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# REALLOCATION OF CORPORATE RESOURCES AND MANAGERIAL INCENTIVES IN INTERNAL CAPITAL MARKETS

## Abstract

Diversified firms often trade at a discount with respect to their focused counterparts. The literature has tried to explain the apparent misallocation of resources with lobbying activities or power struggles. We show that diversification can destroy value even when resources are efficiently allocated ex post. When managers derive utility from the funds under their purview, moving funds across divisions may diminish their incentives. The ex ante reduction in managerial incentives can more than offset the increase in firm value due to the ex post efficient reallocation of funds. This effect is robust to the introduction of monetary incentives. We apply our model to the analysis of the optimal reallocation policy and to the effect of the asymmetry among divisions. In general it is optimal for headquarters to commit not to reallocate at least a fraction of funds. As a result, the investment in a given division is more sensitive to the division's cash flow than to other divisions' cash flow. Asymmetries in size and growth prospects increase the diversification discount.

JEL Classification: D2, L1, L2.

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# 1 Introduction

The analysis of the allocation of funds among different divisions of a conglomerate firm is a relatively young topic. Stein (2001) provides a recent survey. The general theme coming from the empirical literature is that diversified firms trade on average at a discount relative to a portfolio of focused firms in the same industries, as reported by Berger and Ofek (1995), Servaes (1996) and Lins and Servaes (1999). Moreover, the '80s saw a process of dismantling of diversified firms, driven by the idea that the divisions would be more efficiently managed as stand-alones. But if there is by now a wide consensus on the idea that a diversification discount exists, it is much less clear why this is the case.

Stein (1997) has pointed out that internal capital markets can create value in financially constrained firms. In Stein's words, "*Simply put, individual projects must compete for scarce funds, and headquarters' job is to pick winners and losers in this competition.*" Stein denotes this activity of headquarters in a conglomerate firm as 'winner-picking'. Contrary to the empirical findings, Stein's model suggests that internal capital market should create value and thus a premium for diversified firms. One possible way to solve this apparent paradox is to argue that the discount of diversified firms is due to misallocation of resources in internal capital markets. For instance, Rajan *et al.* (2000) find that multi-segment firms allocate relatively more capital to 'weak' lines of business than their stand-alone counterparts, and relatively less to segments in 'strong' lines of business. Scharfstein (1998) finds that the investment of conglomerate divisions is virtually insensitive to investment opportunities, as measured by the industry $q$'s. Lamont (1997) shows that resource allocation in diversified firms is different from that in focused firms and less sensitive to indicators of investment value such as Tobin's $q$.

However, the evidence on inefficient allocation of funds has been disputed. Whited (2001) points out that the inefficiency results appeared in the literature may actually be due to the incorrect measures adopted for the investment opportunities of the divisions. She shows that when measurement problems are taken into account, the evidence of inefficient allocation of funds disappears. Chevalier (2000) analyzes the investment behavior of a sample of firms before and after diversifying mergers, finding no evidence of a change in investment behavior. This implies that, if there is inefficiency in the investment behavior of the divisions of conglomerate firms, such inefficiency does not appear to be due to the presence of internal capital markets.

In this paper we argue that in order to explain the diversification discount we do not need to assume any misallocation of funds in internal capital markets. Conglomerates can destroy value even if resources are (*ex post*) efficiently allocated. If managers derive utility from the funds under their purview, the possibility of implementing a 'winner-picking' policy, while optimizing resources allocation *ex post*, reduces managerial incentives *ex ante*. Taking away from the manager the cash flow generated by the division has the negative implication of reducing the *ex ante* incentives for division managers to spend effort to generate the cash flow. The reduced managerial incentives can more than offset the gains of reallocating funds to the most profitable divisions. In other words, 'winner-picking' is both the bright and the dark side of internal capital markets.

We consider a two-period model with two divisions and a headquarters. Division managers receive private benefits in proportion to the gross return of the division they run. headquarters maximizes total firm value. In the first period the two division managers have to exert a non-verifiable effort to increase the probability of success of a project already in place. The cash flow generated by the existing project will be reinvested inside the firm in the second period. Before the second period, the headquarters receives a signal on the second period profitability of the two divisions and reallocates funds. When divisions operate as stand-alones, each division reinvests the cash flow generated by the first period project. On the contrary, in the diversified firm the headquarters will redistribute the cash flow to the most profitable division. The redistribution has two effects: on one hand it creates value, but on the other hand it reduces the rent for the manager of the (*ex post*) less profitable division. Anticipating the possibility of being expropriated, each division manager will reduce his effort. Consequently, the total cash flow to be reinvested in period two will decrease.

This observation has the following implications. First, a profit- maximizing headquarters will face a time inconsistency problem. Once the funds are generated, headquarters would like to exercise 'winner picking' to the highest extent possible. However, this *ex post* maximizing behavior by headquarters will reduce *ex ante* incentives at the divisional level, and it may cause a loss of value for the corporation. The discount is particularly severe when divisions are *ex post* similar in terms of investment opportunities, i.e. when 'winner-picking' has a limited potential for creating value. In this case the negative effect on the reduced managerial incentives will dominate. On the other hand, when *ex post* diversity in investment opportunities is large, so that the profits generated from reallocation are also large, then the advantages of 'winner-picking' dominate over the reduced managerial incentives, and the diversified firm trades at a premium.[1] Conversely, diversity in the *ex ante* profitability of divisions increases the likelihood that a conglomerate trades at a discount. If one division has a very high probability of having *ex post* the best investment opportunities, the incentives for the manager of the other division are reduced. Therefore the cash flow that can be reallocated to the most profitable division is also reduced, limiting the gains of 'winner-picking'.

Second, if headquarters has some commitment power then a policy which lets divisions to retain part of the cash flow generated, independently of the investment opportunities, may well maximize expected profit. Linking investment to the cash flow produced and not only to investment opportunities restores the right balance between the goal of allocating resources efficiently and providing incentives to division managers.[2] We next pose the following question: If the *ex ante* profitabilities of the divisions are different, which one should be allowed to retain more cash? Here there are two effects at work. On one hand, allowing the *ex ante* most profitable division to retain an extra dollar is less costly, since the dollar is more likely to end up at its best use. On the other hand, allowing the weaker division to retain an extra dollar has a stronger incentive effect. The reason is that the manager of the less profitable division is more likely to be 'expropriated' of the cash generated whenever headquarters does not commit to let the division retain funds. Therefore, fund retention is especially appreciated by the managers of weaker divisions, and they will respond more strongly to the possibility of fund retention than the managers of strong divisions. The interplay of these two forces generates two different regimes. When the difference in profitability is small then the general level of fund retention is high, since providing incentives is more important than efficient *ex post* reallocation of capital, and the division which is *ex ante* more profitable is allowed to retain more of its cash. When the difference in profitability is large then the general level of fund retention will be small. However, in this case it is the *less* profitable division which is allowed to retain more. This pattern of fund retention is a potentially testable prediction of the model.

[1]It is not uncommon to observe diversified firms trading at a premium. Rajan *et al.* (2000) report that 39.3 percent of diversified firms in their sample traded at a premium in 1990.

[2]Shin and Stulz (1998) find that the investment in a given division is more sensitive to the division's cash flow than to other divisions' cash flow. However, Whited (2001) shows that the result may be due to measurement errors.

Third, the diversification discount is greater when a division with a greater potential for immediate cash generation is paired with a division with poor capacity of immediate cash generation but good growth prospects. In this case the manager of the first firm will fear expropriation of the cash flow generated in favor of the high-growth firm, thus reducing the conglomerate's value.

The basic intuition that *ex post* interference by the principal may be harmful for incentives is of course not new. For example, Aghion and Tirole (1997) show that if the principal intervenes too often in the decisional process, it can stifle the agent's initiative.[3] Rotemberg and Saloner (1994) discuss how, in the presence of incomplete contracts, firms may benefit from restricting the scope of their activities. Their basic idea is that diversified firms have a wider range of projects to implement, and for some reason they cannot implement all of them. As a result, they are more likely to implement a project that it is not ideal for providing *ex ante* incentives. They also propose an application of their model to internal capital markets, showing that it may be optimal to force each division to use only funds that it has generated itself. We extend their argument pointing out the cases where internal capital markets are less likely to be beneficial. Moreover we show that allowing divisions to retain a fraction of their cash flow can be superior to both a pure internal capital market and to a narrow business strategy.

