Incentives in Internal Capital Markets: Capital Constraints, Competition, and Investment Opportunities

Author(s): Roman Inderst and Christian Laux

Published by: Wiley on behalf of RAND Corporation
Stable URL: http://www.jstor.org/stable/1593762
Accessed: 26-07-2017 17:57 UTC

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at http://about.jstor.org/terms

RAND Corporation, Wiley are collaborating with JSTOR to digitize, preserve and extend access to The RAND Journal of Economics
Incentives in internal capital markets: capital constraints, competition, and investment opportunities

Roman Inderst*
and
Christian Laux**

We examine the effect of competition for scarce corporate financial resources on managers’ incentives to generate profitable investment opportunities. Operating an active internal capital market is unambiguously beneficial only if divisions have the same level of financial resources and the same investment potential. Otherwise, managers’ incentives may be lower and an internal capital market may decrease firm value even though headquarters allocates capital efficiently. We analyze under which conditions the operation of an internal capital market is more likely to add value, and we derive implications for the boundaries of firms, for a potential conglomerate discount or premium, and for the role of incentive pay for division managers.

1. Introduction

There is ample evidence that large corporations operate an internal capital market, redistributing capital between their divisions (e.g., Lamont, 1997, and Shin and Stulz, 1998). Both the theoretical and the empirical literature focus mainly on the question of whether the operation of an internal capital market improves the allocation of capital over existing investment opportunities. In contrast, this article explores the implications of an internal capital market for the creation of new investment opportunities by self-interested (division) managers. We show that there is potentially a tradeoff between allocative efficiency and incentive provision.

Our main presumption is that when corporate headquarters has control over multiple divisions, it cannot commit ex ante how to allocate capital. Headquarters will engage in “winner picking,” putting scarce resources to their most profitable use. We find that beside increasing allocative efficiency, operating an internal capital market has a profound impact on division managers’ incentives to create profitable investment opportunities.

* INSEAD, LSE, and CEPR; roman.inderst@insead.edu.
** Goethe University Frankfurt and CFS; laux@finance.uni-frankfurt.de.

We are grateful to the Editor, Raymond Deneckere, and two anonymous referees, as well as Mihir Desai, Martin Hellwig, Christian Leuz, Ernst Maug, and Holger Müller for helpful comments. We also thank seminar participants at Bergen, Frankfurt, INSEAD, LSE, Mannheim, Oslo, SITE (Stockholm), Vienna, Zurich, the EEA (2001) and EFA (2002) meetings, and the CEPR Conference “The Firm and Its Stakeholders: The Evolving Role of Corporate Finance” (2001).
If divisions are ex ante homogeneous, i.e., if they generate the same amount of resources and have the same potential to generate new investment opportunities, winner picking unambiguously improves incentives for all division managers. There are two positive effects. First, operating an internal capital market allows the excess funds of one division to be drawn on to increase the investment in other, more-constrained, divisions. This provides additional rewards, as managers prefer to run larger businesses. Second, reallocation of resources need not be confined to excess funds. As further resources are transferred away from underperforming divisions, additional incentives are created by both punishing these divisions and rewarding outperforming ones.

If divisions differ in resources or investment potential, the operation of an internal capital market may, however, reduce incentives for some divisions, creating a tradeoff between greater allocative efficiency over a given set of investment opportunities and the provision of incentives to create profitable opportunities in the first place. The reason is a third effect, which is not present when divisions are homogeneous. If divisions differ in their financial resources or their investment potential, a reallocation of funds from one division to another may take place even if all managers worked hard and succeeded in creating new profitable investment opportunities. In this case, it can be optimal to separately incorporate some divisions (e.g., via a spinoff) in order to increase the sensitivity of capital allocation to the profitability of their own investment opportunities. This is consistent with the finding in Gertner, Powers, and Scharfstein (2002) that, following a spinoff, investment becomes significantly more sensitive to measures of investment opportunities.

We further shed light on the question of which businesses should ultimately be incorporated jointly or separately. We distinguish between more- and less-mature businesses. In a more mature business, managers must have incentives to increase the profitability of a narrow set of opportunities, e.g., by finding ways to streamline production processes. In a less mature business, a manager can create value by opening up new markets or developing new products. Our analysis suggests that separate incorporation (e.g., via a spinoff) may be necessary to adequately motivate managers of less-mature businesses. In contrast, the competition created by an internal capital market may be vital to create incentives for managers of more-mature businesses. We further show that in stark contrast to the case of separate incorporation, tighter financial constraints may increase division managers’ incentives in an internal capital market, though this is more likely to be the case with more-mature businesses. We also discuss the role of capital budgeting mechanisms as a device to precommit to a particular allocation of capital, and we analyze how correlation between divisions’ business prospects affects the potential benefits from joint incorporation.

The article is organized as follows. In Section 2 we discuss the related literature. Section 3 presents the model. In Sections 4 and 5 we derive our main results, comparing incentives under separate and joint incorporation. Section 6 contains a discussion and some robustness results. Section 7 concludes. Proofs are relegated to the Appendix.

2. Related literature

Our assumption that headquarters chooses a profit-maximizing allocation of resources is in line with arguments made by Williamson (1975), Gertner, Scharfstein, and Stein (1994), and Stein (1997). More recently, Scharfstein and Stein (2000) and Rajan, Servaes, and Zingales (2000) have argued that conglomerates may invest inefficiently in underperforming divisions. The evidence on whether internal capital markets allocate resources efficiently or not is mixed. Rajan, Servaes, and Zingales provide evidence of “corporate socialism,” while Khanna and Tice (2001) and Maksimovic and Phillips (2002) document cases where internal capital markets (re)allocate resources efficiently.\footnote{1}

\footnote{1} The extant literature on spinoffs has focused on advantages stemming from a better alignment with shareholders’ interests and a (re)orientation toward core competencies (e.g., Daley, Mehrotra, and Sivakumar, 1997, and Nanda and Narayanan, 1999).

