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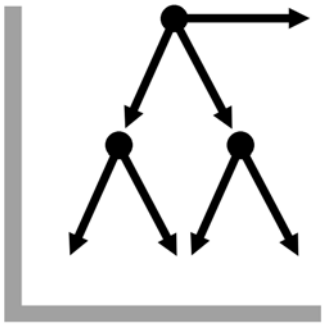

# Delegated Information Acquisition and Capital Budgeting: On the Separation of Project Evaluation and Project Management

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# Delegated Information Acquisition and Capital Budgeting: On the Separation of Project Evaluation and Project Management

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**Abstract**

The paper analyzes the question who should be provided with incentives to acquire and reveal information about the quality of an investment proposal: the divisional manager, who derives private benefits of control from the project and therefore prefers to carry out the project, or the capital budgeting department, which has no personal interests in the decision? Interestingly, private benefits of control may reduce the expected costs of the incentive system. The relative advantage of project evaluation by the manager increases (i) when it is possible to observe a signal for the quality of the project even when it has been rejected and (ii) when the sensitivity of the manager's private benefits of control to the project's quality increases. It decreases when the manager has to exert effort to increase the quality of the proposed project.

*JEL Classification: G31, D82, J33*

*Keywords: capital budgeting, information acquisition, task assignment*

# 1 Introduction

Investment decisions are among the most important decisions made by corporations. A crucial element of sound investment decisions is, of course, reliable information about the quality of investment proposals. The capital budgeting process "governs the way in which managers at various levels produce and share information about proposed investments and determines which decisions are delegated, to whom, and under what constraints" (Harris and Raviv, 1996, p. 1140).

The capital budgeting literature has primarily focused on the information "sharing" problem where (divisional) managers who propose projects have superior (soft) information, which has to be elicited by a properly designed mechanism.[1] In contrast, the present paper takes a closer look at the information "production" and "delegation" aspect of the capital budgeting process. Rather than presupposing that the divisional manager has superior information, it is explicitly recognized that producing information is costly. In addition, the divisional manager is not the only agent who may evaluate the project. The task may, for example, be assigned to the capital budgeting department. In contrast to the divisional manager it is not directly affected by the investment decision and therefore has no personal interests in the decision. Following the argument by Fama and Jensen (1983) that decision management (initiation and implementation of projects) and decision control (ratification and monitoring of projects) should be separated one would be inclined to argue that project evaluation and project management should be separated.[2] However, the decision is not as clear cut.

Consider the simplest setting in which the issue can be addressed: There are two

[1] See, for example, Harris, Kriebel, and Raviv (1982), Antle and Eppen (1985), Taggart (1987), Harris and Raviv (1996), and Milbourn and Thakor (1997).

[2] If an incentive system is in place, which induces an agent to truthfully evaluate the project, project ratification and evaluation are linked in the sense that the project is carried out whenever a success is forecasted and rejected whenever a failure is forecasted.

agents who may evaluate the quality of a proposed project, the divisional manager as well as the capital budgeting department. Project evaluation involves effort costs and yields soft information, which can be manipulated. While the manager derives large private benefits of control from carrying out the project, the capital budgeting department has no personal interests in the investment decision. Both agents are assumed to be risk neutral and to have limited wealth (limited liability). Because of limited liability, project evaluation typically involves a rent for the agent who evaluates the project. The optimal allocation of the project evaluation task minimizes expected wage costs (the agent's rent) of inducing information acquisition and revelation. Interestingly, private benefits of control are *not* sufficient for a separation of project evaluation and project management to be optimal.

How do private benefits of control affect the decision to whom to delegate the information acquisition task? If information is given, the agent who has no private interest in the decision will readily reveal his information. In contrast, an agent who strictly prefers a particular action has to be compensated for his foregone private benefits in order to reveal unfavorable information. It is therefore always more expensive to elicit readily available information from someone who has (opposing) private interests at stake than from someone who has no personal interest in the matter. Put differently: it is expensive to satisfy the truth-telling constraints of an agent who has opposing private interests. This observation is probably underlying the intuition that the agent who has no private interests in the decision should be assigned the information acquisition task. When information acquisition is privately costly, however, the standard truth-telling constraints are no longer binding. Rather, the binding constraints are those that ensure that a report is not made without having acquired information. A manager's private benefits of control tighten the constraint that he must have no incentive to forecast a success without evaluating the project; i.e., incentives to forecast a success without information are stronger in the presence of private benefits. This increases expected wage costs and is a negative

effect of private benefits. However, private benefits of control reduce a manager's incentive to forecast a failure without information; basically, the private benefits are part of the compensation that induces the manager not to forecast a failure without evaluating the project. This decreases expected wage costs and is a positive effect of private benefits. Whether project evaluation by the manager or by the capital budgeting department minimizes expected wage costs depends on the net effect.

Two aspects are shown to be crucial determinants of expected wage costs: The sensitivity of the manager's private benefits of control to the project's quality as well as the availability of a signal on a rejected project's quality (when projects are carried out, future profits serve as a signal for a project's quality). Increasing the sensitivity of private benefits reduces expected wage costs of providing the manager with incentives to evaluate the project. This implies that firms should be tough on managers and fire them as soon as possible when the project fails. The observability of a proxy for the quality of rejected projects decreases expected wage costs if the manager evaluates the project as well as if the capital budgeting department carries out this task. Firms should therefore follow up on rejected projects in order to determine whether or not the rejection was warranted.

