997), Shin and Stulz (1998), Rajan, Servaes, and Zingales (2000), and Billett and Mauer (2002) find evidence consistent with inefficient transfer of funds across divisions of conglomerates. The evidence provided by Berger and Ofek (1995) and Scharfstein (1998) suggests that conglomerate divisions, when compared to single-segment firms, do not respond adequately to investment opportunities. Recently however, the view that there is capital misallocation in conglomerates is being challenged. Maksimovic and Phillips (2002), using plant level data, argue that conglomerate capital allocation is related to industry factors and productivity of firm segments and consistent with the neoclassical theory of optimal investment. Whited (2001) claims that the capital misallocation found by others is an artifact of measurement error arising from the use of Tobin's q to proxy investment opportunities. Correcting for this error, she finds no evidence of capital misallocation in conglomerates. Chevalier (1999) finds that conglomerate divisions exhibit the same investment patterns as they did when they were single-segment firms, suggesting that conglomeration has not created any distortion of investment behavior.

The paper is organized as follows. Section I describes the model. Section II characterizes the first-best solution while Section III characterizes the second-best solution. Section IV analyzes the allocation of capital and intangible resources when the intangible resource allocation is unobservable. Section V derives the determinants of the value loss due to misallocation of capital and intangible resources. Section VI provides a discussion of the implications of the model and Section VII concludes. All proofs are in the Appendix.

I. Model

Consider a conglomerate firm with two divisions, indexed 1 and 2, which is financed entirely by equity. For simplicity, the firm is assumed to be a true conglomerate, that is, there is no synergy between the two divisions.[2] At date 0, investors in the firm hire a chief executive officer (whom we call the "manager") to operate the two divisions. The cash flows of both divisions are realized at date 1.

The cash flow of a division depends on managerial ability and the capital allocated to the division. In addition to these two factors, the divisional cash flow also depends on what we term as "intangible resources" provided to the division. An example of intangible resources we have in mind is the quality and quantity of personnel who may be moved between divisions and who are critical to success. The attention, personal interest, and leadership that the chief executive officer provides to a particular division are other examples. For expositional convenience, we will use the term "resources" to denote intangible resources.

Specifically, the cash flow of a division is given by the following equation:

$$y_j = a + \phi_j(I_j)\psi_j(e_j) + \varepsilon_j, \; j \in \{1, 2\}. \tag{1}$$

Equation (1) states that the cash flow of Division j at date 1, y_j, depends on the manager's ability a, capital invested in the division, $I_j > 0$, resources provided to the division, $e_j > 0$, and a random term ε_j. The multiplicative second term in the above cash flow equation embodies the complementary nature of the two input factors, capital and intangible resources.[3] The expected cash flow of Division j, denoted by $\bar{y}_j$, is an increasing and concave function of the capital and the intangible resources in that division. This assumption implies that the functions $\phi_j(\cdot)$ and $\psi_j(\cdot)$ are positive, increasing and strictly concave: ϕ_j, $\psi_j > 0$, ϕ'_j, $\psi'_j > 0$ and ϕ''_j, $\psi''_j < 0$. This assumption also implies that the Hessian determinant of second partial derivatives of $\bar{y}_j$ with respect to the input factors I_j and e_j is strictly positive.[4] The concavity of the production functions incorporates, in addition to decreasing returns to scale, the notion that balanced input combinations are more productive than unbalanced input combinations.[5] For example, consider two different combinations of capital and resources that yield the same expected cash flow. Then, a combination of capital and resource levels equal to the average of the levels used in the original combinations will yield greater expected cash flow.

The error term in Equation (1) is distributed normally with zero mean and precision $\eta_j(I_j, e_j)$, where η_j is assumed to be differentiable everywhere. That is, the precision of the error term for each division depends on the allocation of capital and intangible resources to that division. Let ρ represent the correlation between the error terms of divisional cash flows, i.e., corr $(\varepsilon_1, \varepsilon_2) = \rho$. Consistent with the notion that economy-wide factors have a major influence over the cash flows, we assume that the correlation is non-negative, i.e., $\rho \geq 0$.[6] We will use the term "informativeness" for the precision of the error term since it reflects how informative the cash flow is about managerial ability. A specific assumption that we make about informativeness is that it is non-increasing in capital and resources. This assumption captures the notion that, as a division gets bigger, not only does the expected cash flows of the division increase, but the size of shocks to the cash flows also increases. We assume that the informativeness differs across the two divisions.

We now specify the information set of the manager and the investors. Managerial ability a is not known to anyone, including the manager. All agents hold the same common prior distribution of a at date 0, which is normal with mean μ_0 and precision h_0. The allocation of intangible resources across divisions is observable only to the manager as it is easier to allocate intangible resources without the knowledge of investors. For example, he can allocate his time, or direct his subordinates to allocate their time and effort, to one or the other division. All other information in the model is common knowledge; in particular, divisional cash flows are common knowledge, reflecting the fact that firms are required to report segment information or, even if such reporting is not mandatory, that investors are able to obtain a noisy version of divisional cash flows. In addition, the investment levels in each division and the total resources available to the firm are also observable and contractible. Therefore, in effect, investors can specify investment levels I_1 and I_2 and the total resources available to the firm, e, which are allocated between the two divisions:

$$e_1 + e_2 = e. \tag{2}$$

There is a cost to providing intangible resources and we assume that the cost is proportional to the quantity of intangible resources. In particular, each unit of intangible resources costs one dollar.[7]

There is no performance contingent contract and the manager is paid in advance for his services. However, career concerns introduce implicit incentives for the manager. The manager will get employment elsewhere in future periods and the expected payoff from that employment will equal his reservation wage. The reservation wage will depend on investors' perception of the manager's ability at the time of hiring. For simplicity, we assume that the reservation wage from future employment is realized at date 1 and that the reservation wage is equal to the manager's perceived ability.[8]

It is assumed that all agents are risk neutral and the risk free rate is zero. There are no imperfections other than the investors' inability to observe the allocation of resources and the absence of performance-based wage contracts. The manager's objective is to maximize his expected future wage. Investors wish to maximize the value of the firm (V), which is the sum of the expected profit from the two divisions.

In the one-period setting of our model, a performance-based wage contract for the current period can resolve the agency problem resulting from the divergent objective functions of the manager and the investors. There are two reasons why we believe that a wage contract cannot completely eliminate the problem in a more general setting. First, even with an incentive contract, the manager might be motivated by career concerns since his perceived ability will determine his payoff in subsequent periods. A wage contract in the current period cannot completely insure the manager against career concerns because the manager has the option to quit the firm at any time and a contract to bond the manager to the firm is infeasible if his initial personal wealth is limited. A second reason that incentive wage contracts may not fully solve the agency problem derives from the argument of Holmstrom and Milgrom (1991). They show that, with managerial risk-aversion, use of incentive contracts to overcome resource misallocation problem is costly and sometimes it may be optimal to provide no incentives at all. While we assume a risk-neutral manager for ease of analysis, the results of our model will hold even with the more realistic assumption of a risk averse manager.

II. The first-best solution

In this case, there is symmetry of information between the manager and the investors and the allocation of resources across divisions is common knowledge. Investors can, therefore, write enforceable contracts and choose I_1, I_2, e_1 and e_2 to maximize the value of the firm. Their optimization problem can be stated as:

$$\underset{I_1, I_2, e_1, e_2}{Max} \; V(I_1, I_2, e_1, e_2) \equiv \sum_{j=1}^{2} \left\{ \mu_0 + \phi_j(I_j)\psi_j(e_j) - I_j - e_j \right\}. \tag{3}$$

We denote by I_j^* and e_j^* the first-best investment and resource allocation, respectively, in Division j, i.e., I_j^* and e_j^* solve the above optimization program. The first-best solution satisfies the following first-order conditions (primes denote first derivatives):

$$\phi_j'(I_j^*)\psi_j(e_j^*) = 1, \;\; j \in \{1, 2\} \tag{4}$$

and

$$\phi_j(I_j^*)\psi_j'(e_j^*) = 1, \; j \in \{1, 2\}. \tag{5}$$

The second-order conditions are satisfied given the concavity assumptions.[9] Note that the first-best solution does not depend on the informativeness of the divisions' cash flows.

III. Characterizing the second-best solution

We now analyze the situation where the resource allocation is unobservable to investors. It can be viewed that investors choose all observable items, namely, divisional investment levels I_1 and I_2, and the total quantity of intangible resources for the firm, e. The manager then chooses e_j, the intangible resources for each division.

