

# Diversification and Delegation in Firms<sup>a</sup>

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## Abstract

This paper shows how separation of ownership and control may arise as a response to overload costs, despite agency costs, and how conglomerates arise as solution to information asymmetries in capital markets. In a context where entrepreneurs have the ability to run projects and improve their future cash flow, there could be rationing of credit due to moral hazard between entrepreneurs and investors. Diversification could mitigate the moral hazard problem. However for a single entrepreneur running many different projects might be increasingly costly due to overload costs. Delegating the running of projects to several managers can not only reduce overload costs, but also the moral hazard problem of external financing. In this paper we show that delegation can be the only way to exploit the gains from diversification when overload costs of diversification are high; delegation thus is the key ingredient to be able to diversify.

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# 1 Introduction

This paper is about the corporate structure, the organizational structure, and the financial structure of firms, and how they relate to each other. We often model the firm as producer of a single good. In reality, however, many firms produce more than one single good and some firms are indeed quite diversified. Why do then firms diversify and is diversification good or bad from a social point of view? Merging different types of activities inside one firm could without any doubts be beneficial whenever there are economies of scope in production, but why would conglomerates, whose main activity is to undertake projects in unrelated lines of business, arise?

A standard result in corporate finance is that, with perfect capital markets, conglomerates do not add any value. The theoretical explanation is that if the investors set of opportunities is not restricted, each single investor can replicate on his own the diversified portfolio of a conglomerate.<sup>1</sup> Furthermore, investors are able to diversify at lower costs than firms do, as there are agency costs in a divisionalized structure that runs many different lines of business as the conglomerate firm does. This implies that there are no benefits from this type of diversification, but firms have better to focus their activity in order to exploit the gains from specialization. How come then that we observe conglomerates?

In the literature there are several explanations as to why firms diversify, although there are no synergies. Many of these explanations are not consistent with the efficient use of resources and some of them are not even consistent with profit maximization. One explanation offered is for example that managers are empire builders, and therefore firms with separation between ownership and control will be too diversified.<sup>2</sup>

However, when capital markets are imperfect, firm diversification may add value. For instance, from the literature on financial intermediation we know that diversification is the mean through which intermediaries can provide liquidity and information services to investors.<sup>3</sup>

The aim of this paper is to explain the role of conglomerates as a solution to information problems in the capital market. We show that firm diversification may be beneficial although it gives rise to agency costs. In a context where entrepreneurs have the ability to run projects and to improve the future cash flow of projects by exercising effort, but have no capital to start the projects, valuable projects might not

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<sup>1</sup>See Brealey and Myers (1991), Chap.33, pp.854-856 for a discussion of the principle of value additivity of mergers between firms.

<sup>2</sup>See as a reference Jensen (1986) and Shleifer and Vishny (1989). Li and Li (1996) show in a model with empire building managers that diversification can be beneficial as it increases the effectiveness of debt as a bonding device.

<sup>3</sup>The standard references are Diamond and Dybvig (1983) and Diamond (1984). Also in the financial intermediation literature, however, there are arguments against diversification. One is that specialization in monitoring similar projects adds value. See for instance Hellwig (1998) for a discussion of the trade-off between specialization and diversification. In Winton (1999) diversification can be bad when projects in different sectors are subject to correlated shocks.

be funded. This rationing occurs as there is moral hazard between the entrepreneur, who runs the project, and external investors, because they do not observe the effort choice of the entrepreneur.

It has been shown that diversification by a borrower, debt financed, increases the borrower's incentive to exert effort.<sup>4</sup> The intuition is that debt makes the agent residual claimant in all states except in bankruptcy and the probability of bankruptcy decreases with diversification. As a matter of fact in some cases non-risky debt maximizes the incentive by the agent exercising the effort. However for a single entrepreneur running many different projects might be increasingly costly due to overload. In other words if limited attention implies that the time spent on each single project affects the time available for the other projects, overload costs might become important. Thus a single entrepreneur might not be able to diversify as much as he would like, if he is going to run all the projects himself.

In this paper we show that delegating the running of projects to several managers can keep overload costs down, although it introduces agency costs, as there is need to monitor the efforts of the managers. Hence, separation of ownership and control arises in response to overload costs. As a matter of fact, a wealthy entrepreneur, who does not need external finance and thus does not diversify, but have capital enough to finance a large number of projects, will indeed delegate the running of projects to managers because this allows to better exploit his managerial skill.

A self-financed entrepreneur will only delegate the running of projects to managers when overload costs are large compared to agency costs. However, an entrepreneur that need external finance has stronger incentives to delegate. First of all, the entrepreneur may be forced to diversify to be able to raise external finance and delegation can be the key ingredient to be able to diversify. Secondly, we show that delegation reduces the moral hazard problem of external finance. In the paper we show that under some circumstances, building a conglomerate is the only solution to overcome asymmetry of information in capital markets.<sup>5</sup>

Our paper thus suggests that we should not worry too much about the agency costs of conglomerates, as they come with the solution of the asymmetric information financing problem. What we should analyze are instead the ways to exploit the gains from diversification. Conglomerates are one possible way to exploit these gains when overload costs prove to be important.

Cross-subsidization within conglomerates has attracted lot of attention, and the

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<sup>4</sup>See Cerasi and Daltung (2000) for a proof of this result in a context where an intermediary has to exerce an unobservable effort in monitoring several projects. This result hinges on the effort choice not being observable to investors. Boot and Schmeits (2000) show that, if there is a positive probability that the effort choice will be observable to investors, there are cases in which diversification reduces the effort level.