In the situation described above no incentive conflict arises with managing the project. In a second part of the paper the manager has to exert effort prior to the investment decision, which determines the project's success probability. Given project evaluation by the capital budgeting department, private benefits provide the manager with (some) incentives to exert high effort in order to increase the probability of carrying out the project. This increases the advantage of separating project evaluation and project management. It may even be optimal to provide the capital budgeting department with incentives to evaluate projects in situations where this would not be optimal without the ex ante effort incentive problem. That is, ex post excessive project evaluations may be ex ante optimal because of their positive incentives on divisional managers' effort decision.

Given incentives to acquire and reveal information, the investment decision is directly linked to the evaluation report: the project is carried out whenever a success is forecasted and rejected whenever a failure is reported. Project evaluation by the divisional manager can therefore be interpreted as decentralized capital budgeting, while project evaluation by the capital budgeting department can be interpreted as centralized capital budgeting. The issue of centralized versus decentralized capital budgeting is also discussed by Baiman and Rajan (1995). In their paper centralized capital budgeting assures decision making in the interest of owners (headquarters can costlessly observe divisional manager's information). This, however, reduces the manager's incentive to invest in firm-specific human capital.[3] Stein (2000) shows that centralized capital budgeting reduces divisional managers' incentive to acquire soft information. If information is hard, however, divisional managers' incentive to acquire information increases under centralized capital budgeting as the information can be used to obtain additional investment funds. In contrast to the present paper, Stein does not consider monetary incentives.

Studies that analyze optimal incentives to acquire and reveal information include Lambert (1986), Demski and Sappington (1987), Prendergast (1993), Lewis and Sappington (1997), and Crémer, Khalil, and Rochet (1998). Among those, only Lewis and Sappington address the issue of the allocation of the information acquisition task. They analyze a procurement problem where information about production costs has to be acquired. In their model the standard trade-off between a seller's (information) rent and efficient production can be avoided by separating the task of gathering information and production.

[3] Another important role of centralized capital budgeting, which is not addressed in the present paper, is of course the allocation of capital to different projects. See, for example, Williamson (1975), Thakor (1990), and Stein (1997). Problems associated with an internal capital allocation are discussed by Scharfstein and Stein (2000) and Rajan, Serveas and Zingales (2000), among many others.

The paper proceeds as follows. The model is outlined in the next section. The question of whether project evaluation and project management should be separated, given that project evaluation is privately costly and that the manager derives private benefits from the project, is addressed in Section 3. Effort at the initiation stage is introduced in Section 4. Section 5 concludes.

# 2 The model

There are three parties: an investor (headquarters) and two agents, a divisional manager and a capital budgeting department. The divisional manager and the capital budgeting department have no personal funds of their own and their reservation utility is zero. All parties are assumed to be risk neutral and the risk-free rate of return is zero.

The divisional manager proposes a new project. If the project is carried out, headquarters has to invest in production facilities and the manager is going to manage the project. Investment in the project yields a verifiable profit, which is uncertain ex ante. Prior to making the investment decision it is possible to evaluate the investment proposal in order to acquire information about the project's quality. For simplicity it is assumed that project evaluation allows to distinguish between two possible states, "success" (state $\overline{\theta}$) and "failure" (state $\underline{\theta}$). The project's (conditional) net present value is positive in state $\overline{\theta}$ and negative in state $\underline{\theta}$. That is, given information about the realized state, investment is only optimal for the investor if the project is a success. The a priori probability of state $\overline{\theta}$ is $p$. Without information it is optimal to invest in the project, i.e., $pNPV(\overline{\theta}) + (1-p)NPV(\underline{\theta}) > 0$.

Project evaluation involves effort costs of, for example, conducting a market study, testing the product, and estimating production costs. Headquarters' opportunity costs of evaluating the project are assumed to be so high that it is never optimal for headquarters to carry out this task. Instead, the divisional manager

or the capital budgeting department may evaluate the project at costs $k^m$ and $k^c$ respectively. To capture the idea that it may be less costly for the divisional manager to evaluate the project than for the capital budgeting department, for example, because the manager already obtained some information when he prepared the proposal or because he has relevant information from managing the division, it is assumed that $\Delta k \equiv k^c - k^m \geq 0$. The project evaluation activity is unobservable and yields soft information, which can be manipulated. The agent who is assigned the project evaluation task therefore has to be provided with incentives to acquire and reveal the information.

The manager derives private benefits of control from running the project when it is carried out. The private benefits may depend on whether the project is a success or a failure and is denoted by $\overline{v}^m \equiv \overline{v} > 0$ and $\underline{v}^m \equiv \underline{v} \geq 0$, respectively, with $\Delta v \equiv \overline{v} - \underline{v} \geq 0$. If the project is not carried out, the manager's private benefits are 0. The capital budgeting department does not associate any private benefits with the investment decision, i.e., $\overline{v}^c = \underline{v}^c = 0$.

Hence, given information about the realized state, the capital budgeting department is indifferent with respect to what state to forecast. The manager of the division, however, prefers to forecast a success. At least for the case that the divisional manager has no cost advantage it seems reasonable to follow the argument in Fama and Jensen that project evaluation (ratification) should be separated from project management (initiation and implementation). The following section analyzes whether and under what conditions this is indeed optimal.