Let $e_j^b, j \in \{1, 2\}$, be investors' belief about the resources allocated to Division j. It follows that

$$\sum_{j=1}^{2} e_j^b = e. \tag{6}$$

After observing divisional cash flows at date 1, investors compute the manager's posterior ability as follows. Let $\mu_1(I_1, I_2, e_1, e_2, e_1^b, e_2^b)$ be the mean perceived ability of the manager at date 1 if the investment levels, resources allocated, and investors' belief of the aforementioned resource allocation in divisions 1 and 2 are I_1 and I_2, e_1 and e_2, and e_1^b and e_2^b, respectively. Then, as shown in the Appendix,

$$\mu_1(I_1, I_2, e_1, e_2, e_1^b, e_2^b)$$
$$= \frac{1}{h_1}\left(\mu_0 h_0 + \frac{1}{1-\rho^2} \sum_{j=1}^{2} \left\{ \eta_j(I_j, e_j^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)} \right\} \{ y_j(I_j, e_j) - \phi_j(I_j)\psi_j(e_j^b) \} \right) \tag{7}$$

and,

$$h_1 \equiv h_0 + \frac{1}{1-\rho^2} \sum_{j=1}^{2} \left\{ \eta_j(I_j, e_j^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)} \right\}, \tag{8}$$

are the mean and the precision of the posterior distribution of the manager's ability based on the investors' belief at date 1.

Note that, in Equation (7), the term $y_j - \phi_j(I_j)\psi_j(e_j^b)$ represents the output of Division j attributable to managerial ability, given investors' belief about resource allocation. Thus, Equation (7) states that investors' perception of the manager's mean ability at date 1 is a weighted average of the prior mean ability and the outputs of each division attributable to managerial ability, given investors' belief about resource allocation. The weights depend on the precision of the prior distribution of managerial ability, investors' estimates of the informativeness of the divisional cash flows, and the correlation between the cash flows. The more informative divisional cash flow receives greater weight than the less informative divisional cash flow. The greater the correlation between divisional cash flows, the less the weight assigned to the prior mean ability, since the cash flows of both divisions together provide a more precise signal of the managerial ability.

When the resource allocation between divisions is unobservable to investors, they allocate capital and resources to maximize expected firm value, subject to the incentive compatibility constraint that the manager will choose the resource allocation to maximize his expected ability as perceived by investors. Formally, the optimization program can be stated as

$$\underset{I_1, I_2, e_1, e_2}{Max} \; V(I_1, I_2, e_1, e_2) \equiv \sum_{j=1}^{2} \{\mu_0 + \phi_j(I_j)\psi_j(e_j) - I_j - e_j\},$$

subject to

$$E[\mu_1(I_1, I_2, e_1, e_2, e_1, e_2)] \geq E[\mu_1(I_1, I_2, \hat{e}_1, \hat{e}_2, e_1, e_2)], \tag{9}$$

for all $\hat{e}_1$ and $\hat{e}_2$ such that $\hat{e}_1 + \hat{e}_2 = e_1 + e_2 = e$.

The incentive compatibility constraint (9) states that, in equilibrium, the manager is better off choosing the resource allocation that is consistent with investors' belief. The expectation in constraint (9) is based on the manager's information set: his expectation of investors' perception of his date 1 mean ability is maximized if he chooses the level of resources e_1 and e_2 that investors believe he will choose.

To solve the manager's resource-allocation problem represented by Equation (9), we will use the first-order approach. Taking expectations of $\mu_1(I_1, I_2, e_1, e_2, e_1^b, e_2^b)$, given the manager's information set, we get

$$E[\mu_1(I_1, I_2, e_1, e_2, e_1^b, e_2^b)]$$

$$= \frac{1}{h_1}\left(\mu_0 h_0 + \frac{1}{1-\rho^2}\sum_{j=1}^{2}\left\{\eta_j(I_j, e_j^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)}\right\}\left\{E[y_j(I_j, e_j)] - \phi_j(I_j)\psi_j(e_j^b)\right\}\right)$$

$$= \frac{1}{h_1}\left(\mu_0 h_0 + \frac{1}{1-\rho^2}\sum_{j=1}^{2}\left\{\eta_j(I_j, e_j^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)}\right\}\left\{\mu_0 + \phi_j(I_j)[\psi_j(e_j) - \psi_j(e_j^b)]\right\}\right).$$

Totally differentiating the expected perceived ability above with respect to resource level e_1 and using Equation (2), we get the first-order condition to the manager's problem as[10]

$$\begin{aligned}&\left\{\eta_1(I_1, e_1^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)}\right\}\phi_1(I_1)\psi_1'(e_1)\\ &\quad = \left\{\eta_2(I_2, e_2^b) - \rho\sqrt{\eta_1(I_1, e_1^b)\eta_2(I_2, e_2^b)}\right\}\phi_2(I_2)\psi_2'(e_2).\end{aligned}$$

In equilibrium, investors' belief about resource allocation must equal the actual resource allocation, i.e., $e_j^b = e_j$, $j \in \{1, 2\}$. Therefore,

$$\begin{aligned}&\left\{\eta_1(I_1, e_1) - \rho\sqrt{\eta_1(I_1, e_1)\eta_2(I_2, e_2)}\right\}\phi_1(I_1)\psi_1'(e_1)\\ &\quad = \left\{\eta_2(I_2, e_2) - \rho\sqrt{\eta_1(I_1, e_1)\eta_2(I_2, e_2)}\right\}\phi_2(I_2)\psi_2'(e_2).\end{aligned} \tag{10}$$

The above condition represents the resource allocation by the manager in response to any given capital allocation and has a unique solution because the ψ_j functions are concave and the η_j functions are nonincreasing in e_j. We can replace the incentive compatibility constraint (9) in the investors' problem by Equation (10).

The investors' problem can be viewed as choosing the capital allocation to each division and the total intangible resources to maximize firm value, knowing that the manager will allocate the intangible resources according to his incentive compatibility constraint, as stated in Equation (10). For notational simplicity, we define the triplet (I_1, I_2, e) of investors' choice variables as the budget B provided to the manager, i.e., $B \equiv (I_1, I_2, e)$. For a given budget B, we denote the resources allocated to Division j under the second-best rule, determined jointly by equations (2) and (10), as $e_j^m(B)$, and the corresponding expected cash flow of Division j and firm value as $\bar{y}_j^m(B)$ and $V^m(B)$, respectively. Then,

$$\bar{y}_j^m(B) \equiv \bar{y}_j\left(I_j, e_j^m(B)\right) = \mu_0 + \phi_j(I_j)\psi_j\left(e_j^m(B)\right), \tag{11}$$

$$V^m(B) \equiv V\left(I_1, I_2, e_1^m(B), e_2^m(B)\right) = \bar{y}_1^m(B) + \bar{y}_2^m(B) - I_1 - I_2 - e. \tag{12}$$

The second-best solution is characterized by Equation (2) and equations (10) − (12) and the following first-order conditions for value maximization:

$$\frac{d}{dI_j} V^m(B) = 0,\ j \in \{1, 2\}, \text{ and,} \tag{13}$$

$$\frac{d}{de} V^m(B) = 0. \tag{14}$$

IV. Misallocation of capital and intangible resources

First we show that if investors provide the first-best budget $B^* \equiv (I_1^*, I_2^*, e^*)$, the manager will allocate more than the first-best level of resources to the more informative division and less than the first-best level of resources to the less informative division. This result is useful in characterizing the second-best capital and resource allocations. Without loss of generality, we assume that Division 1's cash flow is more informative than Division 2's cash flow at the first-best equilibrium.[11] That is,

$$\eta_1(I_1^*, e_1^*) > \eta_2(I_2^*, e_2^*). \tag{15}$$

For the rest of the paper, the term "informativeness" always refers to informativeness in the first-best equilibrium, unless otherwise stated.

Lemma 1: *The manager will allocate more (less) than the first-best level of resources to the more (less) informative division if investors provide the first-best budget. That is,*

$$e_1^m\left(B^*\right) > e_1^* \text{ and } e_2^m\left(B^*\right) < e_2^*. \tag{16}$$

The intuition behind Lemma 1 is as follows. Even though the marginal productivity of resources is equal across divisions at the first-best resource allocation, the cash flow of Division 1 is more informative about the manager's ability. So a marginal change in the cash flow of Division 1 has a larger impact on his perceived ability than the same marginal change in the cash flow of Division 2. Thus, the manager can increase investors' perception of his ability by shifting resources from Division 2 to Division 1. Of course, in equilibrium, investors realize this and the manager does not benefit by the misallocation of resources. It is nevertheless in his interest to do so, as otherwise he would be worse-off.