Other papers which present arguments similar to ours include Gautier and Heider (2000), Inderst and Laux (2000), Inderst and Müller (2001) and De Motta (1999). Gautier and Heider (2000) analyzes a model in which division managers must first produce cash flow that will be then reinvested inside the company. However, in their model projects have a fixed size (an extreme version of decreasing marginal returns of capital) and consequently the scope for winner-picking is reduced. In Inderst and Laux (2000) effort is directed to the generation of investment opportunities rather than cash, and their focus is on the role played by liquidity constraints. Inderst and Müller (2001) is also focused on the impact of conglomerates on financing constraints. De Motta (1999) studies a model in which division managers try to influence the internal capital market's assessment of their division in order to boost their level of funding. In his model the difference between external and internal capital markets is the informational advantage of the

[3] Stein (2000) points out that managers' incentives may be blunted when they do not have ultimate authority. However, his model addresses a different issue, namely how decentralized and hierarchical firms differ in terms of their ability to generate information about investment projects and allocate capital to these projects efficiently.

latter, while in our model the distinctive feature is the headquarters' ability to reallocate funds across divisions and informational asymmetries do not play any role.

At last, a number of papers have tried to explain the 'diversification discount' as the consequence of a non-random selection of firms that become conglomerate. Papers in this literature include Campa and Kedia (1999), Fluck and Lynch (1999) and Maksimovic and Phillips (2001). The general point is that weaker firms may have a comparative advantage in merging. Thus, even if conglomerate firms work efficiently, a diversification discount appears. Our point is different, and it is related to the different managerial incentives provided by conglomerate firms.

As a final remark, we stress that we do not want to argue that resources are indeed allocated efficiently in internal capital markets. Power struggles, influence activities etc. are surely present in most corporations, and such inefficiencies contribute to reducing the value of diversification. Our point is that diversified firms may well trade at a discount *even if internal capital markets allocate funds efficiently.* The optimal policy *ex post* is not necessarily the optimal policy *ex ante.*

The paper is organized as follows. In section 2 we describe the basic model. Section 3 illustrates the main effects of the 'winner picking' policy, comparing the performance of a diversified corporation in which funds are allocated *ex post* efficiently with the performance of a 'stand alone' firm. We also show that the basic results still hold when the firm can provide monetary incentives to the managers. Section 4 discusses applications of the basic model. We first consider the impact of asymmetry in size between the two divisions. Next, we analyze the optimal capital allocation policy, and we show that it may be optimal to make the investment of a division depend on the cash flow generated by the division. Section 5 contains the conclusions, and an appendix collects the proofs.

## 2 The Model

Our model has three agents: headquarters ($H$) and two division managers, $M_1$ and $M_2$. Each division has assets in place and new investment opportunities. Division managers derive private benefits from the assets of their divisions only, while headquarters is interested in total returns. The timing of the model is as follows.

- At $t = 0$ manager $M_i$ works with the assets already in place in his division. The existing project can either succeed or fail. If it fails, it produces a cash flow equal to $C_i = 0$. If the project succeeds, the cash flow is $C_i = 1$. The probability of success is determined by the level of effort exerted by the manager. We assume that if the manager chooses a level of effort $e_i$, then the existing project is successful with probability $e_i$. The disutility of effort $e_i$ is $\psi(e_i) = k\frac{e_i^2}{2}$.[4]

- At $t = .5$ the two managers and headquarters observe a signal $s$ that provides information on the productivity of the investment projects available at $t = 1$ in the two divisions.

- At $t = 1$ headquarters observes the cash flow produced by the two divisions, $C_1$ and $C_2$ and redistributes funds to the divisions. The old assets in place are fully depreciated. We assume that the firm has no access to external finance,[5] so that $C_1 + C_2$ is the total amount of funds that can be reinvested in period 2. headquarters has the power to allocate funds across divisions in a diversified firm. We denote with $K_i$ the funds assigned to division $i$. We assume that headquarters allocate all funds to the divisions, so that $K_1 + K_2 = C_1 + C_2$. This may be justified either by assuming that each division always has sufficiently profitable investment projects. Alternatively, we may assume that headquarters has a preference for empire-building.

- At $t = 2$ the investment in division $i$ yields a cash flow[6] $K_i\widetilde{R}_i$.

For simplicity we will assume that the signal $s$ can only take two values. If $s = s_1$ then the expected return in the first division is higher than in the second, that is $E\left(\widetilde{R}_1\middle| s_1\right) > E\left(\widetilde{R}_2\middle| s_1\right)$, while if $s = s_2$ the opposite occurs[7]. In order to simplify further we assume:

$$E\left(\widetilde{R}_1\middle| s_1\right) = E\left(\widetilde{R}_2\middle| s_2\right) = \bar{R} \qquad E\left(\widetilde{R}_2\middle| s_1\right) = E\left(\widetilde{R}_1\middle| s_2\right) = \underline{R}.$$

[4]Most of the results in section 3 hold for any $\psi(e)$ increasing and convex.

[5]This (admittedly) extreme assumption allows us to focus on the case where funds are scarce and thus winner-picking has a higher potential to create value by reallocating resources across divisions.

[6]As in Scharfstein and Stein (2000), we assume that in the second period the divisional managers do not have to exert any effort. This is obviously non-essential.

[7]Note that we assume that the profitability of each division in period 2 is exogenous. In a more general framework, the return on the investment of each division should be a function of both managerial effort and 'luck'. Then there would be a countervailing effect: competition for funds may boost managerial incentives. For a treatment of this case see Inderst and Laux (2000).

We define $\Delta = \bar{R} - \underline{R}$ and assume $\underline{R} > 0$. The assumption $\underline{R} > 0$ is without loss of generality: it just says that the divisional manager can at most squander completely the funds obtained. At last, we define $p = \Pr(s = s_1)$, and assume $p \in (0, 1)$. Given the assumption on the support of $s$, we have $\Pr(s = s_2) = 1 - p$.

Finally we need to specify the objective functions of the headquarters and of division managers. Headquarters maximizes total returns. Concerning division managers, we follow Stein (1997) and assume that each division manager receives private benefits of control that are proportional to the gross output of its division. More precisely, we assume that a division manager reaps private benefits equal to a fraction $\phi \in (0, 1)$ of the cash flow generated by his division in the second period $K_i \widetilde{R}_i$.[8] This assumption implies that each manager always prefers more capital to less, but conditional on being given a certain amount of capital each manager tries to invest it in the most profitable project available. In other words, managers are empire builders, but they prefer more profitable empires to less profitable empires. Furthermore, it is the possibility of reallocating resources across divisions that may create a divergence of interests between the headquarters and the division managers. Without the possibility of 'winner-picking' there would be no conflict of interests between headquarters and divisions.

As it is common in this literature, we begin our analysis by assuming non-responsiveness of managers to monetary incentives. In subsection 3.1, we consider the case in which monetary incentives can be provided.

Formally, the utility function of the manager of division $i$ is given by:

$$U\left(e_i, K_i, \widetilde{R}_i\right) = \phi K_i \widetilde{R}_i - k \frac{e_i^2}{2}$$

For simplicity we assume that private benefits are psychic, that is they do not derive from 'stealing' or misusing the company's assets.[9] As usual, private benefits can be thought of in a number of ways: the usual perks, the psychic benefits from empire building, etc. Finally, the risk-free interest rate is normalized to zero and all agents are risk neutral.

[8] We could equally assume that division managers derive private benefits also from the first period cash flow. This would not affect our results. The calculations for this case can be found in Brusco and Panunzi (2000).

[9] Given that we assume that private benefits are a constant fraction of the division's gross output, this assumption has no serious implications for the analysis. If private benefits were extracted at the expense of profits, we should multiply the headquarters' profit by a constant.

## 3 The Bright and the Dark Side of 'Winner-Picking'

In this section we want to highlight the basic trade-off between incentive provision and *ex post* efficiency. We therefore consider two alternative 'extreme' organizational forms: The 'stand-alone' one, in which divisions are completely separated and no internal capital market exists, and the pure internal capital market one, in which capital is entirely assigned to the *ex post* most efficient division.