# 3 Optimal incentives and the assignment of project evaluation

Headquarters chooses the incentive system so as to maximize the expected net return from the project. It is assumed that headquarters always provides incentives

to induce information acquisition.[4] Maximizing the net return is therefore equivalent to minimizing expected wage costs of inducing information acquisition and revelation. This involves the decision to whom to assign the project evaluation task as well as the wage structure to be offered. The task may be assigned to the divisional manager (joint project evaluation and project management) or to the capital budgeting department (separate project evaluation and project management). The chosen agent decides whether to accept the wage contract. If he accepts, he chooses whether to acquire information and what state to forecast. After receiving the report, headquarters makes the investment decision. Note that it is optimal for headquarters to invest if a success is reported and to reject the project if failure is announced.

To motivate information acquisition headquarters has to choose an appropriate wage structure. Since profits are verifiable, the project's profit realization may be used as a signal (proxy) for the realized state if the project is carried out. Hence, it is possible to condition the reward on the *reported* profitability and the project's realized profit. Instead of explicitly modeling the project's profit realization as a proxy for the observed state, it is assumed for simplicity and without loss of generality (assuming risk-neutral agents) that the realized state $\theta$ is costlessly verifiable after the project has been carried out. The project's cash flow cannot serve as a proxy when the project is not carried out. In this case one may use market developments (e.g., the demand for a complementary product) or competitors' actions and successes as a proxy for the project's profitability. Assume that when the project is rejected, the state $\theta$ is nevertheless verifiable with probability $q$ $(0 \leq q \leq 1)$ and unobservable with probability $(1-q)$.[5] At this point in time, however, the investment

[4] This is optimal for the investor if the expected saving from avoiding a project with a negative *NPV*, $(1-p)|NPV(\underline{\theta})|$, exceeds expected wage costs of inducing project evaluation at minimal costs.

[5] The availability of a proxy for the profitability (state) of a rejected project has important im-

opportunity is gone.

Let $w^i(\hat{\theta}, \theta)$ be the wage to be paid given the report $\hat{\theta}$ and the actual state $\theta$ (if observable) and $w^i(\underline{\theta})$ the wage to be paid if the agent reports $\underline{\theta}$ and the realized state is unobservable, with $i \in \{m, c\}$. For notational simplicity, $\underline{w}^i \equiv w^i(\underline{\theta}, \underline{\theta})$ and $\overline{w}^i \equiv w^i(\overline{\theta}, \overline{\theta})$. $\mathbf{w}^i$ is the vector of wages.

Headquarters' minimization problem is given by

$$\min_{\mathbf{w}^i, i \in \{m,c\}} p\overline{w}^i + (1-p)[q\underline{w}^i + (1-q)w^i(\underline{\theta})]$$

subject to

$$p(\overline{w}^i + \overline{v}^i) + (1-p)[q\underline{w}^i + (1-q)w^i(\underline{\theta})] - k^i \geq \tag{1}$$
$$p(\overline{w}^i + \overline{v}^i) + (1-p)(w^i(\overline{\theta}, \underline{\theta}) + \underline{v}^i)$$

$$p(\overline{w}^i + \overline{v}^i) + (1-p)[q\underline{w}^i + (1-q)w^i(\underline{\theta})] - k^i \geq \tag{2}$$
$$q[pw^i(\underline{\theta}, \overline{\theta}) + (1-p)\underline{w}^i] + (1-q)w^i(\underline{\theta})$$

$$q\underline{w}^i + (1-q)w^i(\underline{\theta}) \geq w^i(\overline{\theta}, \underline{\theta}) + \underline{v}^i \tag{3}$$

$$\overline{w}^i + \overline{v}^i \geq qw^i(\underline{\theta}, \overline{\theta}) + (1-q)w^i(\underline{\theta}) \tag{4}$$

$$p(\overline{w}^i + \overline{v}^i) + (1-p)[q\underline{w}^i + (1-q)w^i(\underline{\theta})] - k^i \geq 0 \tag{5}$$

and

$$\overline{w}^i, \underline{w}^i, w^i(\overline{\theta}, \underline{\theta}), w^i(\underline{\theta}, \overline{\theta}), w^i(\underline{\theta}) \geq 0 \tag{6}$$

The objective function reflects headquarters' desire to minimize expected wage costs of inducing information acquisition. Constraints 1 to 4 are incentive constraints. The information acquisition constraints (1 and 2) ensure that the agent does not just posit a guess instead of incurring the costs of becoming informed. The truth telling constraints (3 and 4) guarantee that the observed state is reported truthfully. The participation constraint (5) ensures that the task of evaluating the

plications for the level of expected wage costs and the optimal assignment of the project evaluation task. The assumption is therefore discussed in more detail at the end of this section.

project is accepted. The constraints in expression 6 are the limited liability constraints.

The optimization problem is solved in two steps. First, expected wage costs are derived for $i = m$ and $i = c$ (Lemma 1). Second, the optimal allocation of the project evaluation task, which minimizes expected wage costs, is determined (Lemma 2).

**Lemma 1** *Expected wage costs of inducing agent $i \in \{m, c\}$ to acquire and reveal information at minimal costs are given by:*

1. $q > 0$*:* $E[w^i] = 2k^i + (1-p)\underline{v}^i - \min\{k^i, p\overline{v}^i\}$*, i.e.,*

   - $E[w^c] = 2k^c$ *and*
   - $E[w^m] = 2k^m + (1-p)\underline{v} - \min\{k^m, p\overline{v}\}$.

2. $q = 0$*:* $E[w^i] = (2 + \frac{p}{1-p})k^i + (1-p)\underline{v}^i - \min\{(1 + \frac{p}{1-p})k^i, p(\overline{v}^i - \underline{v}^i)\}$*, i.e.,*

   - $E[w^c] = (2 + \frac{p}{1-p})k^c$ *and*
   - $E[w^m] = (2 + \frac{p}{1-p})k^m + (1-p)\underline{v} - \min\{(1 + \frac{p}{1-p})k^m, p(\overline{v} - \underline{v})\}$.