\footnote{2} Billett and Mauer (2000, 2003) provide evidence for both more- and less-efficient allocation in internal capital markets.

© RAND 2005.
Among other studies, Lang and Stulz (1994) and Berger and Ofek (1995) have documented a "conglomerate discount" and linked it to the potential failure of internal capital markets. More recent work, however, casts doubt on the existence of a discount, even though capital is allocated efficiently. Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000) also find that joint incorporation is less likely to create value if divisions are highly different. They argue that headquarters may inefficiently tilt the allocation of resources in favor of less-profitable divisions to mitigate subsequent internal conflicts. Focusing on the creation of investment opportunities, we show that joint incorporation of different divisions can destroy value through its potential negative effect on incentives even though capital is allocated efficiently.

Matsusaka and Nanda (2002) and Inderst and Müller (2003) also explore the relation between internal capital markets and firm boundaries without, however, addressing managerial incentives. Stein (2002) analyzes the incentives of local bank managers to acquire information about new loan opportunities by examining different information regimes. Stein focuses on homogeneous divisions and shows that if information can be shared with headquarters, joint incorporation increases incentives for information acquisition. Taking investment opportunities as given, Brusco and Panunzi (forthcoming) and de Motta (2003) argue that free-riding in an internal capital market can stifle managers' incentives to create cash flow or attract outside funding.

Finally, the assumption that headquarters cannot precommit to a (state-contingent) capital allocation resembles the difficulty of relinquishing formal authority inside an organization in Baker, Gibbons, and Murphy (1999) or between owners and management in Aghion and Tirole (1997). Likewise, Rotemberg and Saloner (1994), Gertner, Scharfstein, and Stein (1994), and Gautier and Heider (2003) show how headquarters' ability to redeploy assets (and managers) inside the organization may create a hold-up problem and stifle incentives.

3. The model

Projects and technologies. Consider a set \( I = \{1, 2, \ldots, n\} \) of projects (or lines of business). Each business is run by a (division) manager, who manages the existing assets and can work on new investment opportunities. The profitability of the investment opportunities of business \( i \) can be either high or low, depending on the project's type \( t_i \in T = \{g, b\} \) ("good" or "bad"). If an amount \( K \) is invested in a project of type \( t_i \), it yields a net present value \( Y_i(K, t_i) \), which is characterized by the following assumption.

**Assumption 1.** For all \( i \in I \), \( Y_i(K, t) \) is continuously differentiable in \( K \), where \( y_i(K, t) := \frac{\partial Y_i(K, t)}{\partial K} \) is strictly decreasing in \( K \), strictly positive for \( K = 0 \), and strictly negative for sufficiently high \( K \). Moreover, \( y_i(K, g) \geq 0 \) implies \( y_i(K, g) > y_i(K, b) \).

By Assumption 1, the marginal net present value for a good project, \( y_i(K, g) \), is higher than that for a bad project, \( y_i(K, b) \). We define the unique investment level that maximizes the net present value by \( K_i^*(t) := \text{argmax}_K \{Y_i(K, t)\} \), where \( K_i^*(g) > K_i^*(b) > 0 \).

The profitability of investment opportunities depends on the effort \( e \in \{\ell, h\} \) ("low" or "high") that is exerted by the respective manager. If manager \( i \) exerts high effort, his project will be of the good type with probability \( p_i^h \). Following low effort, the respective probability is \( p_i^l \), where \( 0 < p_i^l < p_i^h < 1 \) for all \( i \in I \). Exerting high effort comes at the private disutility \( c_i > 0 \), while low effort is costless. The chosen effort level is not observable to other parties. Managers also derive private benefits \( aK_i \) with \( a > 0 \) from controlling the investments under their supervision. Heading larger divisions may be more prestigious, or it may enhance managers' human capital and thus increase their future wage. All parties are risk neutral. We normalize the risk-free rate of return to zero. Hence, if manager \( i \) receives a wage \( w \) and if his division is...
allocated capital $K$, his utility is $w + \alpha K$ or $w + \alpha K - c_i$, depending on whether he chose low or high effort. Managers have no personal funds and a reservation value of zero.

**Financial resources and capital allocation.** Each project $i$ has an initial endowment of financial resources $X_i$. (This could comprise cash, financial assets, and funds from collateralized borrowing.) We distinguish between two cases. In the first case, headquarters can only allocate to a given project the resources generated by this project. This situation is akin to one in which projects are incorporated separately. In the second case, projects are jointly incorporated and headquarters operates an internal capital market, i.e., headquarters can draw on the resources of all divisions when it decides how to optimally allocate capital.

Headquarters can observe the profitability of investment opportunities and allocates the available funds so as to maximize total firm value. We assume that divisions’ types are uncorrelated. Funds that are not invested in divisions’ real assets can be invested in financial assets, which yields the risk-free rate of return. Importantly, headquarters cannot commit to some (state-contingent) allocation of capital. This may be the case because the profitability of projects is hard to verify by outsiders—let alone courts. Also, if projects are operated under a single roof, it may be hard or even impossible for headquarters to tie its hands and commit not to reallocate funds even without the consent of division managers, e.g., by adjusting transfer prices or the allocation of overhead costs.

Two assumptions deserve further comment. First, we assume that the financial resources $X_i$ are the only funds available for investment, implying that a reallocation of funds is possible only within a firm. Stein (1997) provides a formalization of the idea that an internal capital market eases financing constraints as headquarters has an (informational) advantage in picking the most profitable investment opportunities. As we show later, in our model owners may even prefer to constrain the amount of financial resources to boost managers’ incentives. The second assumption that deserves comment is that headquarters acts in the interest of owners when allocating funds. While headquarters may well be reluctant to return funds to investors, it may not want to waste funds by pouring them into relatively unprofitable investments. Putting it succinctly, while headquarters may engage in empire building, it wants to build the most valuable empire.

**Timeline of the model.** We summarize the working of the model by stating the timing of all events. If feasible, headquarters can first offer to pay managers a contingent wage that rewards them for good performance. Subsequently, managers choose their respective effort levels $e_i$, and projects’ types $t_i$ are realized. Based on headquarters’ observations of $t_i$, it chooses the optimal investment levels $K_i$. Finally, payoffs are realized and the game ends.