In the stand-alone case, by exercising effort $e_i$ at $t = 0$ the manager of division $i$ obtains an expected amount $e_i \cdot 1 + (1 - e_i) \cdot 0 = e_i$ of funds for reinvestment at time 1. Given the information at time 0, the expected cash flow generated by those funds at $t = 2$ is:

$$[p_i (\underline{R} + \Delta) + (1 - p_i) \underline{R}] e_i = [\underline{R} + p_i \Delta] e_i$$

where $p_1 = p$ and $p_2 = 1 - p$. The problem of $M_i$ at time zero is:

$$\max_{e_i} \ \phi [\underline{R} + p_i \Delta] e_i - k \frac{e_i^2}{2}$$

The necessary and sufficient condition for a maximum is:

$$e_i = \frac{\phi (\underline{R} + p_i \Delta)}{k} \quad (1)$$

We call $e_i^{SA}$ the solution to this equation. To obtain interior solutions for $e_i$ we impose the following

**Assumption 1** $\underline{R} + \Delta < k$

The sum of the expected profit under the stand alone solution is given by:

$$\Pi^{SA} = (\underline{R} + p\Delta) e_1^{SA} + (\underline{R} + (1 - p) \Delta) e_2^{SA}.$$

Consider now the pure ICM case. Now headquarters observes $s_i$ at time $t = 0.5$ and then allocates entirely the funds to division $i$.[10] Therefore, division $i$ faces a probability $1 - p_i$ of having zero funds and a probability

[10] This implication of our model is extreme and it is due to the assumption that the return to the investment in each division is linear. With decreasing marginal returns of investment, even the less profitable division could obtain a positive amount of funds.

$p_i$ of having all funds. The total expected amount of funds is $e_1 + e_2$. The problem for $M_i$ is therefore:

$$\max_{e_i} \ \phi p_i \left(\underline{R} + \Delta\right) \left(e_i + e_{-i}\right) - k\frac{e_i^2}{2}$$

and the necessary and sufficient condition for a maximum is:

$$e_i = \frac{\phi p_i \left(\underline{R} + \Delta\right)}{k} \tag{2}$$

Let us call $e_i^{ICM}$ the solution to this equation. The expected profit for headquarters is given by:

$$\Pi^{ICM} = \left(\underline{R} + \Delta\right) \left(e_1^{ICM} + e_2^{ICM}\right)$$

We can now compare the expected profits under the pure ICM and stand alone forms. We have:

$$\Pi^{ICM} - \Pi^{SA} = \Delta \left(\left(1-p\right) e_1^{ICM} + p e_2^{ICM}\right) \tag{3}$$

$$- \left[\left(\underline{R} + p\Delta\right) \left(e_1^{SA} - e_1^{ICM}\right) + \left(\underline{R} + \left(1-p\right)\Delta\right) \left(e_2^{SA} - e_2^{ICM}\right)\right]$$

This can be read as follows. The term

$$\Delta \left(\left(1-p\right) e_1^{ICM} + p e_2^{ICM}\right)$$

represents the 'winner picking' effect. With probability $(1-p)$, the second division is the more profitable one. In the SA case, this does not lead to any extra funding for the firm. In the ICM case, division 2 obtains the cash generated by division 1, that is $e_1^{ICM}$. Expected profit therefore increases by $\Delta\left(1-p\right) e_1^{ICM}$. A similar effect is at work when division 1 is the more profitable. This term is the bright side of internal capital markets: Resources are *ex-post* allocated to the best investment.

The key point of our paper is the second term. Notice that this term would be zero if we had $e_i^{ICM} = e_i^{SA}$. However, since:

$$\frac{\phi p_i(\underline{R} + \Delta)}{k} < \frac{\phi(\underline{R} + p_i\Delta)}{k}$$

we have $e_i^{ICM} < e_i^{SA}$. This is the 'incentive effect' denoting the reduction in expected profits as a consequence of the reduced incentives that managers have when funds are redistributed across divisions. In fact, the term

$(\underline{R}+p_i\Delta)$ denotes the gross expected return on funds invested in the division, and the reduction in expected profit in division $i$ is equal to the reduction in the amount of funds generated (that is, $e_i^{SA}-e_i^{ICM}$) times this return.

The sign of $\Pi^{ICM}-\Pi^{SA}$ depends on the parameters as follows.

**Proposition 1** *a) For any given value of $p$ and $\underline{R}$ there exists a value $\Delta^*$ such that if $\Delta<\Delta^*$ then $\Pi^{ICM}-\Pi^{SA}<0$, while if $\Delta>\Delta^*$ then $\Pi^{ICM}-\Pi^{SA}>0$; b) for any given value of $\Delta$ and $\underline{R}$ the difference $\Pi^{ICM}-\Pi^{SA}$ reaches its maximum at $p=\frac{1}{2}$, and it is a decreasing function of $p$ on the interval $\left(\frac{1}{2},1\right)$.*

Part a) states that when the divisions are expected to be *ex post* similar ($\Delta$ is small) there is not much point in reallocating funds, so that the predominant effect of internal capital markets is the reduction in incentives. In this case the diversified firm trades at a discount with respect to the stand-alone benchmark.[11] As $\Delta$ increases reallocation creates more value, and the bright side of internal capital markets eventually prevails.

Part b) addresses the issue of how *ex ante* differences in profitability between the two divisions lead to a higher or lower diversification discount (or premium). The advantage of the ICM form is at its maximum when the two divisions are *ex ante* identical. As the difference between divisions increases, the SA form becomes more appealing. To grasp the intuition, consider the case of $p$ close to 1. Then the manager of division 1 is almost sure of obtaining all the funds in an internal capital market, whilst the manager of division 2 anticipates that it will obtain no funds almost surely. For division 1 incentives are as in the stand alone case. Moreover, since $p$ is close to 1 winner picking does not add much value. On the other hand, the incentives for the manager of division 2 are close to 0 in the case of the internal capital market, while her effort is positive in the stand alone case. Thus, internal capital markets are less desirable when divisions are very diverse. The negative impact of asymmetry on diversified firm has also been pointed out by Rajan *et al.* (2000). They find that as diversity in opportunities among divisions increases, investment becomes less efficient and firms are less valuable. The difference between their paper and ours is that in their model inefficiencies are caused by funds being transferred

[11] It is worth stressing at this point that, as all the papers in this literature, we do not analyze why there is no spin-off of the two divisions.

from divisions with good investment opportunities to divisions with poor opportunities, while in our model funds always go to the most profitable division and inefficiencies are caused by a reduction in incentives.

### 3.1 Monetary Incentives

We now show that the basic model is robust to the presence of monetary incentives for division managers.

The managers' utility function now becomes

$$U\left(e_i, K_i, \widetilde{R}_i, w_i\right) = w_i + \phi K_i \widetilde{R}_i - k\frac{e_i^2}{2}$$

where $w_i$ is the wage paid to the manager of division $i$. headquarters maximizes total returns net of the wages paid to division managers. We assume that managers are protected by limited liability, i.e. $w_i \geq 0$. In principle, there are various observable events on which the wage can be conditioned: How much cash is produced in the division, how funds are allocated across divisions and the return on capital in each division. However, since the problem is to provide incentives to exert effort, the only event on which it makes sense to condition the wage is the amount of cash $C_i$ generated in the division. Given the limited liability constraint and the risk-neutral framework, the optimal wage contract will pay zero to the manager when $C_i = 0$ and a positive amount when $C_i = 1$. Without ambiguity, let $w_i$ denote the wage paid to the manager of division $i$ when the first period cash flow of division $i$ is 1. In the stand-alone case, the problem of $M_i$ is:

$$\max_{e_i} \left[w_i + \phi(\underline{R} + p_i\Delta)\right] e_i - k\frac{e_i^2}{2}$$

The necessary and sufficient condition for a maximum is:

$$e_i = \frac{w_i + \phi(\underline{R} + p_i\Delta)}{k}$$

We denote by $e_i^{SA}(w_i)$ the solution to this equation, and observe that $\frac{\partial e_i^{SA}}{\partial w_i} = \frac{1}{k}$. The sum of the expected profit for the two divisions under the stand alone solution is now[12]:

$$\Pi^{SA} = (\underline{R} + p\Delta - w_1)\, e_1^{SA}(w_1) + (\underline{R} + (1-p)\,\Delta - w_2)\, e_2^{SA}(w_2).$$

[12]We assume that wages are paid at the end of the second period, so that all the cash flow produced at the end of period 1 is reinvested. Since we assume that the interest rate is 0 managers bear no cost for the delay in the payment.