Anticipating the manager's incentive to overallocate intangible resources to the more informative Division 1 if the first-best budget is provided, investors may choose to provide a budget that is different from the first-best one. In particular, they may allocate capital differently from the first-best equilibrium. To understand the intuition behind investors' capital allocation decision, first consider the effect of changes in capital allocation on firm value when resource allocation is unobservable. For $j \in \{1, 2\}$,

$$\frac{dV^m(B)}{dI_j} = \frac{d}{dI_j}\left\{\bar{y}_1^m(B) + \bar{y}_2^m(B)\right\} - 1, \text{ from Equation (12).}$$

$$= \frac{d}{dI_j}\left\{2\mu_0 + \phi_1(I_1)\psi_1\left(e_1^m(B)\right) + \phi_2(I_2)\psi_2\left(e_2^m(B)\right)\right\} - 1, \text{ using Equation (11).}$$

$$= \left\{\phi_j'(I_j)\psi_j\left(e_j^m(B)\right) - 1\right\} + \left\{\phi_1(I_1)\psi_1'\left(e_1^m(B)\right) - \phi_2(I_2)\psi_2'\left(e_2^m(B)\right)\right\}\frac{de_1^m}{dI_j}\ . \tag{17}$$

Equation (17) shows that the marginal effect of changes in capital allocation on firm value consists of two parts: a direct effect due to changes in capital allocation (assuming no changes in resource allocation by the manager) represented by the first term, and an indirect effect due to changes in resource allocation by the manager in response to changes in capital allocation, represented by the second term.

To see the direct effect of capital allocation on firm value, we first consider the case when investors provide the first-best budget allocation and analyze how firm value will change with an increase in capital invested in Division 1. Under the first-best budget allocation, note that the first term in Equation (17) equals zero if the manager allocates resources according to the first-best rule (see Equation (4)). But, the manager allocates more than the first-best level of resources to the more informative Division 1 (Lemma 1). This increases the productivity of capital in Division 1, making the first term in Equation (17) strictly positive. In other words, the direct effect suggests greater than first-best capital allocation to Division 1.

However, the manager changes resource allocation in response to changes in capital allocation (indirect effect). To obtain the intuition for how the manager's resource allocation $e_j^m(B)$ varies with I_j, consider the case of uncorrelated cash flows, with $\rho = 0$. Totally differentiating Equation (10) with respect to I_j and using Equation (2), we get

$$\frac{de_j^m}{dI_j} = \frac{-\left(\eta_j\phi_j' + \dfrac{\partial\eta_j}{\partial I_j}\phi_j\right)\psi_j'}{\dfrac{\partial\eta_1}{\partial e_1^m}\phi_1\psi_1' + \eta_1\phi_1\psi_1'' + \dfrac{\partial\eta_2}{\partial e_2^m}\phi_2\psi_2' + \eta_2\phi_2\psi_2''}, \; j \in \{1, 2\}. \tag{18}$$

Note that the denominator of Equation (18) is negative. The two terms in the numerator of Equation (18) represent the two opposing incentives that affect the manager's resource allocation decision if there is a change in the capital allocated to either of the two divisions. For example, consider the manager's response to an increase in the capital allocated to Division 1. An increase in capital to Division 1 increases the marginal productivity of resources in that division. The manager benefits from allocating more resources to Division 1 (and less to Division 2) since the marginal increase in perceived ability due to increased output of Division 1 more than offsets the marginal decrease in perceived ability due to the decreased output of Division 2. We denote this effect, which causes the manager to increase resources allocated to Division 1, the "productivity" effect. The second effect of increased capital allocation to Division 1 is to (weakly) decrease the precision of the cash flows of that division. This effect follows from the assumption that precision of a division is non-increasing in the capital and resources allocated to that division. The reduction in informativeness of Division 1's cash flows gives the manager the incentive to reduce resources allocated to that division. We denote this effect the "precision" effect. The productivity effect is represented by the first term in the numerator on right hand side of Equation (18) while the precision effect is represented by the second term. If the precision effect dominates, $de_1^m / dI_1 < 0$. That is, as capital allocation to Division 1 is increased, the manager will reduce the resource allocation to that division, thus reducing the misallocation. Reduction in misallocation increases value (the first part of the second term in Equation (17) is negative) firm value increases. Therefore, the indirect effect reinforces the direct effect and there is more than first-best capital allocation to the more informative Division 1. To obtain this result, note that it is not necessary that the precision effect dominates; if it does not, the indirect effect opposes the direct effect but as long as direct effect dominates the indirect effect, the same result obtains. Whether the precision or the productivity effect dominates will depend on the specification of the precision term η_j. The following specification of η_j is sufficient to ensure that the precision effect dominates.

Assumption 1: *Elasticity of precision η_j with respect to $\phi_j(I_j)$ is less than or equal to –1. That is,*

$$\frac{\partial \eta_j}{\partial \phi_j} . \frac{\phi_j}{\eta_j} \leq -1.$$

Assumption 1 implies that, when the expected cash flow due to capital increases by a small fraction, the precision of the cash flows decreases by at least that fraction. Specifications in which the precision $\eta_j(I_j, e_j)$ is proportional to $\left(\phi_j(I_j)\psi_j(e_j)\right)^{-1}$ or $\left(\phi_j(I_j)\psi_j(e_j)\right)^{-2}$ are consistent with our assumption. In the first case, the variance of cash flows increases linearly with the mean of cash flows, whereas, in the second case, the standard deviation of cash flows increases linearly with the mean of the cash flows. Assumption 1 ensures that the precision of cash flow of a division is sufficiently sensitive to the investment in the division so that "precision" effect is the stronger one. The following lemma uses Assumption 1 to show how the manager changes resource allocation in response to changes in capital allocation.

Lemma 2: *When resource allocation is unobservable, the amount of resources allocated by the manager to Division j,* e_j^m*, is decreasing in the capital allocated to that division and increasing in the capital allocated to the other division.*

Using this intermediate result, we can now show that, in the second-best equilibrium, there is overinvestment in the more informative Division 1 and underinvestment in the less informative Division 2.

Proposition 1*: In the second-best equilibrium, more than the first-best equilibrium level of capital is allocated to the more informative division and less than the first-best equilibrium level of capital is allocated to the less informative division.*

The intuition for the proposition is as follows. If investors provide the first-best budget, the manager does not allocate resources according to the first-best rule. Instead, he allocates too much resources to the more informative Division 1 and too little resources to the less informative Division 2 so as to maximize his perceived ability (Lemma 1). This means that the marginal productivity of investment in Division 1 increases beyond unity and the marginal productivity of investment in Division 2 falls below unity. Therefore, investors can benefit by increasing investment in the more productive Division 1 and by reducing investment in the less productive Division 2 (direct effect).

The indirect effect, resulting from changes in resource allocation in response to capital misallocation, reinforces the incentive to shift capital from Division 2 to Division 1. We know that the manager biases resource allocation in favor of Division 1. When investment in Division 1 is increased and the investment in Division 2 is decreased, Lemma 2 shows that the manager reduces resources to Division 1 and increases resources in Division 2 thus bringing resource allocation closer to the first-best allocation. Thus the indirect effect further increases investors' incentive to increase investment in the more informative division and decrease investment in the less informative division. Notice that Lemma 2 is required only for the indirect effect. Even if Assumption 1 and Lemma 2 are violated, the result in Proposition 1 is obtained as long as the direct effect dominates the indirect effect.

We now show that in the second-best equilibrium, the more (less) informative division not only gets more (less) than the first-best capital but also gets more (less) than the first-best resource allocation.

Proposition 2: *In the second-best equilibrium, more than the first-best equilibrium level of resources are allocated to the more informative division and less than the first-best equilibrium level of resources are allocated to the less informative division.*

Lemma 1 showed that, if investors provide the first-best capital allocation, the manager allocates more resources to the more informative Division 1. Proposition 1 shows that investors overinvest in Division 1 not only to take advantage of the increased productivity of capital due to the excess resource allocation to that division, but also to reduce resource misallocation by the manager. Proposition 2 states that such capital misallocation does not eliminate or reverse (excess resources to Division 2) misallocation.