In the case of separate incorporation, the allocation of capital to division $i$ is constrained by the requirement $K_i \leq X_i$. In the case of joint incorporation, an aggregate resource constraint applies: $\sum_{i \in I} K_i \leq \sum_{i \in I} X_i$.

### 4. Analysis: capital allocation and incentives

**Separate incorporation.** If project $i$ is incorporated separately, the optimal allocation of capital is given by $K_i^S(t_i) = \min\{K_i^*(t_i), X_i\}$. For $X_i < K_i^*(t_i)$ the firm is financially constrained and not all profitable investment opportunities can be realized. By Assumption 1, good projects have more investment potential. Consequently, the difference

$$V_i^S := K_i^S(g) - K_i^S(b)$$

is strictly positive unless capital is sufficiently scarce, in which case it holds that $K_i^S(g) = K_i^S(b) = X_i$. We call $V_i^S$ the investment sensitivity. Lemma 1 follows immediately from Assumption 1.

**Lemma 1.** Under separate incorporation, we have $V_i^S = 0$ if $X_i \leq K_i^*(b)$, $V_i^S = X_i - K_i^*(b)$ if $K_i^*(b) < X_i \leq K_i^*(g)$, and $V_i^S = K_i^*(g) - K_i^*(b)$ if $X_i > K_i^*(g)$.
If capital is not extremely scarce or abundant, i.e., if $K^*_i(b) < X_i < K^*_i(g)$, the investment sensitivity is strictly increasing in $X_i$. The investment sensitivity plays a key role in creating incentives for division managers. Suppose first that incentive pay is not feasible, e.g., $t_i$ is not contractible. Incentives are then provided exclusively by the allocation of capital and the manager will choose high effort only if

$$\left(p_i^b - p_i^f\right)\alpha V_i^S \geq c_i,$$

(2)

i.e., if the investment sensitivity is sufficiently large. But even if incentive pay is feasible, $V_i^S$ plays a crucial role in providing incentives. As the manager has zero wealth and a zero reservation value, he will be paid zero for generating a type-$b$ project. If (2) is satisfied, it is clearly also optimal for the firm to pay a wage of zero in the good state, as capital allocation already provides sufficient incentives. (Given our assumption of zero reservation utility, the participation constraint is surely satisfied.) But if (2) does not hold and incentive pay is feasible, the manager receives a strictly positive wage in the good state, $w_i^S(g) > 0$. Optimally, $w_i^S(g)$ is chosen just large enough to satisfy the manager’s incentive constraint $(p_i^h - p_i^f)\left(w_i^S(g) + \alpha V_i^S\right) \geq c_i$, which yields

$$w_i^S(g) = \frac{c_i}{p_i^h - p_i^f} - \alpha V_i^S.$$  

(3)

The higher the investment sensitivity $V_i^S$ in (3), the lower the performance wage that is necessary to elicit high effort. That incentives arising from capital allocation can substitute for incentive pay is confirmed by Wulf (2002), who finds evidence that a lower responsiveness of capital allocation to a division’s own profits goes along with more performance pay.

Joint incorporation and the operation of an internal capital market. Under joint incorporation, headquarters can operate an internal capital market. This has two major implications. First, headquarters can now tap into the resources of all projects. Second, headquarters can pick from all investment opportunities to channel funds to their most profitable use. It is convenient to restrict consideration to only two projects, $I = \{1, 2\}$, though the main insights can be generalized to arbitrary sets $I$. Denote the amount of capital that is optimally allocated to project $i$ by $K_i(t_i, t_j)$. Headquarters chooses $K_i(t_i, t_j)$ to maximize the joint net present value, $Y_1(K_1(t_1, t_2), t_1) + Y_2(K_2(t_2, t_1), t_2)$, subject to the aggregate resource constraint $K_1(t_1, t_2) + K_2(t_2, t_1) \leq X_1 + X_2$. Lemma 2 follows immediately from Assumption 1.

**Lemma 2.** Under joint incorporation, the optimal capital allocation, $K_i(t_i, t_j)$, is uniquely determined. If the capital constraint does not bind as $X_1 + X_2 > K_i^*(g) + K_i^*(b)$, we have $K_i(t_i, t_j) = K_i^*(t_i)$. Otherwise, either $K_i(t_i, t_j)$ is uniquely determined by $y_i(K_i(t_1, t_2), t_1) = y_2(K_2(t_2, t_1), t_2)$ and the binding resource constraint, or else a corner solution exists and one division receives all funds.

The amount of capital that is allocated to a particular project depends now on the profitability of both projects. We denote by $E_{ij} [K_i^L(t_i, t_j)]$ the expected investment in project $i$ when it has type $t_i$. The resulting (expected) investment sensitivity is then given by

$$V_i^L := E_{ij} [K_i^L(g, t_j)] - E_{ij} [K_i^L(b, t_j)].$$  

(4)

Consequently, without monetary incentives, manager $i$ now exerts high effort only if

$$\left(p_i^h - p_i^f\right)\alpha V_i^L \geq c_i.$$  

(5)

If incentive pay is feasible, it is again optimal to pay each manager zero upon generating a project.
with low profitability. When (5) does not hold, the “gap” in incentives is made up by paying a positive wage \( w^J_i(g) \) for managers of high-type projects, where optimally\(^5\)

\[
w^J_i(g) = \frac{c_i}{p_i^h - p_i^b} - \alpha V^J_i.
\]

Hence, the higher the investment sensitivity \( V^J_i \), the lower the \( w^J_i(g) \) in (6) and thus the lower the firm’s expected wage bill.

In what follows, we compare managers’ incentives under separate and joint incorporation by comparing the respective investment sensitivities \( V^S_i \) and \( V^J_i \). If performance pay is not feasible, the difference in sensitivities \( V^J_i - V^S_i \) and thus the mode of incorporation matters if it tilts managers’ effort choice. If performance pay is feasible and if it is also necessary to provide additional incentives, choosing the mode of incorporation that maximizes investment sensitivity minimizes the total wage bill.