The optimal wage for each division is given by the condition:

$$-e_i^{SA}(w_i) + (\underline{R} + p_i\Delta - w_i)\frac{\partial e_i^{SA}}{\partial w_i} = 0$$

and using the expression obtained for $e_i^{SA}(w_i)$ and $\frac{\partial e_i^{SA}}{\partial w_i}$ we have:

$$w_i^{SA} = \frac{1-\phi}{2}(\underline{R} + p_i\Delta)$$

where $w_i^{SA} > 0$ since $\phi < 1$. Note that in the stand-alone case the manager of the most profitable division (i.e. the one with higher $p_i$) is given a more high-powered incentive scheme, since the cash produced by the assets in place is more valuable. Substituting the optimal wage in the expression for $e_i^{SA}(w_i)$ we have

$$e_i^{SA} = \frac{1+\phi}{2k}(\underline{R} + p_i\Delta). \tag{4}$$

Finally, substituting in the expression for total profits we have:

$$\Pi^{SA} = \frac{1}{k}\left[\left(\frac{(1+\phi)(\underline{R} + p\Delta)}{2}\right)^2 + \left(\frac{(1+\phi)(\underline{R} + (1-p)\Delta)}{2}\right)^2\right]$$

We turn now to the analysis of the ICM case. As before, with probability $1 - p_i$ division $i$ has zero funds and with probability $p_i$ receives the total expected amount of funds $e_1 + e_2$. The problem for $M_i$ is therefore:

$$\max_{e_i} \ \phi p_i (\underline{R} + \Delta)(e_i + e_{-i}) + e_i w_i - k\frac{e_i^2}{2}$$

and the necessary and sufficient condition for a maximum is

$$e_i = \frac{w_i + \phi p_i (\underline{R} + \Delta)}{k}.$$

Let us call $e_i^{ICM}(w_i)$ the solution to this equation. The expected profit for headquarters is given by:

$$\Pi^{ICM} = (\underline{R} + \Delta)\left(e_1^{ICM}(w_1) + e_2^{ICM}(w_2)\right) - e_1^{ICM}(w_1)\cdot w_1 - e_2^{ICM}(w_2)\cdot w_2$$

The optimal wage for each division is given by

$$-e_i^{ICM}(w_i) + (\underline{R} + \Delta - w_i)\frac{de_i^{ICM}(w_i)}{dw_i} = 0$$

and using the expression for $e_i^{ICM}(w_i)$ we have

$$w_i^{ICM} = \frac{(1-\phi p_i)}{2}(\underline{R}+\Delta).$$

Note that in an internal capital market monetary incentives are more high powered for the *less* profitable division (i.e. the one with lower $p_i$). The intuition is the following: from the headquarters viewpoint the marginal return of a unit of cash is $\underline{R}+\Delta$, independently of the division that produces the cash flow. On the other hand, abstracting from monetary incentives, the less profitable division would exert a lower effort. To compensate for the reduced incentives, a higher wage is paid to the manager of division 2.

Another interesting comparison is between the wage paid in the stand-alone case and the ICM case. We have:

**Lemma 1** *The optimal wage paid to division managers is always more high-powered in an internal capital market than in the stand-alone case, that is* $w_i^{ICM} \geq w_i^{SA}$.

The intuition is the following: In the ICM case division managers have reduced non-monetary incentives with respect to the SA case, so that it is necessary to provide stronger monetary incentives in order to achieve the same level of effort. Moreover, the marginal value of effort is higher when an internal capital market is active, because of the possibility of winner-picking. Both arguments lead to the conclusion that wages are higher in the ICM case.

We can now compare managers' effort in the SA case and in the ICM case. A priori the result is not obvious. On one hand, the SA form provides stronger non-monetary incentives for effort. On the other hand, Lemma 1 shows that monetary incentives are stronger in the ICM case. The answer is provided in the following:

**Lemma 2** $e_i^{ICM} \geq e_i^{SA}$ *if and only if* $\Delta \geq \phi \underline{R}$.

When the value created by winner picking is high ($\Delta$ is high) headquarters offers division managers a high-powered compensation scheme that induces a high level of effort. Also, when private benefits are small ($\phi$ small) managerial incentives derive mostly from monetary compensation, which is higher in the ICM case.

The most important issue is the relative value of the stand-alone case *vis-à-vis* the internal capital market. Substituting $e_i = \frac{w_i + \phi p_i (\underline{R} + \Delta)}{k}$ in the profit function we have:

$$\Pi^{ICM} = \frac{1}{k}\left[\left((\underline{R} + \Delta)\frac{1+\phi p}{2}\right)^2 + \left((\underline{R} + \Delta)\frac{1+\phi(1-p)}{2}\right)^2\right]$$

Comparing this expression with $\Pi^{SA}$ we have the following:

**Proposition 2** *a) there is a value $\Delta^*$ such that $\Pi^{ICM} \geq \Pi^{SA}$ if and only if $\Delta > \Delta^*$. b) The difference $\Pi^{ICM} - \Pi^{SA}$ decreases in $p$ over the range $\left(\frac{1}{2}, 1\right)$ if $\Delta > \phi\underline{R}$, and increases otherwise.*

Only when the expected value of winner-picking is sufficiently high an internal capital market is superior to the stand-alone case. Otherwise the adverse affect on incentives of the reallocation of corporate resources is the dominant effect and the value of the conglomerate is less than the sum of the stand-alone values of the two divisions. Therefore, the basic result of the previous section still holds: The ICM form is superior when $\Delta$ is large, and the SA form is superior when $\Delta$ is small.

When we look at the impact of asymmetry on the comparative advantage of the ICM form, the results are qualitatively the same as in the case of no monetary incentives when $\Delta > \phi\underline{R}$, that is an increase in asymmetry decreases the advantage of the ICM form. However, the opposite is true when $\Delta < \phi\underline{R}$ (obviously, under the maintained assumption $p > \frac{1}{2}$).

To understand better why it is so, first notice that in the ICM case we have:

$$e_1^{ICM} + e_2^{ICM} = \frac{1}{k}\left(1 + \frac{1}{2}\phi\right)(R + \Delta)$$

which is independent of $p$. Therefore, $(R + \Delta)\left(e_1^{ICM} + e_2^{ICM}\right)$ is constant with respect to $p$ in the ICM case, and any variation must come from the expected salary payment, $e_1^{ICM} w_1^{ICM} + e_2^{ICM} w_2^{ICM}$. When $p$ increases, the expected wage bill decreases. The reason is that an increase in $p$ increases non-monetary incentives in division 1, and decreases non-monetary incentives in division 2. The optimal response by headquarters is to decrease $w_1^{ICM}$ and increase $w_2^{ICM}$, maintaining the sum $w_1^{ICM} + w_2^{ICM}$ constant. As a consequence of the changes in non-monetary and monetary incentives, $e_1^{ICM}$ increases and $e_2^{ICM}$ decreases, while the sum $e_1^{ICM} + e_2^{ICM}$ remains constant. This in turn implies that the low salary $w_1^{ICM}$ is paid more often, and the high salary $w_2^{ICM}$ is paid less often. The expected payment $e_1^{ICM} w_1^{ICM} + e_2^{ICM} w_2^{ICM}$ therefore decreases. Since $(\underline{R} + \Delta)\left(e_1^{ICM} + e_2^{ICM}\right)$ remains constant, $\Pi^{ICM}$ increases. In fact we have.

$$\frac{\partial \Pi^{ICM}}{\partial p} = \frac{1}{2k} \left(\underline{R} + \Delta\right)^2 \phi^2 \left(2p - 1\right)$$

Consider now the SA case. We know that, differently from $w_i^{ICM}$, an increase in $p_i$ increases $w_i^{SA}$. Since $e_i^{SA}$ is also increasing in $p_i$, an opposite effect respect to the ICM case is at work: now the higher salary is paid more often, so that the total wage bill increases. However, we also have a positive effect, since cash ends up more frequently in the division with the higher return. The sum of the two effects must be positive, since headquarters would not optimally choose to pay a higher expected salary if this did not produce a higher profit. In fact we have:

$$\frac{\partial \Pi^{SA}}{\partial p} = \frac{1}{2k} \left(1 + \phi\right)^2 \Delta^2 \left(2p - 1\right)$$

Let us now compare the two derivatives. Consider first the extreme case in which $\phi = 0$, so that the condition $\Delta > \phi \underline{R}$ is always satisfied. In this case the ICM form is insensitive to $p$. The only incentives are monetary, and funds are always allocated to their best use. Furthermore, if $\phi = 0$ effort and salary are the same in both divisions. Things are different for the SA form. Again, incentives are only monetary, but now headquarters optimally choose a higher salary for the division with the higher $p$ and a lower salary for the the other division. The total quantity of effort remains constant, but now more effort is produced in the high-return division. This increases the value of $\Pi^{SA}$, since it is now more likely that funds obtain a high return. Therefore, the comparative advantage of the SA form vs. the ICM increases when $p$ increases. When $\phi$ is sufficiently small a similar effect is at work.

Consider next the other extreme case in which $\Delta$ is very close to 0, so that the condition $\Delta < \phi \underline{R}$ is always satisfied. In this case a change in $p$ has basically no impact on $\Pi^{SA}$, since the optimal amounts of salary and effort remain the same in both divisions. At the same time, it remains true that $\Pi^{ICM}$ increases because of the reduction in the wage bill. Therefore, in this case it is the ICM form that increases its comparative advantage when $p$ increases.