The intuition behind this result is as follows. Suppose the resource misallocation is reversed in the second-best equilibrium so that Division 1 gets less than the first-best level of resources. The marginal return on capital in the first-best equilibrium is zero. Since Division 1 receives there is less than the first-best level of resources and more than the first-best capital, in the proposed equilibrium, both changes lower the productivity of capital, making the marginal return on capital in this division negative. Therefore, decreasing capital allocation to Division 1 will increase firm value, ignoring the manager's reaction in resource allocation. The manager's reaction in response to the reduction in capital allocated to Division 1, however, will be to increase resources allocated to that division (Lemma 2), reducing resource misallocation and further increasing firm value. Therefore, firm value is unambiguously increased by a reduction in capital allocated to Division 1, breaking the proposed equilibrium.

Propositions 1 and 2 imply that the division that receives more capital and resources will be the one that is more informative in the first-best equilibrium. Given that the informativeness of a division's cash flow is a function of its size, the informativeness of the divisional cash flows in the second-best equilibrium is different from the informativeness in the first-best equilibrium. The following proposition implies that the division that receives more capital and resources will be the one that is more informative even in the second-best equilibrium. Since the "observable" equilibrium is the second-best one, this result is useful for testing the implications of the model.

Proposition 3: *The division with the more informative cash flow in the first-best equilibrium will also have the more informative cash flow in the second-best equilibrium.*

Suppose this is not true. Then Division 2 must be more informative at the second-best budget and, following the intuition of Lemma 1, the manager must bias resource allocation in favor of this division.[12] By continuity, there must be an intermediate budget between the first-best and the second-best budgets at which the cash flows of the two divisions are equally informative. In the absence of agency problems, firm value under the intermediate budget is greater than the firm value under the second-best budget. This follows from the concavity of the cash flow functions and the fact that intermediate budget is "closer" to the first-best budget than the second-best budget.[13] The presence of the agency problem further reduces firm value under the second-best budget, while the firm value under the intermediate budget is unchanged since, by definition, the two divisions are equally informative under this budget. This means that the firm value under the intermediate budget is greater than that under the second-best budget in the presence of the agency problem, which is a contradiction.

V. Determinants of the value loss due to inefficient capital and resource allocation

In this section, we derive empirical implications that relate the loss in value to due to inefficient allocation of capital and resources to (a) the relative informativeness of the cash flows of the two divisions; and (b) the correlation between the divisional cash flows.

a. Value loss and the relative informativeness of divisional cash flows

Consider the following specification for the precision of Division *j*'s cash flows:

$$\eta_j(I_j, e_j) = \gamma_j \hat{\eta}_j(I_j, e_j),\ j \in \{1, 2\},$$

where γ_j is a positive constant and the function $\hat{\eta}_j(I_j, e_j)$ is decreasing in its arguments and satisfies Assumption 1. Then, all the previous propositions hold. The assumption that Division 1's cash flow is more informative than Division 2's cash flow in the first-best equilibrium implies that the difference in informativeness between the two divisions increases (in the first-best equilibrium) as the ratio γ_1/γ_2 increases.

It can be seen from the first-order condition for manager's resource allocation problem (Equation (10)) that the higher the ratio γ_1/γ_2, the more the resources allocated to Division 1 in the second-best equilibrium. Since the first-best resource allocation does not depend on informativeness of cash flows, the resource misallocation is increasing in the ratio γ_1/γ_2. This suggests that the value loss in the second-best equilibrium will also increase with γ_1/γ_2. The following proposition confirms this intuition.

Proposition 4: *The value loss from inefficient allocation of capital and resources increases monotonically with the difference in the informativeness of the divisional cash flows.*

Proposition 4 follows from Proposition 3. The more informative division in the first-best equilibrium is also the more informative one in the second-best equilibrium and, therefore, the incentive to misallocate resources persists in the second-best equilibrium. Hence, even in the second-best equilibrium, the manager allocates more (less) than the first-best level of resources to Division 1 (Division 2). If the capital allocation is kept fixed and the informativeness difference in the two divisions is reduced, the manager's incentive to misallocate resources reduces, and the firm value increases. Recognizing this, investors may also change the budget they provide the manager in order to further increase firm value.

The key to testing the implication of Proposition 4 is the measurement of informativeness. It can be seen from Equation (7) that the change in the manager's perceived ability per unit change in the output of a division is positively related to the informativeness of that division. Since the firm value in a multi-period model is an increasing function of managerial ability, the change in firm value per unit change in the output of a division is also positively related to the informativeness of that division. Therefore, a potential measure of informativeness of a division is the ratio of change in stock price to unexpected change in earnings or cash flows of that division. Such a measure, called the "earnings response coefficient" (ERC) is commonly used to study the impact of earnings announcements (see Skinner and Sloan (2002) for details about ERC and its applications). The ERC of a conglomerate division can be proxied by the average or median ERC of single-segment firms in the same industry.[14] Proposition 4 implies that the conglomeration discount and the capital misallocation will be directly related to the cross-sectional variability in the earnings response coefficients of the divisions of a conglomerate.

b. Value loss and the correlation of divisional cash flows

We now explore the effect of the correlation between divisional cash flows on the value loss due to inefficient capital and resource allocation. Correlation and informativeness are two independent concepts that together determine how investors aggregate the information contained in the divisional cash flows to update perceived managerial ability. The correlation determines the precision with which investors can infer the manager's ability from the cash flows. If the divisional cash flows are perfectly positively (or perfectly negatively) correlated, investors can unambiguously infer the manager's ability. On the other hand, the relative importance of each signal in updating managerial ability depends on the informativeness of the two signals as well as on the correlation between them; the cash flow of the more informative division has a larger impact on investors' perception about the managerial ability regardless of the correlation between the cash flows.

The following proposition shows how the correlation between divisional cash flows affects the value loss from inefficient capital and resource allocation.

Proposition 5: *The value loss from inefficient allocation of capital and resources increases monotonically with the correlation between the divisional cash flows.*

The intuition for the proposition is best explained in two stages. First, consider any fixed budget. As the correlation between the divisional cash flows increases from zero, the cash flow of one division provides additional information about the cash flow of the other division. Therefore, the most accurate estimate of the manager's ability is obtained by increasing the weight assigned to the cash flow of the more informative division. As the weight assigned to the more informative division increases, the spread between the weights assigned to the two divisions increases. Note that if the divisional cash flows are weighed equally in estimating manager's ability, the manager will allocate resources according to the first-best rule. As the dispersion in weights increases, the misallocation of resources towards the more informative division increases and firm value decreases.

Since the above result holds for any given budget, it must be true that the firm with the higher correlation will be valued less even when investors choose budgets to maximize firm values. Hence, it follows that, in the second-best equilibrium, firm value decreases with correlation between divisional cash flows. In the first-best equilibrium, however, firm value is independent of the correlation. Therefore, the value loss in conglomerates is increasing in the correlation between divisional cash flows.

One must be careful in interpreting the result of the above proposition: it does not imply that focus necessarily destroys value. For example, consider the case of a firm where the two divisions are two factories producing the same product, and therefore, have positively correlated cash flows. One might be tempted to conclude that the proposition implies that the introduction of the second factory would result in resource misallocation. This is not true since the informativeness of the cash flows of the two divisions in this case would be identical and, therefore, there would be no misallocation at all. In contrast, consider the example where a conglomerate divests a related division and diversifies into activities that have very low correlation with its remaining business. Again, concluding that the proposition implies that such an action reduces inefficiencies ignores the possibility that the managerial expertise in unrelated activities is substantially different. Because of this difference in managerial expertise, the effective informativeness of the cash flows of these activities may be very different (even if the precision of the error terms is the same for the current and the new divisions). What the above proposition implies is that, when the conglomerate consists of divisions with different informativeness of cash flows, the greater the correlation between divisional cash flows the greater the resource misallocation. Since the managerial ability required to operate both divisions is the same in our model, this result argues for a more diversified conglomerate, but within the sphere of managerial competence.

VI. Implications

a. Corporate Socialism

Several studies have offered evidence that is consistent with conglomerates favoring divisions with fewer investment opportunities over divisions with greater opportunities. Shin and Stulz (1998) find that a segment's sensitivity to cash flow does not depend on whether that segment has the best investment opportunity in the firm and interpret this finding to imply that divisions are treated alike when they should not be. Berger and Ofek (1995) find that the value loss in diversified firms is increasing in the level of investment in low-q firms. They also find evidence of cross-subsidization. These results have been viewed as a form of "corporate socialism."