5. Comparing incentives

- Capital allocation and incentives. In principle, there are two reasons why incentives could increase under joint incorporation, i.e., why \( V^J_i > V^S_i \) may hold for a particular division \( i \).

  **Rewarding good performance.** If \( E_{t_j}[K^J_i(g, t_j)] > K^S_i(g) \), then good performance is rewarded more under joint than under separate incorporation.

  **Punishing bad performance.** If \( K^S_i(b) > E_{t_j}[K^J_i(b, t_j)] \), then joint incorporation generates an additional punishment for an underperforming division.

If projects have the same amount of financial resources and the same investment technologies, we can show that joint incorporation provides both higher rewards for good performance and more punishment for bad performance. If projects are heterogeneous because they differ in financial resources or investment technologies, this may no longer be the case.

- Homogeneous projects. Assume that \( X_i = X \) and \( y_i(K, t) = y(K, t) \) for all \( i \in I, K, \) and \( t \in T \). There are two cases to distinguish. For \( X \geq K^*(g) \), capital is not constrained. Consequently, all positive-NPV opportunities will be financed and capital allocation is not affected by the mode of incorporation. For \( X < K^*(g) \), capital is scarce. Still, the mode of incorporation does not affect capital allocation if both projects have the same type. This follows from our assumption that projects have the same technology. If projects have different types, however, the mode of incorporation matters, because joint incorporation creates scope to profitably reallocate capital. It is useful to distinguish between the following two scenarios.

  **Reallocation of “excess funds.”** If \( K^*(b) < X < K^*(g) \), the division with less-attractive investment opportunities has excess funds \( X - K^*(b) \). In contrast, a type-\( g \) project is capital constrained under separate incorporation. Under joint incorporation, headquarters can increase capital allocation to a type-\( g \) project, thus creating additional rewards for good performance.

  **Reallocation of “nonexcess funds.”** In addition to the allocation of excess funds, capital that might have been invested in a type-\( b \) project under separate incorporation may now be allocated to the other division. If \( t_i = g \) and \( t_j = b \), this is always the case whenever capital is scarce. Since \( y(K, t) \) is strictly decreasing in \( K \) (Assumption 1), it is then optimal to reduce the investment in type \( b \) (compared to the stand-alone case) so as to increase the investment in the better-performing division.

We have thus arrived at the following proposition.

---

\(^5\) Recall that we assume for now that projects’ types are uncorrelated such that there are no benefits from relative performance pay.

© RAND 2005.
Proposition 1. Suppose both projects have the same amount of resources and the same investment technologies, i.e., $X_i = X$ and $y_i(K, t) = y(K, t)$ for both $i \in I$ and all $t \in T$.

(i) If capital is constrained because $X < K^*(g)$, we obtain $V_i^J > V_i^S$. Hence, joint incorporation increases the investment sensitivity and thereby incentives.

(ii) If capital is never constrained, we obtain $V_i^J = V_i^S$, i.e., incentives do not depend on the mode of incorporation.

Symmetry in resources and investment technologies leads to clear-cut results. The operation of an internal capital market increases investment sensitivity by increasing capital allocation to the outperforming division and, if capital is sufficiently scarce, by reducing capital allocation to the underperforming division. If projects differ in either their resources or their technologies, this may no longer be the case.

Heterogeneous projects. Suppose first that projects differ only in resources, i.e., $y_i(K, t) = y(K, t)$ holds for both $i \in I$ and all $t \in T$, while $X_1 > X_2$. Take first the “poor” division $i = 2$, which has fewer financial resources than division $i = 1$. In case $X_2 > K^*(g)$, capital is never scarce and joint incorporation consequently has no impact on capital allocation. If capital is scarce, however, joint integration again allows a better reward to division $i = 2$ for having created a type-g project. In fact, given that $X_1 > X_2$ and that divisions have homogeneous investment potential, capital will now always be reallocated to division $i = 2$ if the project is of type $g$, i.e., regardless of the type of division $i = 1$. (Of course, unless $X_1$ is sufficiently large, capital allocation is higher if division $i = 1$ has less-profitable investment opportunities.)

If $X_2 < K^*(b)$ and if $X_1$ is not too low, division $i = 2$ receives more funds under joint incorporation even if it has a type-b project, i.e., $E_t[K_2^J(b, t)] > K_2^S(b)$. For example, this is the case if division $i = 1$ has abundant resources, $X_1 \geq K^*(g)$, which together with $X_2 < K^*(b)$ implies that there is always capital reallocation into $i = 2$, regardless of its type. However, joint incorporation may lead to more capital only for $t = b$ if $K_2(b) = X_2$, in which case $V_i^J = 0$ holds from $K_2(g) = K_2(b) = X_2$. Hence, also in this case, joint incorporation leads to higher incentives for the relatively poor division $i = 2$.

Consider next the “rich” division $i = 1$. If $X_1$ is very large, this division will only act as a provider of excess funds, but its own investment level will not be affected. In contrast, if capital is relatively scarce, joint incorporation may drain resources even if the division has good investment opportunities. This reallocation decreases incentives. At the same time, however, funds may also be diverted if $t_1 = b$, which in turn increases incentives. While the overall effect is generally ambiguous, we can show that as the difference in endowments $X_1 - X_2$ increases, it is more likely that joint incorporation reduces incentives for $i = 1$.

Proposition 2. Suppose that projects have the same investment technology, i.e., $y_i(K, t) = y(K, t)$ for both $i \in I$ and all $t \in T$, while $\Delta := X_1 - X_2 > 0$. Capital allocation is not affected by the mode of incorporation if $X_2 \geq K^*(g)$. Otherwise, incentives for $i = 2$ are strictly higher under joint incorporation and $V_i^J - V_i^S$ is increasing in $\Delta$, holding $X_1 + X_2$ constant. Incentives for $i = 1$ may either increase or decrease under joint incorporation, while $V_i^J - V_i^S$ is decreasing in $\Delta$.