# 4 Applications

In this section we extend the basic model in two directions. First, we analyze the case in which a division is larger than the other (or it has a higher profitability at time 0). We show that the problem of managerial incentives is more severe when a division which is large and mature (a cash cow) is combined with a smaller but more rapidly growing division (a rising star). Second, we study the case in which the headquarters can commit to leave to each division a fraction of the cash flow produced, thereby limiting the scope of 'winner-picking'. We show that it may be optimal to let the divisions retain a fraction of their cash flow and we characterize the optimal retention rules. In both cases we go back to the basic model and we ignore for simplicity monetary incentives.

## 4.1 Cash Cows and Rising Stars

We now investigate how asymmetries in divisions' size impact on the conglomerate discount. More precisely, we are interested in the following question. Assume that division 1 in period 1 is more profitable than division 2, in the sense that it produces a higher expected cash flow. Does this asymmetry in size affect the conglomerate discount? And in which direction?

Assume that division 1 has assets in place that produce a cash flow equal to $C > 1$ with probability $e_1$, where $e_1$ denotes as before the effort exerted by the manager of division 1, and a cash flow equal to 0 otherwise. The case $C = 1$ is the one we have analyzed in section 3. If $p > \frac{1}{2}$ then division 1 produces a higher expected cash flow for a given amount of managerial effort than division 2 and it also has better investment opportunities. Instead, if $p < \frac{1}{2}$ then division 1 is a 'cash cow' and division 2 a 'rising star'.

As usual, consider first the stand-alone case. The problem of $M_1$ at time zero is:

$$\max_{e_1} \ \phi\left(\underline{R} + p\Delta\right) C e_1 - k\frac{e_1^2}{2}$$

The necessary and sufficient condition for a maximum is:

$$e_1^{SA} = \frac{\phi\left(\underline{R} + p\Delta\right) C}{k}$$

We will consider values of $C$ such that $\frac{(\underline{R}+\Delta)C}{k} < 1$, so that the solution is always interior.

The problem for division 2 is unchanged and thus

$$e_2^{SA} = \frac{\phi \left(\underline{R} + (1-p)\Delta\right)}{k}$$

The expected cash flow produced in the stand-alone case is

$$e_1^{SA}C + e_2^{SA} = \frac{\phi}{k}\left[\left(\underline{R} + p\Delta\right)C^2 + \underline{R} + (1-p)\Delta\right]$$

The sum of the expected profit for the two divisions under the stand alone solution is given by:

$$\begin{aligned} \Pi^{SA} &= \left(\underline{R} + p\Delta\right)Ce_1^{SA} + \left(\underline{R} + (1-p)\,\Delta\right)e_2^{SA} = \\ &= \frac{\phi}{k}\left\{\left[\underline{R} + p\Delta\right]^2 C^2 + \left[\underline{R} + (1-p)\Delta\right]^2\right\} \end{aligned}$$

Notice that both total cash flow and the sum of profits are increasing in $C$.

Consider now the pure ICM case. Division 1 faces a probability $1-p$ of having zero funds and a probability $p$ of having all funds. The problem for $M_1$ is therefore:

$$\max_{e_1} \qquad \phi p \left(\underline{R} + \Delta\right)\left(e_1 C + e_2\right) - k\frac{e_1^2}{2}$$

and the necessary and sufficient condition for a maximum is:

$$e_1^{ICM} = \frac{\phi}{k} p \left(\underline{R} + \Delta\right) C$$

The problem of division 2 is unchanged and thus:

$$e_2^{ICM} = \frac{\phi}{k}(1-p)\left(\underline{R} + \Delta\right)$$

The total expected cash flow produced in the ICM case is

$$e_1^{ICM}C + e_2^{ICM} = \frac{\phi}{k}\left(\underline{R} + \Delta\right)\left[pC^2 + (1-p)\right]$$

The expected profit for headquarters is given by:

$$\begin{aligned} \Pi^{ICM} &= \left(\underline{R} + \Delta\right)\left(e_1^{ICM}C + e_2^{ICM}\right) = \\ &= \frac{\phi}{k}\left(\underline{R} + \Delta\right)^2\left[pC^2 + (1-p)\right] \end{aligned}$$

Note that also in the ICM case both the total expected cash flow produced and expected profits are increasing in $C$ since the effort of the manager of division 1 is increased without affecting the effort of the manager of division 2. More in general, when $C$ increases both $\Pi^{ICM}$ and $\Pi^{SA}$ increase, since a higher $C$ is equivalent to a better technology.

We can now address the question of the impact of differences in $C$ on the conglomerate discount. Following the analysis of section 3, the difference in profit between the ICM case and the SA case can be written as:

$$\Pi^{ICM} - \Pi^{SA} = \Delta \left[ (1-p)\, e_1^{ICM} C + p e_2^{ICM} \right]$$

$$-\left(\underline{R} + p\Delta\right)\left(e_1^{SA}C - e_1^{ICM}C\right) - \left(\underline{R} + (1-p)\Delta\right)\left(e_2^{SA} - e_2^{ICM}\right)$$

Differentiating with respect to $C$ we obtain:

$$\frac{d(\Pi^{ICM} - \Pi^{SA})}{dC} = (1-p)\,\Delta \frac{\partial \left[e_1^{ICM}C\right]}{\partial C} - \left(\underline{R} + p\Delta\right)\frac{\partial \left[e_1^{SA}C - e_1^{ICM}C\right]}{\partial C}$$

This expression can be interpreted as follows. When we look at the difference between $\Pi^{ICM}$ and $\Pi^{SA}$ we have to remember that there are two main components: The 'winner-picking' part and the 'incentive-reduction' part.

The first component is given by the first term, and it favors the ICM form when $C$ increases. We have:

$$\frac{\partial \left[e_1^{ICM}C\right]}{\partial C} = 2\frac{\phi}{k} p \left(\underline{R} + \Delta\right) C > 0$$

that is, the expected cash flow of the first division increases when $C$ increases. This increased cash flow is used more efficiently when division 2 is more profitable, which happens with probability $1-p$, and in such cases profit increases by an amount $\Delta$. Notice that the magnitude of $\frac{\partial\left[e_1^{ICM}C\right]}{\partial C}$ depends on $p$. In particular, the lower the probability of receiving funds, the weaker is the effect of an increased $C$ on the expected cash flow.

The second term represents the incentive-reduction component. Using the formulas for $e_1^{SA}$ and $e_1^{ICM}$ we have:

$$e_1^{SA}C - e_1^{ICM}C = \frac{\phi}{k}\,(1-p)\,\underline{R}C^2$$

so that:

$$\frac{\partial \left[e_1^{SA}C - e_1^{ICM}C\right]}{\partial C} = 2\frac{\phi}{k}\,(1-p)\,\underline{R}C$$

As $C$ increases, the incentive effect becomes stronger. The expected cash flow grows under both regimes, but it increases more under the stand alone form: When division 1 becomes larger the difference between the cash flow produced under the SA form and under the ICM form is more pronounced. This is a consequence of the fact that effort depends linearly on $C$. Notice also that the difference $e_1^{SA}C - e_1^{ICM}C$ is higher when $p$ is smaller.

Intuitively, an increase in $C$ should give a comparative advantage to the ICM form when the winner picking effect is stronger, which happens when $\Delta$ is large. Furthermore, when $p$ is low an increase in $C$ has a weak effect on $e_1^{ICM}$, and a stronger effect on incentive reduction, that is the difference $e_1^{SA}C - e_1^{ICM}C$. In fact we have the following result.

**Proposition 3** *The difference* $\Pi^{ICM} - \Pi^{SA}$ *is increasing in* $C$ *if* $p\Delta^2 > \underline{R}^2$*, and decreasing otherwise.*

The result implies that the ICM form is more likely to be disadvantageous when a 'cash cow' and a 'rising star' are put together. In this case $p$ is small, since the division with the higher cash flow is the one with the worst investment opportunities. Thus, we are likely to have $p\Delta^2 < \underline{R}^2$, and an increase in asymmetry reduces the comparative advantage of the ICM form vs. the SA form. Other things equal, we should therefore observe on average a higher conglomerate discount when divisions are asymmetric in current profitability and growth prospects, with the divisions having more cash also being the ones with poorer growth prospects.

### 4.2 Optimal Reallocation Rules

We pointed out in the previous section that the pure ICM case is the result of the inability to commit on the part of headquarters. Such assumption is probably extreme. In general the organizational structure can be harnessed in a way that makes (at least partial) commitment not to interfere possible. For example, headquarters may decide that only investment projects of a certain size need superior approval, allowing divisions to spend their own cash on projects of smaller size. This would result in giving real authority to divisional managers over a part of the cash flow they generate.