The lemma is proven in the appendix where the optimal wage structures and the expected wage costs are derived. Clearly, it is not optimal to reward false forecasts and $w^i(\overline{\theta}, \underline{\theta}) = w^i(\underline{\theta}, \overline{\theta}) = 0$, which is the lowest admissible wage (maximum punishment) given the limited liability constraint. In addition, it is optimal to choose $w^i(\underline{\theta}) = 0$ if $q > 0$. The other wages are determined by the information acquisition constraints (constraints 1 and 2), which are discussed at greater length below. Two observations are interesting: First, project evaluation is associated with a rent.[6] Second, expected wage costs depend on whether a signal about the project's

[6] Crémer and McLean (1985, 1988), Riordan and Sappington (1988), McAfee, McMillan, and Reny (1989), and McAfee and Reny (1992), among others, have shown that private information can be costlessly extracted from risk-neutral agents when there is a publicly observable signal that is correlated with the private information. In the present paper information extraction is associated with a rent because of limited liability. (See footnote 9.)

quality—when it is not carried out—is observable with positive probability ($q > 0$) or not ($q = 0$).[7] The reasons for the differences will be discussed below.[8]

**Lemma 2** *Comparison of the expected wage costs yields:*

1. $q > 0$*: project evaluation by the manager is optimal if*

$$(1-p)\underline{v} - \min\{k^m, p\overline{v}\} \leq 2\Delta k.$$

2. $q = 0$*: project evaluation by the manager is optimal if*

$$(1-p)\underline{v} - \min\{(1+\frac{p}{1-p})k^m, p\Delta v\} \leq (2+\frac{p}{1-p})\Delta k.$$

Lemma 2 directly follows from comparing the expected wage costs in Lemma 1 and rearranging terms. The conditions in Lemma 2 will be interpreted below. Note that the comparison of the expected wage costs does not yield any clear-cut statement regarding the optimal alternative. The lessons to be learned from the perspective of the present paper are summarized in the following proposition:

**Proposition 1**

1. *If either $q > 0$ or $\Delta v > 0$, project evaluation by the manager may be optimal even when the manager has no cost advantage in evaluating the project (i.e., $\Delta k = 0$).*

2. *If $\underline{v} = 0$, project evaluation by the manager is always optimal (since $\Delta k \geq 0$).*

3. *If $q = 0$ and $\Delta v = 0$, project evaluation by the manager will never be optimal unless the manager's cost advantage in evaluating the project is sufficiently high.*

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[7] Expected wage costs are independent of the level of $q$ (given $q > 0$) since all parties are risk neutral.

[8] Note that the assumption that the project evaluation task is assigned to only one agent is without loss of generality if $q > 0$. If, however, $q = 0$, it may be optimal to ask both agents to evaluate the project. Their forecasts may then be used instead of a signal in each other's wage contracts.

Proposition 1 states that it may be optimal to let the divisional manager—who associates private benefits with the project—evaluate the project even when he has no cost advantage in evaluating the project. This is surprising at first sight. Intuition suggests that it is more expensive to provide the manager with incentives to truthfully evaluate the project. Because of his private benefits, he has personal preferences for forecasting a success. Hence, he seems to have less incentives to become informed in the first place and less incentives to reveal an unfavorable state. This intuition, however, stems from the case where information is costlessly available to the reporting agent. It is not correct when information acquisition involves effort costs.

When information acquisition is costly, the relevant incentive constraints are the information acquisition constraints. These constraints also imply that the agent reveals the obtained information, i.e., the truth telling constraints are satisfied. For the sake of discussing the effect of private benefits on the incentive problem and on expected wage costs it suffices to consider the polar cases of $q = 1$ and $q = 0$.

Consider first the case where $q = 1$. Substituting $q = 1$ and $w^i(\overline{\theta}, \underline{\theta}) = w^i(\underline{\theta}, \overline{\theta}) = w^i(\underline{\theta}) = 0$ into the information acquisition constraints 1 and 2 and rearranging terms yields

$$\underline{w}^i \geq \frac{k^i}{1-p} + \underline{v}^i \tag{1}$$

$$\overline{w}^i \geq \frac{k^i}{p} - \overline{v}^i \tag{2}$$

Constraint 1 assures that the agent has no incentive to forecast a success without acquiring information. It determines the wage $\underline{w}^i$ to be paid if a failure is forecasted correctly. Correspondingly, constraint 2 assures that the agent does not forecast a failure without information and determines the wage $\overline{w}^i$, which is paid if a success is forecasted correctly.

If the capital budgeting department is assigned the information acquisition task ($i = c$), private benefits of control are zero since $\underline{v}^c = \overline{v}^c = 0$. In this case a reward

has to be paid for correctly forecasting a success as well as for correctly forecasting a failure in order to satisfy the two constraints. In addition, the reward has to be high enough to make it worthwhile to become informed because the capital budgeting department can always just posit a guess and receive an expected reward of $(1-p)\underline{w}^i$ or $p\overline{w}^i$.[9]

We now turn to the effect of private benefits on the wage structure when the manager is provided with incentives to acquire information ($i = m$). Private benefits of control are associated with a disadvantage as well as an advantage: $\underline{v} > 0$ tightens constraint 1; $\overline{v} > 0$ relaxes constraint 2. That is, the manager has a stronger incentive to forecast a success without evaluating the project than the capital budgeting department because of his private benefits $\underline{v}$ (if $\underline{v} > 0$), which he derives from the project even when it turns out to be a failure. In order to provide the manager with incentives to truthfully evaluate the project instead of just reporting a success, he has to be compensated for his loss in private benefits $\underline{v}$. This is the negative effect of private benefits. However, the manager has a lower incentive to forecast a failure without evaluating the project than the capital budgeting department because of his private benefits $\overline{v}$, which he associates with a successful project. This reduces his incentive to forecast a failure without evaluating the project and is the positive effect of private benefits.