Below we will choose a particular functional form for the investment technology and explore when it is more likely that incentives for the “rich” division decrease under joint incorporation.

If divisions have the same level of financial resources but differ in their investment technologies, it is also no longer guaranteed that competition in an internal capital market boosts incentives for all division managers. Again, it depends on how joint incorporation affects the allocation in the good state relative to that in the bad state. In this case, examples (such as those provided below) show that the results are very sensitive to the specific functional choice of investment opportunities.

Incentive provision versus allocative efficiency. As this is the novelty in our article, the analysis focuses on how joint incorporation affects division managers’ incentives to create
new investment opportunities. Another aspect of an internal capital market is that it allows for improvement of allocative efficiency. With heterogeneous projects, this may create a tension between achieving the right incentives for all divisions and greater (ex post) allocative efficiency. One particular case where the incentive effect can dominate the allocation effect is when incentive pay is not feasible. In this case, operating different businesses under one roof may not provide sufficient incentives for all division managers and thus may stifle the creation of new investment opportunities.

**Investment sensitivity and capital constraints.** We next analyze how changes in the total amount of financial resources affect investment sensitivity and thereby managers’ incentives. For instance, one way in which total resources can be increased is by including a “cash cow” project, i.e., a project that generates cash from assets in place but is itself no longer a competitor for fresh capital injections. We find that integrating a cash cow may dampen incentives if the firm previously operated an active internal capital market.

Consider first separate incorporation. Here, a marginal increase in $X_i$ has no effect on incentives if capital is very scarce or if it is abundant. While it does not affect capital allocation at all in the latter case, where $X_i \geq K^*_i(g)$, it increases capital allocation by the same amount in both states if $X_i < K^*_i(b)$, which leaves $V_i^S$ unaffected. In contrast, in the intermediate case, where $K^*_i(b) \leq X_i < K^*_i(g)$, an increase in $X_i$ strictly increases $V_i^S$. In total, if we increase financial resources under separate incorporation, incentives will never decrease. This is no longer the case under joint incorporation.

**Proposition 3.** Under separate incorporation, incentives are (weakly) increasing in financial resources. In contrast, under joint incorporation the incentives for division $i$ are increasing in the total financial resources $X_0 := X_1 + X_2$ if and only if

$$dE_{ij}(K_i^J(b, t_j)) / dX_0 < dE_{ij}(K_i^J(g, t_j)) / dX_0.$$  

Condition (7) follows immediately from the relation between incentives and investment sensitivity and (5). Focusing once more on homogeneous divisions, we next analyze when it is more likely that (7) holds.

**Proposition 4.** Suppose that projects have the same investment technologies. Then an increase in $X_0$ has the following effect on incentives under joint incorporation.

(i) Incentives are always higher if capital is not too constrained, i.e., if $X_0 \geq K^*(g) + K^*(b)$.

(ii) Incentives are always lower if capital is very scarce, i.e., if $X_0 < 2K^*(b)$, and if

$$dK(b, g) / dX_0 > dK(g, b) / dX_0.$$  

Condition (8) requires that if projects have different types, then a larger fraction of additional financial resources goes to the type-$b$ project. Intuitively, whether (8) holds will depend on a comparison of the (local) slope of the marginal NPV for the type-$g$ and the type-$b$ project. Hence, to obtain more insights we must proceed to a specification of the investment technologies, which we do next.

**Linear investment technologies.** In a slight abuse of notation, suppose project $i$ has the marginal NPV $Y_i = \alpha_i - \beta_i K$. (For now, it is convenient to skip the dependency on type $t_i$.) With separate incorporation, the optimal investment level is $K_i = \min\{X_i, \alpha_i / \beta_i\}$. With joint incorporation and $X_0 = X_1 + X_2$, we obtain $K_i = \alpha_i / \beta_i$ if capital is not constrained, i.e., if $X_0 \geq \alpha_i / \beta_i + \alpha_2 / \beta_2$. Otherwise, we have

$$K_i = \begin{cases} 
0 & \text{if } \alpha_j - \alpha_i \geq \beta_j X_0 \\
\frac{\beta_j}{\beta_i + \beta_j} X_0 + \frac{\alpha_i - \alpha_j}{\beta_i + \beta_j} & \text{otherwise} \\
X_0 & \text{if } \alpha_i - \alpha_j \geq \beta_j X_0.
\end{cases}$$  

© RAND 2005.

This content downloaded from 85.180.184.173 on Wed, 26 Jul 2017 17:57:12 UTC
All use subject to http://about.jstor.org/terms
We now assume that bad projects have the marginal NPV $y_i = 1 - K$, i.e., $\alpha_i = \beta_i = 1$. The marginal NPV with good investment opportunities depends on whether the respective projects are located in more- or less-mature industries. With more-mature businesses, profit-growth potential should come primarily from increasing the profitability of existing investment opportunities. In this case we specify that $y_i(K, g) = \beta_i(1 - K_i)$, where $\beta_i > 1$. Hence, together with $y_i(K, b) = 1 - K_i$, this implies that there is always a fixed set of positive-NPV opportunities, (almost) all of which are, however, strictly more profitable for a type-$g$ project. With less-mature businesses, high effort increases the chance of creating additional opportunities with positive NPV. Formally, we specify in this case that $y_i(K, g) = 1 - y_i K_i$, where $y_i < 1$.

Joint incorporation of more-mature businesses. Consider a stand-alone division $i$ with $y_i(K, b) = 1 - K$ and $y_i(K, g) = \beta_i(1 - K)$. Since $K_i^*(g) = K_i^*(b) = 1$, it follows that $K_i(g) = K_i(b) = \min\{X_i, 1\}$. Hence, the investment sensitivity is zero in the stand-alone case. Intuitively, as effort can only increase the profitability of existing positive-NPV projects but cannot open up entirely new opportunities, it will not affect the amount of allocated capital. Consequently, the manager of a more mature business receives no incentives from capital allocation.