In this section we ignore the exact microeconomic mechanism through which commitment is attained, and we simply assume that headquarters can decide the fraction of funds that each divisional manager is allowed to retain and automatically reinvest in the division.

Allowing divisions to retain a fraction of their cash flow has costs and benefits for the headquarters. On the one hand, the funds retained by the division may be reinvested in a suboptimal project from the headquarters point of view (less 'winner-picking'); on the other hand, retaining funds boosts managerial initiative. The optimal degree of intervention optimally balances these two contrasting effects. For simplicity we abstract again from monetary incentives and we go back to the case where managers are motivated only by private benefits. We assume $p > \frac{1}{2}$, so that the first division is *ex ante* more profitable. We denote by $\gamma_i$ the share of its cash flow $C_i$ retained by division $i$,[13] so that in each period a total amount of cash $(1-\gamma_1)\,C_1 + (1-\gamma_2)\,C_2$ can be reallocated by the headquarters to the division with the highest expected return. The manager of division $i$ maximizes:

$$\phi\left\{\gamma_i e_i\left[\underline{R}+p_i\Delta\right]+p_i\left(\underline{R}+\Delta\right)\left[(1-\gamma_i)e_i+(1-\gamma_{3-i})e_{3-i}^{*}\right]\right\}-k\frac{e_i^2}{2}$$

so that the FOC for division $i$ is:

$$e_i=\frac{\phi}{k}\left[p_i\left(\underline{R}+\Delta\right)+\left(1-p_i\right)\gamma_i\underline{R}\right]. \tag{5}$$

We denote by $e_i\left(\gamma_i\right)$ the unique solution to this equation.

We start our analysis from the following simple observation.

**Lemma 3** *Suppose that $H$ wants to implement the same level of effort $e^* = e_1 = e_2$ in the two divisions, and let $\bar{\gamma}_1$ and $\bar{\gamma}_2$ be the two levels of fund retention that attain this goal. Then $\bar{\gamma}_1 < \bar{\gamma}_2$.*

The proposition states that whenever the same level of effort is required in the two divisions, then the *less* profitable division is allowed to retain a *higher* share of its own cash flow. The intuition is the following: due to the reallocation of funds operated by headquarters, it is harder to motivate the manager of the less profitable division, since she anticipates a higher probability that funds will be allocated to the other division. Thus, in order to extract a given amount of effort, it is necessary to allow managers of less profitable divisions to retain and have discretion over a larger fraction of their cash flow.

[13] Although the cash flow of each firm can be either 0 or 1, our retention rule is not the most general one, since we do not allow conditioning $\gamma_i$ to the realizaton of the cash flow of division $-i$.

Notice however that in general it will be optimal for headquarters to implement different levels of effort between the two divisions. In particular, eliciting effort from the second division is more costly than eliciting effort from the first division, since a greater share of funds has to be diverted to the less productive division (in expected value), and this leads to a decrease in the amount of effort which is optimal to require to the less profitable division. This in turn reduces the share of funds necessary to implement the desired level of effort. Depending on which one of the two effects prevails, the share of funds assigned to the less profitable division may be higher or lower than the share assigned to the more profitable division.

The problem can be formally addressed as follows. headquarters' expected profit can now be written as:

$$\begin{aligned}\Pi(\gamma_1,\gamma_2) &= p\left[\left(e_1(\gamma_1)+(1-\gamma_2)\,e_2(\gamma_2)\right)(\underline{R}+\Delta)+\gamma_2 e_2(\gamma_2)\,\underline{R}\right] \\ &\quad +(1-p)\left[\gamma_1 e_1(\gamma_1)\,\underline{R}+\left(e_2(\gamma_2)+(1-\gamma_1)\,e_1(\gamma_1)\right)(\underline{R}+\Delta)\right]\end{aligned}$$

The problem is therefore:

$$\max_{\gamma_1\in[0,1],\gamma_2\in[0,1]} \Pi(\gamma_1,\gamma_2).$$

Using the expressions for $e_1(\gamma_1)$ and $e_2(\gamma_2)$ given by (5) and considering values of the parameters for which an interior solution exists, we have that the unique solution is given by:

$$\gamma_1^* = \frac{(\underline{R}+\Delta)(\underline{R}-p\Delta)}{2(1-p)\Delta\underline{R}}$$

$$\gamma_2^* = \frac{(\underline{R}+\Delta)(\underline{R}-(1-p)\Delta)}{2p\Delta\underline{R}}$$

whenever the parameters are such that $\gamma_i^* \in (0,1)$. If $\frac{(\underline{R}+\Delta)(\underline{R}-p_i\Delta)}{2(1-p_i)\Delta\underline{R}} \geq 1$ then the solution is $\gamma_i^* = 1$, and if $\frac{(\underline{R}+\Delta)(\underline{R}-p_i\Delta)}{2(1-p_i)\Delta\underline{R}} \leq 0$ then the solution is $\gamma_i^* = 0$.

More generally, observe that the optimal fraction $\gamma_i^*$ for a division having probability $p_i$ of being the most profitable one can be written as:

$$\gamma^*(p_i) = \frac{(\underline{R}+\Delta)(\underline{R}-p_i\Delta)}{2(1-p_i)\Delta\underline{R}}$$

Note that $\gamma^*(p_i)$ can be strictly positive, that is it can be optimal to allow divisions to retain a fraction of the cash flow they have produced. This result sheds a different light on the findings of Shin and Stulz (1998). They show that the allocation of funds does not only depend on the investment opportunities, but also on the cash flow generated by each division. More precisely, the funds allocated to a division are more sensitive to the division's cash flow than to other divisions' cash flow. This is consistent with the finding of our model. Suppose the cash flow of division $i$ is increased by one dollar. Then the investment of division $i$ will be increased by $\gamma_i^* + (1 - \gamma_i^*)p_i$. Each division is allowed to retain a fraction $\gamma_i^*$ of its cash flow. The remaining fraction $(1 - \gamma_i^*)$ will be allocated to division $i$ only when it has the most profitable investment opportunity, i.e. with probability $p_i$. Suppose now the cash flow of division $j$ is increased by one dollar. Then the investment of division $i$ will be increased by $p_i(1 - \gamma_j^*)$. Division $i$ will capture a fraction $(1 - \gamma_j^*)$ of the cash flow of division $j$ only when its investment opportunity is the most profitable. It is easy to note that

$$\gamma_i^* + (1 - \gamma_i^*)p_i > p_i(1 - \gamma_j^*)$$

whenever $\gamma_i^* > 0$ and/or $\gamma_j^* > 0$ and $p_i > 0$. Shin and Stulz (1998) interpret the higher sensitivity of a division's investment to its cash flow than to other divisions' cash flow as evidence that funds are not allocated efficiently in an internal capital market.[14] According to our model, this higher sensitivity is consistent with the use of an optimal cash flow redistribution policy by the headquarters.

The general form of $\gamma^*(p_i)$ is the following. Take $\underline{R}$ as given. When the *ex post* difference in profitability in the second period is small ($\Delta$ is small) the gain from reallocation is limited. It is therefore optimal to provide the highest possible incentives ($\gamma^* = 1$). As $\Delta$ increases the gains from reallocation become large. At some point $\Delta^*$ the gains from reallocation become too large, so it is optimal to sacrifice incentives' provision. We therefore enter an intermediate range in which there is only a partial internal capital market: a fraction of the cash flow is left to the division that has produced it, in order to boost managerial effort. When the difference in *ex-post* profitability is very high ($p_i\Delta \geq \underline{R}$ for each $i$) a pure internal capital market is optimal ($\gamma_1^* = \gamma_2^* = 0$).

Take now $\Delta$ as given. When $\underline{R}$ is close to zero, it is very costly to allow a division to retain funds. Therefore, the optimal policy will be to set $\gamma^*(p_i) = 0$. As $\underline{R}$ increases it becomes less costly to provide incentives

[14] Whited (2001) has challenged Shin and Stulz (1998)'s results arguing that they may be caused by measurement errors.

through fund retention, so that eventually $\gamma^* (p_i)$ becomes positive. At last, for $\underline{R}$ sufficiently high the comparative advantage of winner picking is so low that a conglomerate firm prefers to concentrate on providing incentives, setting $\gamma^* (p_i) = 1$. We collect the general properties of $\gamma^* (p_i)$ in the following lemma.