The resource misallocation in our model may manifest itself as corporate socialism in capital allocation. We have shown that there is overinvestment in divisions with higher informativeness and underinvestment in divisions with lower informativeness. More informative divisions are likely to be in more mature industries with less uncertainty about their future cash flows. These are the industries that have fewer investment opportunities and, therefore, a lower Tobin's q-ratio. To the extent that the q-ratio is negatively related to informativeness of a division, our results are consistent with corporate socialism.

b. Corporate Hedging

Since the loss in firm value is increasing in the difference in informativeness between the divisions, one way to alleviate this problem is to bridge the informativeness gap through corporate hedging. Corporate hedging of the cash flows of the less informative division may reduce the dependence of firm performance on factors not under the control of the management and, therefore, increase the extent to which cash flows reflect managerial ability. This provides a benefit to corporate hedging even when shareholders can diversify on their own. This rationale for hedging is different from the rationale that hedging improves disclosure to shareholders and managers enabling better decision making. The latter rationale would suggest the same level of hedging for a single-segment firm and a segment of a conglomerate in the same industry (after controlling for the diversification effect in a conglomerate), whereas our rationale suggests that the level of hedging in a division should be increasing in the informativeness of the other division.

c. Segment Disclosure and Tracking Stocks

The rationale we provide for the misallocation of resources in conglomerates also highlights a cost to segment reporting. Segment reporting provides managers an avenue to boost their perceived abilities by misallocating resources. In our model, if no segment data was available, the manager will be evaluated according to $y_1 + y_2$, the total output of the firm. The differential informativeness of the divisions is no more an issue and hence the manager maximizes investors' perception of his ability by simply maximizing the total cash flows of the firm. Thus, career concerns introduced by segment reporting create a cost that is based on managerial incentives. This cost contrasts from the external cost arising from providing more information to competitors which has been the focus in the literature on segment reporting (see, for instance, Hayes and Lundholm (1996), and the papers cited therein).

Similar to segment reporting, tracking stocks provide a mechanism for firms to provide additional information about their segments to investors. While there are clearly benefits from the additional information provided by tracking stocks, they also create incentives for senior management to misallocate resources.

VII. Conclusion

In this paper, we explore a cause of inefficiency in conglomerates. In particular, we examine the issue of capital misallocation in conglomerates even though such misallocation is observable and enforceable contracts can be written based on capital allocation. We show that, in a setting where some of the intangible resources are unobservable, managers with career concerns will allocate more of these resources to divisions whose cash flows are more informative about their ability. This misallocation of intangible resources, in turn, makes it value-maximizing for investors to overallocate observable capital to the more informative divisions.

We have shown that such an inefficient allocation of capital and intangible resources may result in the value of a conglomerate being less than that of a portfolio of similar single-segment firms. The model enables the characterization of some of the determinants of this value loss. The value loss is predicted to increase with the variance of informativeness, and with the correlation between divisional cash flows.

The model provides some insight into why we observe a form of socialism within conglomerate firms, with the weaker divisions being subsidized by the stronger ones. It also highlights a drawback of segment reporting and tracking stocks, namely that they provide additional avenues for managers to manipulate perceptions of their ability.

Appendix

<u>Derivation of the posterior distribution of managerial ability</u>

The prior distribution of managerial ability a is normal with mean μ_0 and precision h_0. The corresponding probability density function of a is given by

$$f_0(a) = \sqrt{\frac{h_0}{2\pi}} \exp\left(\frac{-(a-\mu_0)^2 h_0}{2}\right).$$

Let z_1 and z_2 be two correlated signals of managerial ability:

$$z_j = a + \varepsilon_j,\ j \in \{1, 2\},$$

where $\varepsilon_j \sim N(0, \eta_j)$ with precision η_j, and corr $(\varepsilon_1, \varepsilon_2) = \rho$. Then, the density function $g(z_1, z_2 \mid a)$ is given by

$$g(z_1, z_2 | a)$$
$$= \frac{\sqrt{\eta_1\eta_2}}{2\pi\sqrt{1-\rho^2}} \exp\left(\frac{-1}{2(1-\rho^2)}\left\{(z_1-a)^2\eta_1 + (z_2-a)^2\eta_2 - 2\rho(z_1-a)(z_2-a)\sqrt{\eta_1\eta_2}\right\}\right)$$

Using Bayes' rule, the posterior density f^1 of ability a, conditional on z_1 and z_2, is given by

$$f^1(a|z_1, z_2) = \frac{g(z_1, z_2|a) f_0(a)}{\int_{\hat{a}} g(z_1, z_2|\hat{a}) f_0(\hat{a}) d\hat{a}}$$
$$= C_1 \exp\left(\frac{-1}{2(1-\rho^2)}\left\{(z_1-a)^2\eta_1 + (z_2-a)^2\eta_2 - 2\rho(z_1-a)(z_2-a)\sqrt{\eta_1\eta_2}\right\} - \frac{(a-\mu_0)^2 h_0}{2}\right),$$

where C_1 is a constant independent of z_1 and z_2. The form of the posterior density function above corresponds to that of the normal distribution. Let the mean and the precision of this normal distribution be μ_1 and h_1, respectively. Then it follows that

$$\frac{-(a-\mu_1)^2 h_1}{2}$$
$$=\frac{-1}{2(1-\rho^2)}\left\{(z_1-a)^2\eta_1+(z_2-a)^2\eta_2-2\rho(z_1-a)(z_2-a)\sqrt{\eta_1\eta_2}\right\}-\frac{(a-\mu_0)^2 h_0}{2}+C_2,$$

where C_2 is a constant. Comparing coefficients of a^2 terms and a terms, we get

$$h_1=h_0+\frac{1}{1-\rho^2}\left\{\eta_1+\eta_2-2\rho\sqrt{\eta_1\eta_2}\right\},$$
$$\mu_1=\frac{1}{h_1}\left(\mu_0 h_0+\frac{\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)}{1-\rho^2}z_1+\frac{\left(\eta_2-\rho\sqrt{\eta_1\eta_2}\right)}{1-\rho^2}z_2\right).$$

Substituting $z_j=y_j-\phi_j(I_j)\psi_j(e_j^b)$, we obtain equations (7) and (8). □

We first prove a lemma that is useful for several proofs that follow.

Lemma A1: *Consider any budget $B \equiv \{I_1, I_2, e\}$ under which Division 1 cash flow is more informative than Division 2 cash flow when resources are allocated according to the first-best rule, i.e.,*

$$\eta_1\left(I_1,e_1^*(B)\right)>\eta_2\left(I_2,e_2^*(B)\right). \tag{A1}$$

Then,

(i) The manager biases resources (relative to the first-best rule) in favor of Division 1, i.e.,

$$e_1^m(B)>e_1^*(B),\quad e_2^m(B)<e_2^*(B). \tag{A2}$$

(ii) The Division 1 cash flow is more informative than Division 2 cash flow when the manager allocates resources according to the second-best rule, i.e.,

$$\eta_1\left(I_1,e_1^m(B)\right)>\eta_2\left(I_2,e_2^m(B)\right). \tag{A3}$$

<u>Proof:</u>

(i) At any budget B, the resource allocation according to the first-best rule satisfies the following equation (see Equation (5)):[15]

$$\phi_1(I_1)\psi_1'\left(e_1^*(B)\right)=\phi_2(I_2)\psi_2'\left(e_2^*(B)\right). \tag{A4}$$

The resource allocation according to the second-best rule is given by Equation (10):

$$\begin{aligned}&\left\{\eta_1\left(I_1,e_1^m(B)\right)-\rho\sqrt{\eta_1\left(I_1,e_1^m(B)\right)\eta_2\left(I_2,e_2^m(B)\right)}\right\}\phi_1(I_1)\psi_1'\left(e_1^m(B)\right)\\ &\quad=\left\{\eta_2\left(I_2,e_2^m(B)\right)-\rho\sqrt{\eta_1\left(I_1,e_1^m(B)\right)\eta_2\left(I_2,e_2^m(B)\right)}\right\}\phi_2(I_2)\psi_2'\left(e_2^m(B)\right).\end{aligned} \tag{A5}$$

We first show that $e_1^m(B) > e_1^*(B)$. Suppose this is not true and $e_1^m(B) \le e_1^*(B)$. It follows that $e_2^m(B) \ge e_2^*(B)$ since the total resources are fixed by the budget *B*. From Equation (A4) and the concavity of the ψ_j functions, we get

$$\phi_1(I_1)\psi_1'\left(e_1^m(B)\right)\ge\phi_2(I_2)\psi_2'\left(e_2^m(B)\right). \tag{A6}$$

Furthermore,

$$\eta_1\left(I_1,e_1^m(B)\right)\ge\eta_1\left(I_1,e_1^*(B)\right)>\eta_2\left(I_2,e_2^*(B)\right)\ge\eta_2\left(I_2,e_2^m(B)\right). \tag{A7}$$

The first and last inequalities follow from our contradictory assumption and the assumption that informativeness is non-increasing in its arguments. The middle inequality follows from the statement of the lemma. Equations (A6) and (A7) contradict Equation (A5). Therefore, it must be that $e_1^m(B) > e_1^*(B)$ in which case it follows that $e_2^m(B) < e_2^*(B)$.