The net effect of private benefits is positive if the positive effect dominates the

[9] Since there are only two possible states, the probability of guessing the correct state is high and providing incentives to acquire information involves a high rent. It is straightforward to show that—given $n \geq 2$ possible states and public signals that are perfectly correlated with the realized states—the rent is given by $\frac{1}{n-1}k$. The rent decreases with the number of possible states and approaches zero as $n$ goes to infinity. The rent approaches zero because the probability of forecasting the correct state without information goes to zero. Forecasting the correct state, however, is the only chance of receiving a reward if the signal and the realized state are perfectly correlated. If both are imperfectly correlated, the rent may be positive even when the number of possible states approaches infinity—because of limited liability.

negative effect. In this case the left hand side of the condition in Lemma 1 is negative, i.e., $(1-p)\underline{v} - \min\{h, p\overline{v}\} < 0$, and private benefits reduce expected wage costs.

If $q = 0$, no signal for the realized state is available when the project is not carried out. Substituting $q = 0$ and $w^i(\overline{\theta}, \underline{\theta}) = 0$ into the information acquisition constraints 1 and 2 and rearranging terms yields

$$w^i(\underline{\theta}) \geq \frac{k^i}{1-p} + \underline{v}^i \tag{1}$$

$$\overline{w}^i \geq w^i(\underline{\theta}) + \frac{k^i}{p} - \overline{v}^i \tag{2}$$

The fact that the wage can only depend on the report when the project is not carried out has no effect on constraint 1 (minimization of expected wage costs implies $w^i(\underline{\theta}) = \underline{w}^i$). However, this wage now has to be paid independently of whether the report is correct or not. This has an effect on constraint 2. Since the wage for forecasting failure is not state contingent, $\overline{w}^i$ has to "include" this wage.

This is important with respect to the effect of the manager's private benefits. $w^m(\underline{\theta})$ includes a compensation for the foregone private benefits $\underline{v}$ if the manager forecasts a failure. Since a false forecast of failure cannot be detected, the manager is certain to receive $\underline{v}$ if he forecasts failure without information. Therefore only the net benefits of control $\Delta v$ reduces the managers incentive to forecast a failure without acquiring information. Hence, the positive effect of private benefits is lower. The net effect is now positive and reduces expected wage costs if $(1-p)\underline{v} - \min\{(1+\frac{p}{1-p})h, p\Delta v\} < 0$. Clearly, this condition can only be satisfied if $\Delta v > 0$.

It is now straightforward to interpret the results in Proposition 1: (1) "$q > 0$ *or* $\Delta v > 0$" is a necessary condition for private benefits to reduce expected wage costs: If $q > 0$, private benefits may reduce expected wage costs even when $\Delta v = 0$; if, however, $q = 0$, private benefits may only reduce expected wage costs if $\Delta v > 0$. (2) $\underline{v} = 0$ implies that there is no disadvantage associated with private benefits and private benefits always reduce expected wage costs. (3) Given $q = 0$ *and* $\Delta v = 0$,

private benefits always increase expected wage costs.

For a given $q$, the advantage of joint project evaluation and project management increases in the success probability, $p$, the sensitivity of private benefits to the projects quality, $\Delta v$, and the manager's cost advantage in evaluating the project, $\Delta k$.

These parameters are not all exogenous. Headquarters may influence the level of private benefits, which managers may derive from failed projects, by being tough and firing managers as soon as possible if failure is revealed. Headquarters may also follow up on projects that were rejected in order to determine whether the rejection was indeed optimal and thereby change a situation where $q = 0$ to one where $q > 0$. This reduces expected wage costs if the manager evaluates the project as well as if the capital budgeting department is responsible for evaluating the project. Firms in which divisional managers are fired as soon as failure of a project is observed and in which information is collected about the quality of rejected project proposals are more likely to have a decentralized decision system in the sense that project evaluation is carried out by divisional managers.

The suggestion to collect information about rejected projects may seem odd at first sight. It is therefore interesting to discuss possible scenarios regarding the observability of a projects quality (state) after the project has been rejected. For example, the relevant information may always be observable even after rejection of the project ($q = 1$) if the relevant information is a future market condition, which is exogenous to the project. It may never be possible to observe a proxy for the realized state ($q = 0$) if the relevant information is to a large extent firm specific. The probability is positive ($q > 0$) if the relevant information is primarily project and not firm specific and if another firm is likely to carry out the project after it has been rejected. Spectacular cases of misjudgment of the potential of new projects in practise, where projects were rejected and subsequently carried out by another corporation, provide evidence that this may indeed be possible. This issue has so

far been neglected in the capital budgeting literature.