**Lemma 4** *The fraction $\gamma^* (p_i)$ is decreasing in $\Delta$ and increasing in $\underline{R}$.*

When $\Delta$ increases the benefits of winner picking are greater, since allocating funds to the more profitable division yields a higher return. This lowers the optimal level of $\gamma^*$. There is no countervailing effect, since the way in which the level of effort depends on $\gamma^*$ is independent of $\Delta$. In fact, the difference between the level of effort exercised at $\overline{\gamma}$ and at $\underline{\gamma}$ is:

$$e_i (\overline{\gamma}) - e_i \left(\underline{\gamma}\right) = \frac{\phi}{k} (1 - p_i) \left(\overline{\gamma} - \underline{\gamma}\right) \underline{R}$$

and it is therefore independent of $\Delta$. This implies that the cost of decreasing $\gamma$ is not affected by an increase in $\Delta$. The net effect if therefore that a higher $\Delta$ makes a lower $\gamma$ optimal.

An increase in $\underline{R}$ increases by the same amount the profitability of both retained and reallocated funds. It therefore makes the capital generated more productive, independently of its allocation. This in turn implies that it becomes convenient to increase the quantity of funds generated. The only way to achieve this is by increasing the fraction of funds retained. This explains why $\gamma^*$ depends positively on $\underline{R}$.

We now come to the question of how $\gamma^*$ depends on $p_i$, the probability of success of the division.

In general, there is a tension between two forces. Suppose headquarters wants to generate one (expected) extra unit of cash from the divisions. In order to do that, it has to increase the share retained by the divisions, which in this model is the only way to generate more funds in the first period. Which division should be allowed to retain more funds? Increasing the share retained by the more profitable division is better because any dollar remaining in the division obtains a higher return. On the other hand, we have:

$$\frac{\partial e}{\partial \gamma} = \frac{\phi}{k} (1 - p_i) \underline{R}.$$

so that an increase in $\gamma$ is less effective in generating more funds when $p_i$ is high. Providing incentives through fund retention is more effective in divisions with *ex ante* low profitability, since these divisions are more likely not to be the winner in the next period, and therefore have a lower probability of seeing again any dollar taken away for reallocation.

We can now finally analyze the impact of $p_i$ on $\gamma^* (p_i)$.

**Proposition 4** *The fraction $\gamma^* (p_i)$ is decreasing in $p_i$ if $\Delta > \underline{R}$, and it is increasing in $p_i$ otherwise.*

We can therefore detect two different regimes. When $\Delta$ is low and $\underline{R}$ is high then the fractions $\gamma_1^*$ and $\gamma_2^*$ of retained funds will be high, and the most profitable divisions will be allowed to retain a higher fraction of funds. These are situations in which 'winner picking' does not add much value to the firm, so incentive provision is the relevant issue. In this cases we also observe that the fraction of funds retained by the more profitable division is higher. The intuition of why it should be so comes from lemma 4: As $\underline{R}$ increases, it is optimal to increase more the fraction $\gamma$ of the most profitable division, since each dollar put in the more profitable division has a higher return.

The second regime is the one in which the condition $\Delta > \underline{R}$ is satisfied. In this case winner picking is profitable, and the divisions are allowed to retain only a small fraction of funds, if any. However, it is the less profitable division which is allowed to retain more. Again, we can look at lemma 4 for intuition. As $\Delta$ increases the fraction of retained funds decreases for all divisions, but it is the most profitable division which suffers the highest reduction. An increase in $\Delta$ provides incentives for the divisions, since we have $\frac{\partial e_i}{\partial \Delta} = \frac{\phi}{k} p_i$. This occurs because divisional managers recognize that any dollar generated for investment will have a higher payout, and so exercise more effort. From the point of view of headquarters, this means that a lower level of $\gamma_i$ is necessary to extract a given level of effort, so the optimal level of fund retention decreases. The decrease is stronger in divisions with a high $p_i$, since in such divisions the increase in $\Delta$ has a stronger impact on $e_i$.

One empirical implication of Proposition 4 is that there should be a correlation between the general level of fund retention and the (apparent) misallocation of funds. Conglomerate firms that allow high levels of fund retention will also allow more retention by the *ex ante* more profitable divisions. On the other hand, conglomerate firms that allow for low levels of fund retention are more likely to permit a higher retention rate to divisions with poorer prospects.

# 5 Conclusions

This paper has argued that one of the distinctive features of internal capital markets, that is the ability of headquarters to reallocate funds across divisions (winner-picking) is associated both with costs and benefits. The benefits derive from transferring funds to the most profitable divisions; the costs derive from the weakening of managerial incentives. In other words, winner-picking is simultaneously the dark and the bright side of internal capital markets. Our theory can explain why conglomerate firms trade at a discount (or at a premium) with respect to their focused counterparts. More importantly, it does so without assuming any inefficiency in the allocation of corporate resources. We show that *ex ante* diversity in divisions' profitability increases the inefficiency of an internal capital market, confirming the findings of Rajan *et al.* (2000). Furthermore, an implication of our model is that allowing divisions to retain a fraction of the cash flow they have produced irrespective of their investment opportunities can be an optimal policy for the headquarters since it leads to a better balance between the two conflicting goals of allocating optimally *ex post* corporate resources and providing managers with adequate *ex ante* incentives to perform. Allowing divisions to spend discretionary a fraction of their cash flow is a way of delegating real authority to division manager. As we know from Aghion and Tirole (1997), the gains of delegation in terms of boosted managerial initiative can more than compensate the loss in control of headquarters.

An important *caveat* is that we have not addressed the reasons why divisions that are very different in terms of their profitability are brought together in the same firm and why some divisions are not spun-off in those circumstances where conglomerates are inefficient. Moreover, we have assumed that all resources are internally generated, ignoring the role of external financing. These limitations notwithstanding, we believe that the analysis of internal capital markets in terms of allocation of delegation of authority may be a promising direction for future research.

# Appendix

**Proof of Proposition 1.** Using the expression for $\Pi^{ICM} - \Pi^{SA}$ given by (3) and the expressions for $e_i^{SA}$, $e_i^{ICM}$ given by (1) and (2) we obtain:

$$\begin{aligned}\Pi^{ICM} - \Pi^{SA} &= \frac{\phi}{k}\left(\underline{R}+\Delta\right)^2 - \frac{\phi}{k}\left[(\underline{R}+p\Delta)^2 + (\underline{R}+(1-p)\Delta)^2\right] = \\ &\quad \frac{\phi}{k}\left[2p\left(1-p\right)\Delta^2 - \underline{R}^2\right]\end{aligned}$$

This is a strictly increasing function of $\Delta$ and a strictly decreasing function of $\underline{R}$. For a given pair $\underline{R}$, $\Delta$ the function reaches a maximum at $p = \frac{1}{2}$ and is decreasing in $p$ for $p > \frac{1}{2}$. ■

**Proof of Lemma 1.** The condition $w_i^{ICM} > w_i^{SA}$ is equivalent to:

$$\frac{1-\phi p_i}{2}\left(\underline{R}+\Delta\right) > \frac{1-\phi}{2}\left(\underline{R}+p_i\Delta\right)$$

or, after simplifications,

$$\left(\Delta + \phi\underline{R}\right)\left(1-p_i\right) \geq 0$$

which is always satisfied. ■

**Proof of Lemma 2.** Substituting for the expressions found for the optimal wage, we have:

$$e_i^{ICM} = \frac{(1+\phi p_i)(\underline{R}+\Delta)}{2k}.$$

Comparing it with expression of $e_i^{SA}$ given by (4) yields the result after some easy manipulations. ■

**Proof of Proposition 2.** Define the ratio:

$$\frac{\Pi^{ICM}\left(\Delta,p\right)}{\Pi^{SA}\left(\Delta,p\right)} = \frac{\left(\left(\underline{R}+\Delta\right)\frac{1+\phi p}{2}\right)^2 + \left(\left(\underline{R}+\Delta\right)\frac{1+\phi(1-p)}{2}\right)^2}{\left(\frac{(1+\phi)(\underline{R}+p\Delta)}{2}\right)^2 + \left(\frac{(1+\phi)(\underline{R}+(1-p)\Delta)}{2}\right)^2}$$

Consider point a). Direct computation shows that, for each $p$:

$$\frac{\Pi^{ICM}\left(0,p\right)}{\Pi^{SA}\left(0,p\right)} < 1 \qquad\qquad \lim_{\Delta\to+\infty}\frac{\Pi^{ICM}\left(\Delta,p\right)}{\Pi^{SA}\left(\Delta,p\right)} > 1$$

and:

$$\frac{\partial \frac{\Pi^{ICM}(\Delta,p)}{\Pi^{SA}(\Delta,p)}}{\partial \Delta} > 0$$

thus establishing the result.