(ii) Follows from equations (A2), (A4), and (A5) and from the concavity of ψ_j functions. □

Proof of Lemma 1

Since Division 1 cash flow is more informative than Division 2 cash flow at the first-best equilibrium, this lemma is a special case of Lemma *A*1 with $B = B^*$. □

Proof of Lemma 2

We prove that the manager allocates less effort to Division 1 if I_1 is increased. The proof for the effect of I_2 on the effort allocated to Division 1 is similar.

Totally differentiating Equation (10) with respect to I_1, we get

$$\left\{\left(\frac{\partial\eta_1}{\partial I_1}+\frac{\partial\eta_1}{\partial e_1^m}\frac{de_1^m}{dI_1}\right)\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\right)+\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\frac{\partial\eta_2}{\partial e_2^m}\frac{de_1^m}{dI_1}\right\}\phi_1\psi_1'+\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)\left(\phi_1'\psi_1'+\phi_1\psi_1''\frac{de_1^m}{dI_1}\right)$$
$$=\left\{\left(-\frac{\partial\eta_2}{\partial e_2^m}\frac{de_1^m}{dI_1}\right)\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\right)-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\left(\frac{\partial\eta_1}{\partial I_1}+\frac{\partial\eta_1}{\partial e_1^m}\frac{de_1^m}{dI_1}\right)\right\}\phi_2\psi_2'-\left(\eta_2-\rho\sqrt{\eta_1\eta_2}\right)\phi_2\psi_2''\frac{de_1^m}{dI_1}.$$

On simplification this yields,

$$\frac{de_1^m}{dI_1}=\frac{N}{D},$$

where

$$N=-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\frac{\partial\eta_1}{\partial I_1}\phi_2\psi_2'-\left\{\frac{\partial\eta_1}{\partial I_1}\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\right)\phi_1+\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)\phi_1'\right\}\psi_1',$$

and

$$D=\left\{\frac{\partial\eta_1}{\partial e_1^m}\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\right)+\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\frac{\partial\eta_2}{\partial e_2^m}\right\}\phi_1\psi_1'+\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)\phi_1\psi_1''$$
$$+\left\{\frac{\partial\eta_2}{\partial e_2^m}\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\right)+\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\frac{\partial\eta_1}{\partial e_1^m}\right\}\phi_2\psi_2'+\left(\eta_2-\rho\sqrt{\eta_1\eta_2}\right)\phi_2\psi_2''.$$

For any budget B, note that the manager's first-order condition (10) holds only if

$$\rho\sqrt{\eta_1/\eta_2}<1,\quad \rho\sqrt{\eta_2/\eta_1}<1. \tag{A8}$$

Using the above inequalities in (A8), the concavity of ψ, and the assumption that the informativeness decreases with both capital and resources, it can be seen that $D < 0$. Thus, it is sufficient to show that N is positive. Using Equation (10), N can be simplified to

$$N=-\left\{\frac{\partial\eta_1}{\partial I_1}\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}+\frac{\rho}{2}\frac{\sqrt{\eta_1}-\rho\sqrt{\eta_2}}{\sqrt{\eta_2}-\rho\sqrt{\eta_1}}\right)\phi_1+\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)\phi_1'\right\}\psi_1'.$$

Therefore, N is positive if

$$\frac{\partial\eta_1/\partial I_1}{\phi_1'}\frac{\phi_1}{\eta_1}\le -\frac{\left(1-\rho\sqrt{\frac{\eta_2}{\eta_1}}\right)}{\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}+\frac{\rho}{2}\frac{\sqrt{\eta_1}-\rho\sqrt{\eta_2}}{\sqrt{\eta_2}-\rho\sqrt{\eta_1}}\right)}. \tag{A9}$$

For $\rho \geq 0$, the application of inequalities (A8) shows that the right side of (A9) is at least -1. The left hand side of (A9) is at most -1 by assumption A1. □

Proof of Proposition 1

The following notation is used. For any budget $B \equiv (I_1, I_2, e)$, $e_j^*(B)$ denotes allocation of intangible resources to Division j according to the first-best rule, i.e., the resource allocation that would be made by investors to maximize firm value, given budget B. The corresponding expected cash flow of Division j and firm value are denoted by $\bar{y}_j^*(B)$ and $V^*(B)$, respectively, i.e.,

$$\bar{y}_j^*(B) \equiv \bar{y}_j\left(I_j^*, e_j^*(B)\right);$$

$$V^*(B) = V\left(I_1, I_2, e_1^*(B), e_2^*(B)\right) = \bar{y}_1^*(B) + \bar{y}_2^*(B) - I_1 - I_2 - e.$$

Note that $e_j^*(B^*) \equiv e_j^*$.

For any budget B, $e_j^m(B)$ denotes allocation of intangible resources to Division j according to the second-best rule, i.e., the resource allocation that would be made by the manager to maximize his perceived ability, given budget B. The corresponding expected cash flow of Division j and firm value are denoted by $\bar{y}_j^m$ and $V^m(B)$, respectively, i.e.,

$$V^m(B) = V\left(I_1, I_2, e_1^m(B), e_2^m(B)\right) = \bar{y}_1^m(B) + \bar{y}_2^m(B) - I_1 - I_2 - e. \tag{A10}$$

$\bar{y}_j^m$ is defined in Equation (11). For notational simplicity, we define $e_j^m(B^m) \equiv e_j^m$.

In the first-best equilibrium, the budget, the corresponding intangible resource allocation to Division j and firm value are denoted, respectively, by B^*, $e_j^*(B^*)$, and $V^*(B^*)$. The corresponding items in the second-best equilibrium are, respectively, B^m, $e_j^m(B^m)$, and $V^m(B^m)$.

The proof is provided as a series of results.

Result 1: $V^*(B)$ *declines as the "distance" between B and* B^* *increases.*

First we define the notion of "distance" between two budgets. Consider a budget $B^a \equiv \left(I_1^a, I_2^a, e^a\right)$ different from the first-best budget B^*. A linear combination of budgets B^* and B^a is obtained as $B^r \equiv \left(I_1^r, I_2^r, e^r\right)$ such that $I_1^r = I_1^* + r(I_1^a - I_1^*)$, $I_2^r = I_2^* + r(I_2^a - I_2^*)$, and $e^r = e^* + r(e^a - e^*)$. The greater the value of *r*, the greater the distance between budget B^r and budget B^*. To prove the result, we need to show that, for $0 < r < 1$, $V^*(B^r) > V^*(B^a)$.

$$V^*(B^r) \equiv V\left(I_1^r, I_2^r, e_1^*\left(B^r\right), e_2^*\left(B^r\right)\right) \geq V\left(I_1^r, I_2^r, e_1^r, e_2^r\right),$$

where $e_j^r = e_j^*(B^*) + r\left\{e_j^*(B^a) - e_j^*(B^*)\right\}$, $j \in \{1, 2\}$. The inequality follows from the fact that the resource allocation based on the first-best rule results in the highest value. Now,

$$\begin{aligned} V\left(I_1^r, I_2^r, e_1^r, e_2^r\right) &\equiv \sum_{j=1}^{2} \bar{y}_j\left(I_j^r, e_j^r\right) - I_j^r - e_j^r \\ &> \sum_{j=1}^{2} \min\left\{\bar{y}_j\left(I_j^*, e_j^*(B^*)\right) - I_j^* - e_j^*(B^*), \bar{y}_j\left(I_j^a, e_j^*(B^a)\right) - I_j^a - e_j^*(B^a)\right\} \\ &= \sum_{j=1}^{2} \bar{y}_j\left(I_j^a, e_j^*(B^a)\right) - I_j^a - e_j^*(B^a) \equiv V^*(B^a). \end{aligned}$$

The inequality follows from the quasi-concavity (implied by the concavity) of the $\bar{y}_j$ functions. The equality follows from the fact that B^* is the first-best budget. This proves the result.