# 4 Ex ante effort choice

For the remainder of the paper it is assumed that reported failure is verifiable ex post ($q = 1$). In the previous sections, there was no incentive problem involved in managing the project. In this section it is assumed that the manager has to choose an unobservable effort level $e \in \{e_h, e_l\}$ prior to the investment decision. For example, the manager has to search for profitable investment projects, make strategic decisions with respect to the quality and design of the product, develop a marketing strategy, prepare the market for the new product, and develop a prototype. The effort the manager carries out to fulfill these activities determines the project's success probability. Given high effort, the probability of state $\overline{\theta}$ is $p_h$. If the manager exerts low effort (shirks), this probability is $p_l < p_h$. High effort $e_h$ involves a non-pecuniary cost $c$, while low effort $e_l$ is costless. The $NPV$ without information about the state is assumed to be positive given high effort.

It is assumed that headquarters wants to induce a truthful evaluation of the project as well as high ex ante effort by the manager. If the manager is chosen to evaluate the project, the wage structure has to provide the manager with incentives to exert effort *and* to evaluate the project. If the evaluation activity is assigned to the capital budgeting department, headquarters also assures that the manager has incentives to exert high effort. The divisional manager as well as the capital budgeting department (if assigned a task) decide whether to accept the offer. If accepted, the manager chooses his effort level, and—after the manager's effort choice—the agent who is entrusted with evaluating the project decides whether to become informed and what state to forecast. After receiving the report, headquarters makes the investment decision.

**Lemma 3** *Project evaluation by the manager is optimal if*

$$\underline{v} + \max\{\frac{p_h}{p_h - p_l}c + \frac{2p_h - 1}{1 - p_h}k^m, c + \frac{p_h - p_l}{1 - p_h}k^m - p_l\underline{v}\} - \max\{p_h\overline{v}, \frac{p_h}{p_h - p_l}c\} \leq 2\Delta k.$$

The lemma is proven in the appendix where the optimal wage structures and the expected wage costs are derived. Again, it is difficult to draw any general conclusions. What is important for the present paper is that the introduction of the additional incentive conflict on the side of the divisional manager influences the optimal assignment of the evaluation task.

**Proposition 2** *If the manager has to exert effort prior to the investment decision, the advantage of assigning the project evaluation task to the capital budgeting department increases since it provides the manager with incentives to exert high effort.*

The analysis of the effect of private benefits on the information acquisition problem revealed a trade-off between a negative effect and a positive effect of private benefits. If the manager is to be provided with incentives to exert effort, the trade-off looks quite differently: The private benefits of control are not "lost" if the capital budgeting department evaluates the project. Rather, the threat of losing his private benefits provides the manager with incentives to exert high effort in order to increase the probability that the project is carried out. Assume that no project evaluation occurs (or, alternatively, that the manager's private benefits are zero). The wage structure that induces the manager to exert high effort at minimal costs is given by $\underline{w} = 0$ and $\overline{w} = \frac{c}{\overline{p}_h - \overline{p}_l}$. Given project evaluation by the capital budgeting department, the wage in the case of a success is $\overline{w} = \max\{0, \frac{c}{\overline{p}_h - \overline{p}_l} - \overline{v}\}$. The manager's private benefits are part of the compensation and reduce the wage payment $\overline{w}$ accordingly. If $\overline{v}$ is high enough, project evaluation—or more precisely, the threat that the project is not carried out in state $\underline{\theta}$—is sufficient to induce the manager to exert high effort. If the manager is provided with incentives to evaluate the project, this

effect is reduced as the manager has to be compensated for $\underline{v}$. External project evaluation in a centralized capital budgeting system therefore has important incentive implications.

**Proposition 3** *Assume that the capital budgeting department is responsible for evaluating projects and that the divisional manager is provided with incentives to exert effort. Incentives to evaluate project proposals are provided for a larger set of parameters than if there were no effort problem: Projects are evaluated that would have been accepted without prior evaluation in order to induce effort.*

**Proof.** Providing the capital budgeting department with incentives to evaluate the project is optimal given that the divisional manager is provided with incentives to exert effort $\Leftrightarrow p_h NPV(\overline{\theta}) - 2k^c - \max\{0, \frac{p_h}{p_h - p_l}c - p_h\overline{v}\} > p_h NPV(\overline{\theta}) + (1 - p_h)NPV(\underline{\theta}) - \frac{p_h}{p_h - p_l}c$. Rearranging yields $(1-p_h)|NPV(\underline{\theta})| > 2k^c - \min\{\frac{p_h}{p_h - p_l}c, p_h\overline{v}\}$. The equivalent condition without the effort problem is $(1 - p_h)|NPV(\underline{\theta})| > 2k^c$. ■

Because of the positive external effect of project evaluation on managers' incentives, it may be optimal to have high powered incentives to evaluate projects for the capital budgeting department. Divisional managers' are then quite right if they complain about "too much control" in the sense that projects are evaluated that are "obviously" good projects and should be carried out.

# 5 Conclusion

The paper analyzed the question whether project evaluation and project management should be separated. It has been shown that private benefits of control are *not* sufficient to make a separation optimal even if the divisional manager has no cost advantage in evaluating the project. On the contrary, private benefits of control may actually reduce expected wage costs. Two factors affect whether it is optimal to separate project evaluation and project management over which firms have some

influence: First, the level of private benefits of running an unsuccessful project. Second, the availability of a proxy for the project's quality even after it has been rejected. Firms in which headquarters is tough on divisional managers after project failure and in which even rejected project proposals are followed up on are more likely to have a decentralized decision system in the sense that project evaluation is carried out by divisional managers.