Under joint incorporation, managers again have no incentives if capital is abundant. But if capital is scarce, i.e., if $X_0 = X_1 + X_2$ falls short of $K_i^*(g) + K_i^*(b) = 2$, operating an internal capital market leads to strictly positive incentives: $V_i \geq 0$. In an internal capital market where funds are not abundant, the investment criterion is no longer whether the incremental NPV from additional investment is positive. Instead, competition establishes a performance benchmark that is strictly above the zero-NPV rule. Consequently, it now pays for division managers to exert effort so as to increase the marginal NPV and thereby receive a larger fraction of total investment. We have thus arrived at the following result.

**Proposition 5.** If both projects are in more-mature businesses (as defined above), joint incorporation strictly increases incentives unless capital is abundant, in which case incentives are not affected.

We next analyze how incentives under joint incorporation are affected by a change in total financial resources. We again assume that projects have homogeneous investment technologies, i.e., that $\beta_1 = \beta_2 = \beta$. With the specified investment technology, $X_0 < 2K^*(b)$ holds whenever capital is scarce. By Proposition 4, condition (8) then determines how a relaxation of financial constraints affects incentives. We distinguish between two cases. If $1 - 1/\beta \leq X_0 < 2$, capital is not too scarce and we obtain from (9) that $K_i(b, g) = [1/(1 + \beta)][X_0 + (\beta - 1)]$ and $K_i(g, g) = [1/(1 + \beta)][\beta X_0 - (\beta - 1)]$. By $\beta > 1$ we thus have that $dK_i(b, g)/dX_0$ strictly exceeds $dK_i(g, g)/dX_0$ such that (8) holds. Hence, for intermediate levels of financial resources, a larger fraction of additional capital goes into the type-$b$ project and incentives are consequently muted. However, if capital is very scarce, $X_0 < 1 - 1/\beta$, all capital goes into the type-$g$ project, and a marginal increase in $X_0$ thus increases incentives. We summarize results as follows.

**Proposition 6.** If both projects are in more-mature businesses (as defined above) and have the same investment technology, a marginal increase of financial resources under joint incorporation increases incentives if capital is sufficiently scarce, i.e., if $X_0 < 1 - 1/\beta$. If capital is less scarce (but also not abundant), i.e., if $1 - 1/\beta \leq X_0 < 2$, relaxing the capital constraint reduces incentives.

Joint incorporation of less-mature businesses. Suppose now that project $i$ is in a less mature business such that $y_i(K, b) = 1 - K$ and $y_i(K, g) = 1 - y_i K$. Since $K_i^*(b) = 1$ and $K_i^*(g) = 1/y_i$, we now have that $K_i(b) = \max\{X_i, 1\}$ and $K_i(g) = \max\{X_i, 1/y_i\}$. Hence, unless $X_i < 1$, incentives from capital allocation are now always strictly positive. This is intuitive, as creating a type-$g$ project enlarges the set of positive-NPV projects and increases investment.

---

6 We can generate $y_i = 1 - y_i K_i$ as follows. Suppose each “marginal” project, e.g., each marginal market, is characterized by the marginal NPV $y = 1 - K$. In the bad state, $t_i = b$, the manager creates projects of mass one, while in the good state, $t_i = g$, he creates projects of mass $y_i > 1$. © RAND 2005.
In contrast to the case with more-mature businesses, creating or intensifying competition in an internal capital market is now no longer unambiguously beneficial for incentives. The result that brings this out most clearly is that, in stark contrast to the case with more-mature businesses, relaxing the capital constraint in an internal capital market will now always increase incentives for both divisions. (This is proven formally in Proposition 7.) In addition, if projects are heterogeneous, it is now easy to find examples such that joint incorporation reduces incentives for at least one division.

To see this, suppose first that projects differ only in their financial resources such that \( y_1 = y_2 = \gamma \) and \( X_1 > X_2 \). We ignore from now on the trivial case \( X_2 > K^*(g) \), where capital is never scarce. From Proposition 2 we know that the “poor” division’s incentives are always higher under joint incorporation. In case \( K^*(g) + K^*(b) < X_0 < 2K^*(g) \), which becomes

\[
1 + 1/\gamma < X_0 < 2/\gamma, \tag{10}
\]

the allocation to \( i = 1 \) is the same as under separate incorporation unless both projects are of type \( g \), in which case it is strictly lower. Consequently, if \( X_0 \) satisfies (10), i.e., for intermediate levels of total financial resources, joint incorporation strictly reduces incentives for the “rich” division.

Suppose next that \( X_1 = X_2 = X \) and that \( i = 1 \) can generate more growth opportunities as \( y_1 < y_2 \). It is immediate to see that joint incorporation increases incentives for \( i = 1 \). To see that it can stifle incentives for \( i = 2 \), we take again the case of intermediate levels of financial resources. In analogy to condition (10), suppose that

\[
1 + 1/\gamma_1 \leq X_0 < 1/\gamma_1 + 1/\gamma_2. \tag{11}
\]

If (11) holds, joint incorporation leads to less capital allocation to \( i = 2 \) if both projects are of type \( g \), but capital allocation remains unchanged if \( i = 2 \) is of type \( b \). We have the following result.

**Proposition 7.** If both projects are in less-mature businesses (as defined above), joint incorporation can reduce incentives. Moreover, relaxing the capital constraint under joint incorporation always increases incentives.

### 6. Discussion and robustness

- **Correlation of types.** So far, we have assumed that project types are uncorrelated. If this assumption is relaxed, the likelihood that business \( i \) has more profitable investment opportunities (for a given choice of effort) is positively correlated with that of business \( j \), and joint incorporation becomes relatively less profitable. This holds for two reasons. First and most obviously, from the perspective of allocative efficiency, the expected gains from reallocating scarce funds decrease. In addition, under joint incorporation, the investment sensitivity and thus managerial incentives can be shown to be strictly lower if investment opportunities are positively correlated. The intuitive reason is that if a given project is of type \( g \), the rewards are higher if the other project is of type \( b \). Likewise, if a project is of type \( b \), the punishment is again higher if the other project has the opposite type \( g \).