Next, consider point b). Using the expressions for $\Pi^{ICM}$ and $\Pi^{SA}$ given in the text we have:

$$\frac{\partial \left(\Pi^{ICM} - \Pi^{SA}\right)}{\partial p} = \frac{(\Delta + 2\Delta\phi + \phi R)(\phi R - \Delta)(2p-1)}{2k}$$

If $p > \frac{1}{2}$ then the sign of the derivative is equal to the sign of $(\phi R - \Delta)$, thus establishing the result. ■

**Proof of Proposition 3.** By direct computation we have:

$$\frac{d(\Pi^{ICM} - \Pi^{SA})}{dC} = 2\frac{\phi}{k}(1-p)\left(p\Delta^2 - \underline{R}^2\right) C$$

so that the difference $\Pi^{ICM} - \Pi^{SA}$ increases with $C$ when $p\Delta^2 > \underline{R}^2$ and decreases otherwise. ■

**Proof of Lemma 3.** By equating the two right hand sides of the two first order conditions, we have:

$$p(\underline{R} + \Delta) + (1-p)\,\bar{\gamma}_1\,\underline{R} = (1-p)(\underline{R} + \Delta) + p\,\bar{\gamma}_2\,\underline{R}$$

so that:

$$\bar{\gamma}_2 = \left(\frac{2p-1}{p}\right)\frac{(\underline{R} + \Delta)}{\underline{R}} + \frac{(1-p)}{p}\,\bar{\gamma}_1\ .$$

The condition $\bar{\gamma}_2 > \bar{\gamma}_1$ is equivalent to:

$$\left(\frac{2p-1}{p}\right)\frac{(\underline{R} + \Delta)}{\underline{R}} + \frac{(1-p)}{p}\,\bar{\gamma}_1 > \bar{\gamma}_1$$

or:

$$\frac{(\underline{R} + \Delta)}{\underline{R}} > \bar{\gamma}_1$$

which is always satisfied since we have restricted attention to $\gamma_1 \in [0,1]$. ■

**Proof of Lemma 4.** Let $\Delta^*$ be the value of $\Delta$ such that:

$$\frac{(\underline{R} + \Delta^*)(\underline{R} - p_i\Delta^*)}{2(1-p_i)\Delta^*\underline{R}} = 1$$

and let $\Delta^{**}$ be the value of $\Delta$ such that:

$$\frac{\left(\underline{R}+\Delta^{**}\right)\left(\underline{R}-p_i\Delta^{**}\right)}{2\left(1-p_i\right)\Delta^{**}\underline{R}}=0$$

Then $\gamma^*\left(p_i\right)=1$ for $\Delta\leq\Delta^*$ and $\gamma^*\left(p_i\right)=0$ for $\Delta\geq\Delta^{**}$, so that the function is constant. If $\Delta\in\left(\Delta^*,\Delta^{**}\right)$ then $\gamma^*\left(p_i\right)$ is given by:

$$\gamma^*\left(p_i\right)=\frac{\left(\underline{R}+\Delta\right)\left(\underline{R}-p_i\Delta\right)}{2\left(1-p_i\right)\Delta\underline{R}}$$

so that:

$$\frac{\partial\gamma^*}{\partial\Delta}=-\frac{1}{2}\frac{p_i\Delta^2+\underline{R}^2}{\left(1-p_i\right)\Delta^2\underline{R}}<0.$$

To prove that $\gamma^*\left(p_i\right)$ is increasing $\underline{R}$, let $\underline{R}^*$ be the value such that:

$$\frac{\left(\underline{R}^*+\Delta\right)\left(\underline{R}^*-p_i\Delta\right)}{2\left(1-p_i\right)\Delta\underline{R}^*}=0$$

and $\underline{R}^{**}$ the value such that:

$$\frac{\left(\underline{R}^{**}+\Delta\right)\left(\underline{R}^{**}-p_i\Delta\right)}{2\left(1-p_i\right)\Delta\underline{R}^{**}}=1$$

For $\underline{R}\leq\underline{R}^*$ we have $\gamma^*\left(p_i\right)=0$, and for $\underline{R}\geq\underline{R}^{**}$ we have $\gamma^*\left(p_i\right)=1$. If $\underline{R}\in\left(\underline{R}^*,\underline{R}^{**}\right)$ then: $\frac{\partial\gamma^*}{\partial\underline{R}}=\frac{1}{2}\frac{\underline{R}^2+\Delta^2p_i}{\left(1-p_i\right)\Delta\underline{R}^2}>0.$ ■

**Proof of Proposition 4.** When $\gamma$ is constant then $\frac{\partial\gamma}{\partial p_i}=0$. In the region in which $\gamma\left(p_i\right)\in(0,1)$ we have:

$$\frac{\partial\gamma}{\partial p_i}=\frac{1}{2}\frac{\left(\underline{R}^2-\Delta^2\right)}{\left(1-p_i\right)^2\Delta\underline{R}}$$

so that the sign of is equal $\frac{\partial\gamma}{\partial p_i}$ is equal to the sign of $\left(\underline{R}-\Delta\right)$. ■

## References


[1] Aghion, Philippe and Jean Tirole (1997) 'Formal and Real Authority in Organizations', *Journal of Political Economy*, **105**(1): 1-29.

[2] Berger, Philip and Eli Ofek (1995) 'Diversification's Effect on Firm Value', *Journal of Financial Economics*, **37**(1): 39-65.

[3] Brusco, Sandro and Fausto Panunzi (2000) 'Reallocation of Corporate Resources and Managerial Incentives in Internal Capital Markets', Financial Markets Group D.P. 353.

[4] Campa, José and Simi Kedia (1999) 'Explaining the Diversification Discount', mimeo, New York University and Harvard University.

[5] Chevalier, Judith (2000) 'What do We Know about Cross-Subsidization? Evidence from the Investment Policies of Merging Firms', Working paper, University of Chicago.

[6] De Motta, Adolfo (1999) 'Managerial Incentives and Internal Capital Markets', mimeo, MIT.

[7] Fluck, Zsuzsanna and Anthony Lynch (1999) 'Why Do Firms Merge and then Divest? A Theory of Financial Synergy', *Journal of Business*, **72**: 319-346.

[8] Gautier Axel and Florian Heider (2000) 'What Do Internal Capital Markets Do? Redistribution vs. Incentives', mimeo, London School of Economics.

[9] Inderst, Roman and Christian Laux (2000) 'Incentives in Internal Capital Markets: Capital Constraints, Competition and Investment Opportunities', mimeo, University College London.

[10] Inderst, Roman and Holger Müller (2001) 'Corporate Borrowing and Financing Constraints', CEPR working paper No 2784.

[11] Lamont, Owen (1997) 'Cash Flow and Investment: Evidence from Internal Capital Markets', *Journal of Finance*, **52**(1): 83-109.

[12] Lins, Karl and Henri Servaes (1999) 'International Evidence on the Value of Corporate Diversification', *Journal of Finance*, **54**(6): 2215-2239.

[13] Maksimovic, Vojislav and Gordon Phillips (2001) 'Do Conglomerate Firms Allocate Resources Inefficiently?', mimeo, University of Maryland.

[14] Rajan, Raghuram, Henri Servaes and Luigi Zingales (2000) 'The Cost of Diversity: The Diversification Discount and Inefficient Investment', *Journal of Finance*, **55**(1): 35-80.

[15] Rotemberg, Julio and Garth Saloner (1994) 'Benefits of Narrow Business Strategies', *American Economic Review*, **84**(5): 1330-1349.

[16] Scharfstein, David (1998), 'The Dark Side of Internal Capital Markets II', NBER Working Paper No. 6352.

[17] Scharfstein, David and Jeremy Stein (2000) 'The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment', *Journal of Finance,* **55** (6): 2537-64.

[18] Servaes, Henri (1996) 'The Value of Diversification During the Conglomerate Merger Wave', *Journal of Finance*, **51** (4): 1201-25.

[19] Shin, Hyun Han and René Stulz (1998) 'Are Internal Capital Markets Efficient?', *Quarterly Journal of Economics*; **113**(2): 531-52.

[20] Stein, Jeremy (1997) 'Internal Capital Markets and the Competition for Corporate Resources', *Journal of Finance*, **52**(1): 111-33.

[21] Stein, Jeremy (2000), 'Information Production and Capital Allocation: Decentralized vs. Hierarchical Firms', mimeo, MIT.

[22] Stein, Jeremy (2001), 'Agency, Information and Corporate Investment', forthcoming, *Handbook of Economics and Finance*, North Holland.

[23] Whited, Toni M. (2001) 'Is It Inefficient Investment that Causes the Diversification Discount?', *Journal of Finance*, **56**(5): 1667-91.