However, if the divisional manager has to exert effort at the initiation stage of the project in order to increase the project's probability of being a success, the advantage of project evaluation by the capital budgeting department increases because "external" project evaluation provides the manager with incentives to exert high effort prior to submitting the investment proposal.

# 6 Appendix

## 6.1 Proof of Lemma 1

Note first that the incentive constraints can be relaxed by reducing $w^i(\overline{\theta},\underline{\theta})$ and $w^i(\underline{\theta},\overline{\theta})$. The lowest wage permitted by the limited liability constraints is zero. It is therefore optimal to choose $w^i(\overline{\theta},\underline{\theta}) = w^i(\underline{\theta},\overline{\theta}) = 0$. Substituting this into the constraints 1-5 and rearranging terms yields

$$q\underline{w}^i + (1-q)w^i(\underline{\theta}) \geq \frac{k^i}{1-p} + \underline{v}^i \tag{1}$$

$$\overline{w}^i - (1-q)w^i(\underline{\theta}) \geq \frac{k^i}{p} - \overline{v}^i \tag{2}$$

$$q\underline{w}^i + (1-q)w^i(\underline{\theta}) \geq \underline{v}^i \tag{3}$$

$$\underline{w}^i + (1-q)w^i(\underline{\theta}) \geq -\underline{v}^i \tag{4}$$

$$p(\overline{w}^i + \overline{v}^i) + (1-p)[q\underline{w}^i + (1-q)w^i(\underline{\theta})] - k^i \geq 0 \tag{5}$$

1 and 2 imply 3 and 4, respectively; jointly they also imply 5. Constraints 1 and 2 are therefore the only constraints that are potentially binding. To derive the optimal wages $\overline{w}^i$, $\underline{w}^i$, and $w^i(\underline{\theta})$ from 1 and 2, two case are distinguished: $q > 0$ and $q = 0$. If $q > 0$, it is optimal to choose $w^i(\underline{\theta}) = 0$: Consider the incentive compatible wages $\widehat{\overline{w}}^i$, $\widehat{\underline{w}}^i$, and $\widehat{w}^i(\underline{\theta}) > 0$; replacing these wages by $\overline{w}^i = \widehat{\overline{w}}^i - (1-q)\widehat{w}^i(\underline{\theta})$, $\underline{w}^i = \widehat{\underline{w}}^i + \frac{(1-q)}{q}\widehat{w}^i(\underline{\theta})$, and $w^i(\underline{\theta}) = 0$, reduces expected wage costs (when $1 > q > 0$) without violating constraints 1 and 2.[10]

It is now straightforward to determine the optimal wage structures for $q > 0$ and $q = 0$.

1. Given $q > 0$: The wage structure that induces information acquisition and revelation at minimal costs is given by $\overline{w}^i = \max\{0, \frac{k^i}{p} - \overline{v}^i\}$, $\underline{w}^i = \frac{1}{q}(\frac{k^i}{1-p} + \underline{v}^i)$,

[10] $E[w^\phi] = p(\widehat{\overline{w}}^\phi - (1-q)\widehat{w}^\phi(\underline{\theta})) + (1-p)q(\widehat{\underline{w}}^\phi + \frac{(1-q)}{q}\widehat{w}^\phi(\underline{\theta})) = p\widehat{\overline{w}}^\phi + (1-p)[q\widehat{\underline{w}}^\phi + (1-q)\widehat{w}^\phi(\underline{\theta})] - p(1-q)\widehat{w}^\phi(\underline{\theta}) = E[\widehat{w}^\phi] - p(1-q)\widehat{w}^\phi(\underline{\theta})$, i.e., $E[w^\phi] < E[\widehat{w}^\phi]$ if $0 < q < 1$.

and $w^i(\overline{\theta},\underline{\theta}) = w^i(\underline{\theta},\overline{\theta}) = w^i(\underline{\theta}) = 0$. Expected wage costs are

$$\begin{aligned} E[w^i] &= k^i + (1-p)\underline{v}^i + \max\{0, k^i - p\overline{v}^i\} \\ &= 2k^i + (1-p)\underline{v}^i - \min\{k^i, p\overline{v}^i\}. \end{aligned}$$

2. Given $q = 0$: The optimal wage structure is given by $\overline{w}^i = \max\{0, \frac{k^i}{p} + \frac{k^i}{1-p} - (\overline{v}^i - \underline{v}^i)\}$, $w^i(\underline{\theta}) = \frac{k^i}{1-p} + \underline{v}^i$, and $w^i(\overline{\theta},\underline{\theta}) = 0$; and

$$\begin{aligned} E[w^i|q &= 0] = k^i + (1-p)\underline{v}^i + \max\{0, (1+\frac{p}{1-p})k^i - p(\overline{v}^i - \underline{v}^i)\} \\ &= (2+\frac{p}{1-p})k^i + (1-p)\underline{v}^i - \min\{(1+\frac{p}{1-p})k^i, p(\overline{v}^i - \underline{v}^i)\}. \end{aligned}$$

## 6.2 Proof of Lemma 3

(1) Joint project evaluation and project management: The wage structure, which induces the manager to exert high effort and to acquire and reveal information, has to satisfy the following incentive constraints:[11]

$$p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{w}^m - k^m - c \geq p_l(\overline{w}^m + \overline{v}) + (1-p_l)\underline{w}^m - k^m \quad \text{(I)}$$

$$p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{w}^m - k^m - c \geq p_l(\overline{w}^m + \overline{v}) + (1-p_l)\underline{v} \quad \text{(II)}$$

$$p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{w}^m - k^m - c \geq (1-p_l)\underline{w}^m \quad \text{(III)}$$

$$p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{w}^m - k^m - c \geq p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{v} - c \quad \text{(IV)}$$

$$p_h(\overline{w}^m + \overline{v}) + (1-p_h)\underline{w}^m - k^m - c \geq (1-p_h)\underline{w}^m - c \quad \text{(V)}$$

as well as the limited liability constraints.