Result 2:The second-best budget B^m *satisfies condition (A1), i.e.,*

$$\eta_1\left(I_1^m, e_1^*(B^m)\right) > \eta_2\left(I_2^m, e_2^*(B^m)\right). \tag{A11}$$

Suppose the result is not true and Division 2 is more informative at budget B^m when resource allocation is made according to the first-best rule. By assumption, Division 1 is more informative at the first-best solution. Therefore, by continuity, there is some budget B^x which is a linear combination of budgets B^m and B^* such that the informativeness of the two divisions is equal if resource allocation is made according to the first-best rule. At this budget B^x, then, the manager's incentive constraint (10) is satisfied if resource allocation is made according to the first-best rule. Consequently, $V^*(B^x) = V^m(B^x)$. But $V^*(B^x) > V^*(B^m) > V^m(B^m)$. The first inequality is from Result 1 while the second one follows from the fact that firm value is maximized for any given budget if the resource allocation is made according to the first-best rule. Therefore, $V^m(B^x) > V^m(B^m)$, which is a contradiction as $V^m(B^m)$ is the second-best equilibrium value of the firm.

Now suppose that the two divisions are equally informative at budget B^m when resource allocation is made according to the first-best rule. Then, $V^*(B^m) = V^m(B^m)$. But $V^*(B) \geq V^m(B)$ for all budgets so V^* and V^m have the same tangent plane at B^m. From Result 1, $V^*(B)$ increases as the budget moves from B^m towards B^*. Hence, $V^m(B)$ also increases as the budget moves from B^m towards B^*. This is a contradiction and, therefore, the result holds. □

Result 3: The resources allocated by the manager to any division are increasing in the total resources provided by the investors in the budget.

Total differentiation of Equation (10) with respect to resources *e* yields

$$\left\{\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\right)\frac{d\eta_1}{de_1}\frac{de_1}{de}-\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\frac{d\eta_2}{de_2}\frac{de_2}{de}\right\}\phi_1\psi_1'+\left(\eta_1-\rho\sqrt{\eta_1\eta_2}\right)\frac{de_1}{de}\phi_1\psi_1''$$

$$=\left\{\left(1-\frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\right)\frac{d\eta_2}{de_2}\frac{de_2}{de}-\frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\frac{d\eta_1}{de_1}\frac{de_1}{de}\right\}\phi_2\psi_2'+\left(\eta_2-\rho\sqrt{\eta_1\eta_2}\right)\frac{de_2}{de}\phi_2\psi_2''.$$

Since sum of resources equals *e*, $de_1/de + de_2/de = 1$. Substituting this condition in the above equation and simplifying,

$$\frac{de_1}{de} = \frac{Q}{P+Q}, \quad \frac{de_2}{de} = \frac{P}{P+Q},$$

where $P = \frac{d\eta_1}{de_1}\left\{\left(1 - \frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\right)\phi_1\psi_1' + \frac{\rho}{2}\sqrt{\frac{\eta_2}{\eta_1}}\phi_2\psi_2'\right\} + \left(\eta_1 - \rho\sqrt{\eta_1\eta_2}\right)\phi_1\psi_1''$,

$$Q = \frac{d\eta_2}{de_2}\left\{\left(1 - \frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\right)\phi_2\psi_2' + \frac{\rho}{2}\sqrt{\frac{\eta_1}{\eta_2}}\phi_1\psi_1'\right\} + \left(\eta_2 - \rho\sqrt{\eta_1\eta_2}\right)\phi_2\psi_2''.$$

It is sufficient to show that $P < 0$ and $Q < 0$. Inequalities (A8), concavity of ψ_1 and the fact that informativeness is a decreasing function imply $P < 0$. Similarly, we can show that $Q < 0$.

Result 4: At the second-best equilibrium, $\phi_1\left(I_1^m\right)\psi_1'\left(e_1^m(B^m)\right) < 1$ *and* $\phi_2\left(I_2^m\right)\psi_2'\left(e_2^m(B^m)\right) > 1$.

From Result 2 and Lemma A1 we know that, at budget B^m,

$$e_1^m(B^m) > e_1^*(B^m) \text{ and } e_2^m(B^m) < e_2^*(B^m). \tag{A12}$$

At budget B^m, the resource allocation according to the first-best rule satisfies the following equation (see Equation (A4)):

$$\phi_1(I_1^m)\psi_1'\left(e_1^*(B^m)\right) = \phi_2(I_2^m)\psi_2'\left(e_2^*(B^m)\right). \tag{A13}$$

From equations (A12) and (A13) we get:

$$\phi_1(I_1^m)\psi_1'\left(e_1^m(B^m)\right) < \phi_2(I_2^m)\psi_2'\left(e_2^m(B^m)\right). \tag{A14}$$

From Equation (14), the first-order condition for the second-best solution with respect to *e* yields

$$\frac{dV^m(B^m)}{de} = \phi_1\left(I_1^m\right)\psi_1'\left(e_1^m(B^m)\right)\frac{de_1^m\left(B^m\right)}{de} + \phi_2\left(I_2^m\right)\psi_2'\left(e_2^m(B^m)\right)\frac{de_2^m\left(B^m\right)}{de} - 1 = 0.$$

Using the fact that the sum of the divisional resources equals *e* (Equation (2)), we get

$$\phi_1\left(I_1^m\right)\psi_1'\left(e_1^m(B^m)\right) - 1 + \left\{\phi_2\left(I_2^m\right)\psi_2'\left(e_2^m(B^m)\right) - \phi_1\left(I_1^m\right)\psi_1'\left(e_1^m(B^m)\right)\right\}\frac{de_2^m\left(B^m\right)}{de} = 0. \tag{A15}$$

Using Result 3, and equations (A14) and (A15), we get

$$\phi_1(I_1^m)\psi_1'(e_1^m(B^m)) < 1. \tag{A16}$$

Using a similar process, we can show that

$$\phi_2(I_2^m)\psi_2'(e_2^m(B^m)) > 1. \tag{A17}$$

Result 5: At the second-best equilibrium, $\phi_1'(I_1^m)\psi_1(e_1^m(B^m)) < 1$ *and* $\phi_2'(I_2^m)\psi_2(e_2^m(B^m)) > 1$.

From Equation (13), the first-order condition for the second-best solution with respect to I_1 yields

$$\frac{dV^m(B^m)}{dI_1} = 0 = \phi_1'(I_1^m)\psi_1(e_1^m(B^m)) - 1$$
$$+ \{\phi_1(I_1^m)\psi_1'(e_1^m(B^m)) - \phi_2(I_2^m)\psi_2'(e_2^m(B^m))\}\frac{de_1^m(B^m)}{dI_1}.$$

Using Lemma 2 and Equation (A14), it can be seen that the third term in the above equation is positive. Therefore,

$$\phi_1'(I_1^m)\psi_1(e_1^m(B^m)) < 1. \tag{A18}$$

Similarly, from the first-order condition with respect to I_2 given in Equation (13), using Lemma 2 and Equation (A14), we get

$$\phi_2'(I_2^m)\psi_2(e_2^m(B^m)) > 1. \tag{A19}$$

Using the above results, we can now prove Proposition 1. From equations (4) and (A18), it can be seen that relations $I_1^m \le I_1^*$, $e_1^m > e_1^*$ cannot hold. From equations (5) and (A16), it can be seen that relations $I_1^m > I_1^*$, $e_1^m \le e_1^*$ cannot hold. Therefore, either the relations $I_1^m \le I_1^*$ and $e_1^m \le e_1^*$, or the relations $I_1^m > I_1^*$ and $e_1^m > e_1^*$ must hold. Suppose the former set of inequalities holds. Clearly, one of these inequalities must be strict for (4) and (A18) to be consistent. Then,

$$\bar{y}(I_1^*, e_1^*) - I_1^* - e_1^*$$

$$
\begin{aligned}
&\le \bar{y}\left(I_1^m, e_1^m\right) - I_1^m - e_1^m \\
&\quad + \left(I_1^* - I_1^m\right)\frac{d}{dI_1}\left\{\bar{y}\left(I_1^m, e_1^m\right) - I_1^m - e_1^m\right\} + \left(e_1^* - e_1^m\right)\frac{d}{de_1}\left\{\bar{y}\left(I_1^m, e_1^m\right) - I_1^m - e_1^m\right\} \\
&= \bar{y}\left(I_1^m, e_1^m\right) - I_1^m - e_1^m + \left(I_1^* - I_1^m\right)\left\{\phi_1'\left(I_1^m\right)\psi_1\left(e_1^m\right) - 1\right\} + \left(e_1^* - e_1^m\right)\left\{\phi_1\left(I_1^m\right)\psi_1'\left(e_1^m\right) - 1\right\} \\
&< \bar{y}\left(I_1^m, e_1^m\right).
\end{aligned}
$$