**Proposition 8.** The investment sensitivity under joint incorporation decreases as projects become more (positively) correlated.

- **Contracting on capital allocation.** A key feature so far is that headquarters cannot commit ex ante how to allocate capital. Instead, after the projects' types have been revealed, headquarters allocates capital so as to maximize profits. From an ex ante perspective, however, this may not be optimal due to the way capital allocation affects incentives. To highlight the potential benefits of committing to a particular capital allocation, we examine the case in which capital constraints are

© RAND 2005.
In this case, headquarters can freely choose how much capital to allocate to each project. We denote the respective optimal (commitment) levels by $K_i(g)$ and $K_i(b)$.

**Proposition 9.** Suppose that headquarters can commit to a state-contingent capital allocation. If there are no capital constraints, headquarters optimally chooses $K_i(g)$ such that $y_i(K_i(g), g) = -\alpha$, while $K_i(b)$ solves $y_i(K_i(b), b) = \frac{p_i^b}{(1 - p_i^g)}\alpha$ if this yields a positive solution and equals zero otherwise.

From Assumption 1, Proposition 9 immediately implies that $K_i(g) > K_i^*(g)$ and $K_i(b) < K_i^*(b)$. Thus, if commitment is feasible, headquarters optimally increases the investment sensitivity and thereby creates additional incentives. For a type-g project this implies a strictly higher capital allocation up to the point where the marginal net present value equals $-\alpha$. This is intuitive because $\alpha$ is just the marginal reduction in the performance wage that is feasible following a marginal increase of capital in the good state. Likewise, it is optimal to reduce capital allocated to a type-b project up to the point where the loss in marginal returns is just equal to the afforded marginal reduction in the wage bill.

If the firm has excess funds, investing less than the amount that is ex post optimal for headquarters is not renegotiation proof. Ex post, both headquarters and the manager would prefer a higher investment level. In this case, another interesting advantage of operating an internal capital market arises. If funds are already promised to another division, any changes in investment levels require the consent of both managers. We can show that joint integration can make additional punishment of the type-b project feasible if this is not the case under separate incorporation.$^8$

- **Multiple periods.** In this article, self-interested managers care about the profitability of their projects because higher profitability leads to higher capital allocation, for which managers have a strict preference. If we extended our model to multiple periods, managers could also derive incentives from the fact that the subsequently generated cash flow is needed to (re)finance investments. However, in an internal capital market this additional source of incentives may be relatively weak due to a public-good problem: cash flow is first confiscated by headquarters before being redistributed to divisions.

This free-riding effect in generating cash is at the heart of Brusco and Panunzi (forthcoming). Focusing only on this effect, they show that joint integration always stifles incentives. A potentially interesting combination of their work and ours could consider a multitask framework in which managers can work on various projects. We would conjecture that under joint incorporation, managers become biased in favor of creating new investment opportunities and consequently neglect to create current cash flow. Since everybody hopes to have a free ride on the cash flow generated by other divisions, the company may in the end be left short of funds, which may in turn stifle the creation of opportunities. Ultimately, the integrated firm might get the worst of both worlds: little cash for investments and few profitable investment opportunities.

7. **Conclusion**

We have analyzed how an internal capital market can affect managers’ incentives to generate profitable investment opportunities. Our analysis suggests that firm value increases if investment becomes more sensitive to projects’ (or divisions’) profitability because this increases managers’ incentives to generate profitable investment opportunities.

Studying different modes of incorporation, we show that operating an internal capital market can both increase and decrease the investment sensitivity of an individual business unit. Consequently, a lower investment sensitivity under joint integration does not provide per se evidence of an inefficient allocation of capital. Moreover, operating an internal capital market does not unambiguously create value even if capital is allocated efficiently. We find that competition for

$^7$ The other cases lead to similar qualitative implications on how capital allocation is optimally distorted under commitment.

$^8$ For details, see our working paper, Inderst and Laux (2000).
scarce financial resources unambiguously increases incentives only if projects are homogeneous. If projects are heterogeneous, i.e., if they have different financial resources or growth potential, joint incorporation may stifle incentives for some divisions.

We also find that making capital more scarce can create additional incentives in an internal capital market. This result is markedly different from the case of separate incorporation, where more capital always (weakly) increases investment sensitivity and thereby incentives.

With linear investment technologies, we find that if managerial effort is primarily required to enhance the profit potential of a fixed set of investment opportunities, an internal capital market is vital for creating incentives. In contrast, an internal capital market can reduce incentives for managers of less-mature businesses, who must be motivated to create new growth opportunities.

Appendix

**Proof of Proposition 2.** Take first the case of \( i = 2 \). From Lemma 1 we have that \( V_2^g \) (weakly) increases in \( X_2 \), while \( V_2^b \) does not change as \( X_0 = X_1 + X_2 \) is held constant. Hence, \( V_2^g - V_2^b \) is (weakly) increasing in \( \Delta \).