Constraint I assures that the manager has not incentive to choose the low effort level. Constraints II and III assure that the manager has no incentive to choose the low effort level *and* to remain uninformed. Constraints IV and V are the information acquisition constraints given a high effort level.

[11] It is easy to check that—as in the case without the ex ante effort problem—the truth telling constraints and the participation constraint are not binding. These constraints are therefore omitted.

Since $(1-p_l)\underline{w}^m > (1-p_h)\underline{w}^m - c$, III implies V. Rearranging the constraints I to IV yields

$$\begin{aligned}
(p_h-p_l)(\overline{w}^m+\overline{v}-\underline{w}^m) &\geq c && \text{(I)}\\
(p_h-p_l)(\overline{w}^m+\overline{v}-\underline{w}^m)+(1-p_l)(\underline{w}^m-\underline{v}) &\geq k^m+c && \text{(II)}\\
p_h(\overline{w}^m+\overline{v})-(p_h-p_l)\underline{w}^m &\geq k^m+c && \text{(III)}\\
(1-p_h)(\underline{w}^m-\underline{v}) &\geq k^m && \text{(IV)}
\end{aligned}$$

Since $(1-p_l)(\underline{w}^m-\underline{v}) > (1-p_h)(\underline{w}^m-\underline{v})$, I and IV jointly imply II. Note that reducing $\underline{w}^m$ relaxes I and III. IV therefore yields $\underline{w}^m = \frac{k^m}{1-p_h}+\underline{v}$. Substituting $\underline{w}^m$ in I and III and rearranging terms, one obtains

$$\begin{aligned}
\overline{w}^m &\geq \frac{c}{p_h-p_l}+\frac{k^m}{1-p_h}-(\overline{v}-\underline{v}) && \text{(I)}\\
\overline{w}^m &\geq \frac{c}{p_h}+\frac{1-p_l}{p_h(1-p_h)}k^m-\frac{p_l}{p_h}\underline{v}-(\overline{v}-\underline{v}) && \text{(III)}
\end{aligned}$$

The optimal wage structure, which induces the manager to exert high effort and to evaluate the project at minimal costs, is given by $\underline{w}^m = \frac{k^m}{1-p_h}+\underline{v}$, $\overline{w}^m = \max\{\frac{c}{p_h-p_l}+\frac{k^m}{1-p_h}-(\overline{v}-\underline{v}), \frac{c}{p_h}+\frac{1-p_l}{p_h(1-p_h)}k^m-(\overline{v}-\underline{v})-\frac{p_l}{p_h}\underline{v}\}$ and zero for all other wages. Expected wage costs are

$$\begin{aligned}
E[w^m] &= \max\{\frac{p_h}{p_h-p_l}c+\frac{1}{1-p_h}k^m+\underline{v}-p_h\overline{v}, c+\frac{2-(p_h+p_l)}{1-p_h}k^m+(1-p_l)\underline{v}-p_h\overline{v}\}\\
&= 2k^m+\max\{\frac{p_h}{p_h-p_l}c+\frac{2p_h-1}{1-p_h}k^m+\underline{v}-p_h\overline{v}, c+\frac{p_h-p_l}{1-p_h}k^m+(1-p_l)\underline{v}-p_h\overline{v}\}\\
&= 2k^m+\underline{v}-p_h\overline{v}+\max\{\frac{p_h}{p_h-p_l}c+\frac{2p_h-1}{1-p_h}k^m, c+\frac{p_h-p_l}{1-p_h}k^m-p_l\underline{v}\}
\end{aligned}$$

(2) Separate project evaluation and project management: We search for the least cost wage structure for which high effort by the manager and project evaluation by the capital budgeting department constitute a Nash equilibrium. The capital budgeting department evaluates the project at minimal costs given high effort by the manager if $\overline{w}^c = \frac{k^c}{p_h}$, $\underline{w}^c = \frac{k^c}{1-p_h}$, and $w^c(\overline{\theta},\underline{\theta}) = w^c(\underline{\theta},\overline{\theta}) = 0$. This wage structure directly follows from the discussion of the case without ex ante effort. The wage

structure, which induces the manager to exert high effort given project evaluation by the capital budgeting department, has to satisfy the incentive constraint

$$p_h(w^m(\overline{\theta}) + \overline{v}) + (1 - p_h)w^m(\underline{\theta}) - c \geq p_l(w^m(\overline{\theta}) + \overline{v}) + (1 - p_l)w^m(\underline{\theta})$$

as well as the limited liability constraint, where $w^m(\theta)$ is the manager's wage if the capital budgeting department reports $\theta$.[12] The optimal wage structure, which induces the manager to exert high effort at minimal costs, is given by $w^m(\overline{\theta}) = \max\{0, \frac{c}{p_h - p_l} - \overline{v}\}$ and $w^m(\underline{\theta}) = 0$. Total expected wage costs are

$$E[w^c + w^m] = 2k^c + p_h \max\{0, \frac{c}{p_h - p_l} - \overline{v}\}.$$

Lemma 3 directly follows from comparing the expected wage costs for two alternatives.

[12]It is easy to check that the manager's participation constraint is implied by the incentive constraint.

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