The first inequality follows from the concavity of the expected divisional cash flow which implies that any tangent plane to the function always lies above the function (see Mas-Collell, Whinston, and Green (1995), p. 931). The last inequality follows from equations (A16) and (A18) and our assumption that $I_1^m \le I_1^*$ and $e_1^m \le e_1^*$ with at least one inequality strict. This is a contradiction as the expected value of each division should be maximized at the first-best solution. Therefore, we must have

$$
I_1^m > I_1^* \text{ and } e_1^m > e_1^*. \tag{A20}
$$

Using a similar line of reasoning, it can be shown that

$$
I_2^m < I_2^* \text{ and } e_2^m < e_2^*. \tag{A21}
$$

This proves the proposition. □

<u>Proof of Proposition 2</u>

The proof follows from equations (A20) and (A21). □

<u>Proof of Proposition 3</u>

The proof follows from Lemma $A1$ and Result 2. □

<u>Proof of Proposition 4</u>

The manager's incentive compatibility constraint (10) can be rewritten as

$$
S \equiv \frac{\left\{\sqrt{r}\hat{\eta}_1(I_1,e_1) - \rho\sqrt{\hat{\eta}_1(I_1,e_1)\hat{\eta}_2(I_2,e_2)}\right\}\phi_1(I_1)\psi_1'(e_1)}{\left\{\hat{\eta}_2(I_2,e_2)/\sqrt{r} - \rho\sqrt{\hat{\eta}_1(I_1,e_1)\hat{\eta}_2(I_2,e_2)}\right\}\phi_2(I_2)\psi_2'(e_2)} = 1, \tag{A22}
$$

where r is the ratio γ_1/γ_2. Suppose the budget is fixed at the second-best budget. Totally differentiating (A22) with respect to r,

$$\frac{dS}{de_1}\frac{de_1}{dr}+\frac{dS}{de_2}\frac{de_2}{dr}+\frac{dS}{dr}=0.$$

Using the fact that $e_1 + e_2 = e$,

$$\frac{de_1}{dr}=\frac{dS}{dr}\bigg/\left(\frac{dS}{de_2}-\frac{dS}{de_1}\right).$$

Differentiation of Equation (A22) shows that $\partial S/\partial r > 0$, $\partial S/\partial e_2 > 0$, and $\partial S/\partial e_1 < 0$. Therefore, it follows that $de_1/dr > 0$. Thus, as the difference in informativeness reduces, the manager reduces resource allocation to Division 1 and increases resource allocation to Division 2. Equations (A16) and (A17) show that these changes increase firm value. Moreover, investors may change the budget allocation to further increase firm value. □

Proof of Proposition 5

Suppose firm value decreases with correlation for any given budget $B \equiv \{I_1, I_2, e\}$ that satisfies the condition (A1). Since the second-best budget satisfies this condition (Equation (A11)), the firm value in the second-best equilibrium is the supremum of the firm values over all budgets that satisfy the above condition. Therefore, the second-best value is also a decreasing function of the correlation. The proposition follows because the first-best value of the firm is independent of the correlation.

To show that firm value decreases with correlation for a budget B that satisfies the above condition, we first show that the resource misallocation is increasing in correlation. For the budget B, consider the manager's resource allocations for two different values of correlation. Let $e_{j1}^m = e_j^m(B;\rho_1)$ be the resource allocation to Division j when the correlation is ρ_1 and $e_{j2}^m = e_j^m(B;\rho_2)$ be the resource allocation when the correlation is ρ_2 with $\rho_2 > \rho_1$. From Lemma A1, we know that $e_{11}^m > e_1^*$, $e_{12}^m > e_1^*$, $e_{21}^m < e_2^*$, and $e_{22}^m < e_2^*$. Suppose our claim is not true: that is, $e_{12}^m \le e_{11}^m$ and $e_{22}^m \ge e_{21}^m$. Then,

$$\frac{\phi_1(I_1)}{\phi_2(I_2)}=\frac{\sqrt{\eta_2\left(I_2,e_{21}^m\right)/\eta_1\left(I_1,e_{11}^m\right)}-\rho_1}{\sqrt{\eta_1\left(I_1,e_{11}^m\right)/\eta_2\left(I_2,e_{21}^m\right)}-\rho_1}\times\frac{\psi_2'\left(e_{21}^m\right)}{\psi_1'\left(e_{11}^m\right)}>\frac{\sqrt{\eta_2\left(I_2,e_{21}^m\right)/\eta_1\left(I_1,e_{11}^m\right)}-\rho_2}{\sqrt{\eta_1\left(I_1,e_{11}^m\right)/\eta_2\left(I_2,e_{21}^m\right)}-\rho_2}\times\frac{\psi_2'\left(e_{21}^m\right)}{\psi_1'\left(e_{11}^m\right)}$$

$$\geq\frac{\sqrt{\eta_2\left(I_2,e_{22}^m\right)/\eta_1\left(I_1,e_{12}^m\right)}-\rho_2}{\sqrt{\eta_1\left(I_1,e_{12}^m\right)/\eta_2\left(I_2,e_{22}^m\right)}-\rho_2}\times\frac{\psi_2'\left(e_{22}^m\right)}{\psi_1'\left(e_{12}^m\right)}=\frac{\phi_1(I_1)}{\phi_2(I_2)}.$$

The first and the last equality follow from Equation (10) while the first inequality results from Lemma A1(ii). The second inequality follows from the fact that the ψ functions are concave and that informativeness is decreasing in scale. Since this is a contradiction,

$$e_{12}^m>e_{11}^m,\quad e_{22}^m<e_{21}^m.$$

Since the resource misallocation (always biased towards the more informative division) increases with correlation and the ψ_j functions are concave, firm value decreases with correlation for budget B. □

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Footnotes

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[1] Our model has similarities to the career concerns models of Holmstrom (1999) and Narayanan (1985).

[2] The synergy between the divisions might be the reason for the conglomeration in the first place. Since our focus in this paper is the inefficiencies of conglomeration, we ignore any synergy between the divisions. Incorporating synergy does not change the central theme of the paper, that career concerns lead to capital misallocation.

[3] Our results do not depend on the input factors being complementary. We can obtain the same results with a production function where capital and intangible resources are additive.

[4] We assume that the technical conditions $\phi_j'(0) = \psi_j'(0) = \infty$, and $\phi_j'(\infty) = \psi_j'(\infty) = 0$ are satisfied.

[5] See Mas-Collell, Whinston, and Green (1995), p. 131.

[6] All the results hold even with negative correlation as long a more restrictive version of the sufficient condition stated later in Assumption 1 holds.

[7] The assumption of linear cost avoids creating a rationale for firm scope based purely on minimizing the cost of intangible resources. If the cost of intangible resources was assumed to be concave, for example, minimizing this cost provides a motive for conglomeration. Similarly, a convex cost function will create a disadvantage for conglomeration.

[8] The results of the paper hold exactly if the reservation wage is a linear and increasing function of perceived managerial ability. The results will also hold qualitatively if the reservation wage is a monotonic increasing function of perceived ability.

[9] Concavity of functions ϕ and ψ and the conditions in footnote 4 are sufficient for the existence of a unique interior solution.

[10] Given our assumption of concavity of the resource functions ψ_j, it is easily verified that the second-order condition is satisfied.

[11] The precision of the cash flows of a division is a function of the capital and resources allocated to that division. Therefore, one cannot in general, compare the informativeness of two divisions without specifying the capital and resource allocations.

[12] This result is shown formally in the Appendix (see Lemma A1 and Result 2 in the proof of Proposition 1.

[13] See Result 1 in the proof of Proposition 1 for a formal derivation.

[14] Note that Proposition 4 is stated in terms of first-best informativeness. The use of the ERC of single-segment firms to proxy the divisional ERC of a conglomerate is consistent with the statement of the proposition because, in the context of our model, capital and resource allocation in single-segment firms are at the first-best levels.

[15] Note that these expressions need not equal 1 as in Equation (5) since the budget is fixed at B.