Take next \( i = 1 \), for which we first analyze when joint integration increases and when it decreases incentives. We have to distinguish several cases. In case (i) we have that \( X_1 \leq K^*(b) \) such that \( V_1^g = 0 \) and \( V_1^b = p(h)[X_0/2 - K_2(g, b) + (1 - p(h))[K_2(g, b) - X_0/2]] \), implying \( V_1^g - V_1^b > 0 \). In case (ii) it holds that \( K^*(g) > X_1 \geq K^*(b) \) such that \( K_1(b) = K^*(b), K_1(g) = X_1 \), and thus \( V_1^g = X_1 - K^*(b) \). We discuss three subcases of (ii). First, we have that \( K^*(g) + K^*(b) \leq X_0 \), implying \( K_1(g) = X_0/2, K(b, g) = K^*(g), K(b, b) = K^*(b) \), and \( K_2(g, b) = K^*(b) \). Hence, we have \( V_1^g = p(h)[X_0/2 + (1 - p(h))[K^*(g) - K^*(b)] - X_1] > 0 \) holds if and only if \( p(h)[X_0/2 + (1 - p(h))[K^*(g) - K^*(b)] > X_1 \). In the second subcase of (ii) we have that \( K^*(g) + K^*(b) > X_0 \geq 2K^*(b) \), implying \( K_1(g) = X_0/2, K_2(g, b) = K^*(g), K_1(b, g) = X_0/2, K_2(b, b) = K^*(b) \). Hence, \( V_1^g - V_1^b > 0 \) holds if and only if \( p(h)[X_0/2 + (1 - p(h))[K^*(g) - K^*(b)] > X_1 \). Finally, in the third subcase of (ii) we have \( K^*(g) + K^*(b) > X_0 \geq 2K^*(b) \), implying \( K_1(g) = X_0/2, K_2(g, b) = K^*(g), K_1(b, g) = X_0/2, K_2(b, b) = K^*(b) \). Hence, \( V_1^g - V_1^b > 0 \) holds if and only if \( p(h)[X_0/2 + (1 - p(h))[K^*(g) - K^*(b)] > X_1 \).

Finally, we again have from Lemma 1 that \( V_2^g \) (weakly) increases in \( X_1 \), while \( V_2^b \) does not change in \( \Delta \). This completes the proof of Proposition 2. Q.E.D.

**Proof of Proposition 4.** Take first the case where \( X_0 \geq K^*(g) + K^*(b) \). If also \( X_0 \geq 2K^*(g) \), a (marginal) increase in \( X_0 \) does not affect allocations and incentives. If \( X_0 < 2K^*(g) \), an increase only affects \( K(g, g) = X_0/2 \) and \( K_2(b, g) = X_0/2 \). Differentiating (4) we thus have \( dV_1^g/dX_0 = p(h)/2 \). For assertion (ii) suppose next that \( X_0 < 2K^*(b) \), where we have \( K(g, g) = K(g, b) = X_0/2 \) and \( K_2(b, b) = X_0/2 \). Substitution into (4) transforms condition \( dV_1^g/dX_0 \) into condition (8).

For the sake of completeness, we finally discuss the case of intermediate financial resources, \( 2K^*(b) < X_0 < K^*(g) + K^*(b) \). Here, we have that \( K(g, g) = X_0/2, K(g, b) = K^*(b) \), and \( K_2(g, b) = X_0/2 \). From (4) we then have that \( dV_1^g/dX_0 > 0 \) holds if \( dK(g, b)/dX_0 > p(h)/2 \). Q.E.D.

**Proof of Proposition 7.** It remains to show that an increase in \( X_0 \) always increases \( V_1^g \) for \( i = 1, 2 \). This follows from (4) after substituting all values \( K^*(ti, tj) \), which we derive next from (9). We have to distinguish between several cases. In case (i) we have that \( X_0 \geq 1/y_i + 1/y_2 \) such that \( K_2(ti, tj) = K^*(ti) \) for all states. In case (ii) we have that \( 1 + 1/y_1 \leq X_0 < 1/y_1 + 1/y_2 \) and thus \( K(g, g) = [y_1/(y_1 + y_2)]X_0 \) and \( K_2(ti, tj) = K^*(ti) \) for all other states. In case (iii) we have that \( 1 + 1/y_2 \leq X_0 < 1 + 1/y_2 \) and thus \( K(g, g) = [y_2/(y_1 + y_2)]X_0, K_2(b, g) = [1/(1 + y_1)]X_0, K_2(g, b) = [1/(1 + y_2)]X_0 \), and \( K_1(b, b) = 1 \). In (iv) it holds that \( 1 + 1/y_2 < X_0 < 2 \). Consequently, we have that \( K(g, g) = [y_1/(y_1 + y_2)]X_0, K(g, b) = [y_2/(y_1 + y_2)]X_0, K_1(g, b) = [1/(1 + y_1)]X_0, K_2(g, b) = [1/(1 + y_2)]X_0 \), and \( K(b, b) = 1 \). Finally, in case (v) we have \( X_0 < 2 \), from which it follows that \( K(g, g) = [y_1/(y_1 + y_2)]X_0, K(g, b) = [y_2/(y_1 + y_2)]X_0, K_1(g, b) = [1/(1 + y_1)]X_0, \) and \( K(b, b) = X_0/2 \). Q.E.D.

**Proof of Proposition 8.** Let \( p(h)(ti) \) be the conditional probability that project \( j \) is of the good type, given that project \( i \)'s type is \( ti \). The investment sensitivity of division \( i \) is then

\[
E_{jt}[K_1(g, tj)] - E_{jt}[K_1(b, tj)] = K_1(g, b) - K_1(b, b) - p(h)[K_1(g, g) - K_1(b, b)] + p(h)[K_1(b, g) - K_1(b, b)].
\]

By optimality we have \( K_1^*(ti, b) \geq K_1^*(ti, g) \) for \( ti = b, g \). If capital is constrained, this holds strictly at least in case \( ti = g \). Since \( p(h)(g) \) increases with the correlation coefficient \( \rho \in (-1,1) \), while \( p(h)(b) \) decreases, we then obtain

\[
\partial E_{jt}[K_1(g, tj)] / \partial \rho < 0.
\]

Q.E.D.
Proof of Proposition 9. We first substitute into the firm’s objective function the binding wage constraint \( w_i^f(g) = \frac{c_i}{p_i^h - p_i^l} - \alpha[K_i(g) - K_i(b)] \). Then \( K_i(g) \) and \( K_i(b) \) maximize

\[
p_i^h Y_i(K_i(g), g) + (1 - p_i^h) Y_i(K_i(b), b) - \frac{c_i}{p_i^h - p_i^l} - \alpha[K_i(g) - K_i(b)]
\]

(Given that there are no constraints on financial resources, the only constraint is that \( K_i(t_i) \geq 0 \).) The results follow from differentiation of (A1). \( Q.E.D. \)

References