<sup>5</sup>The idea that diversification adds value only when there is separation of ownership and control is also in Markides and Williamson (1996). However they focus on economies of scope, while we concentrate on the benefits of delegation for external finance.

common opinion seems to be that there is misallocation of funds inside the conglomerate.<sup>6</sup> This paper shows that cross-subsidization among subsidiaries in a conglomerate actually is beneficial when it allows the firm to make more credible promises to investors and thereby to reduce the moral hazard in external financing.

There is evidence that conglomerates trade, on average, at a discount relative to a portfolio of single-segment firms in the same industries<sup>7</sup>. This has been taken as evidence that conglomerates are not profitable. However, this paper shows that conglomerates can be a solution to information problems in the capital market. Firms' head-quarters provide information services to investors, i.e. head-quarters monitor managers of the different divisions within the same conglomerate on behalf of investors. Thus the return of the conglomerate's shares should actually be lower compared to the return on equity in firms where the investors have to do the monitoring by themselves.

Our paper is related to the literature on multiple agents within the principal-agent literature.<sup>8</sup> In contrast to this literature, however, we have two moral hazard layers. The paper is in fact closely related to Quian (1994), where incentives are studied in order to find the optimal hierarchical structure in firms with delegation. There are two aspects in common: the first is the idea that the larger the span of control of the supervisor, the less effective is his monitoring; the second is that, in a context where efforts are non observable, delegation takes place in the form of efficiency wages contracts, i.e. with a mixture of monetary benefits and monitoring by the principal. However our paper differs from Quian's paper in that we assume that the owner of the firm does not have enough inside capital and this explains why his monitoring effort can be insufficient. It is the financial structure that provides proper incentives to monitor to the owner.

This paper is also related to the management literature on the optimal scope of firms. Our paper contrasts with the idea that narrowness is valuable for firms.<sup>9</sup> We show that, despite diseconomies of scale in monitoring, it is better to add unrelated lines of business to the core business of the firm to strengthen top management incentives to monitor.

The structure of the paper is as follows. First, in the next section, we set up the model. In section 3 we discuss the conditions under which a self-financed entrepreneur would like to delegate to avoid overload costs, although this introduces agency costs inside the firm. In section 4 we show that when there is need for external finance and effort is not observable, delegation might be even more beneficial than in the

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<sup>6</sup>See Rajan et al. (2000) for a comprehensive analysis of this issue.

<sup>7</sup>See for instance Berger and Ofek (1995) among others for reference to evidence of a diversification discount.

<sup>8</sup>The references are Holmstrom (1982) and Holmstrom and Milgrom (1990).

<sup>9</sup>For instance Rotemberg and Saloner (1994) show that focusing on fewer lines of business is better for incentive reasons in innovative firms.

case of self-financed entrepreneurs as it helps to reduce the moral hazard between entrepreneurs and investors. Finally in section 5 we show that, when overload costs are too high for a diversified entrepreneur to be able to raise any external funding, delegating the task of running the projects to managers inside the firm can make the firm viable, thus explaining the rise of conglomerates.

## 2 The setup

Consider a one-period economy in which risk-neutral agents are endowed with different amounts of capital. There are two types of investment technology in the economy. There is a safe constant-return technology which requires capital and returns  $y$  per unit of capital. There are also indivisible projects which require capital and some management skill. Each project requires an initial input of one unit of capital. An agent must run the project in order for it to return anything. There are two types of agent in the economy; entrepreneurs who have the ability to run projects, and investors, who do not have this ability. We assume that there are infinitely many projects in the economy, but that there is a limited number of entrepreneurs so that management skill is a scarce resource in the economy. Therefore the total endowment of capital exceeds the total number of projects seeking finance.

Project cash flows are assumed to be stochastic and independently distributed. The expected return of a specific project depends on how much effort the entrepreneur puts into the project. Each project returns  $R$  in case of success and  $0$  in case of failure. The probability of success of the project,  $p$ ; depends on the effort level,  $e$ ; according to the following function:

$$p(e) = p_L + e\Phi p \quad (= p_H \text{ if } (1 - e)\Phi p);$$

where  $\Phi p = p_H - p_L > 0$  and  $e \in [0; 1]$ : By putting effort into the project the entrepreneur can increase the probability of success of the project from  $p_L$ . If the project is badly run, that is if the entrepreneur does not exert any effort, the probability of success is  $p_L$ , but if the entrepreneur puts enough effort into the project ( $e = 1$ ) it will with certainty have the highest probability of success,  $p_H$ .

We assume that only properly run projects are worth financing, while without effort the net present value of the project is negative, that is:

**Assumption 1**  $p_L R < y$ :

Assume that effort is costly to the entrepreneur and that the marginal cost of effort is increasing. Moreover, one entrepreneur can run several projects, but the effort cost is increasing more than proportionally with the number of projects, due to overload. This cost structure is captured by the following cost function

$$c(e) = \frac{c_1}{2} \sum_{i=1}^n e_i^2 + \frac{c_2}{2} \sum_{i=1}^n \sum_{j \neq i} e_i e_j;$$

where  $\underline{e} = (e_1, \dots, e_n)$  is a vector of efforts,  $n$  is the number of projects run by the entrepreneur, and  $c_1$  and  $c_2$  are positive parameters. A strictly positive value of  $c_2$  implies that the marginal cost of running a particular project increases with the number of projects run by the entrepreneur. Furthermore, it implies that increasing the effort put into the running of one project does not only increase the marginal cost of running that specific project, but also the marginal cost of running all the other projects. Hence, when  $c_2 > 0$  there are overload costs.

We assume that:

**Assumption 2**  $\Phi pR > c_1$ :

This implies that the social marginal return from effort exceeds the social marginal cost of effort for any effort level when the entrepreneur runs one project alone. We also assume that:

**Assumption 3**  $p_H R_i - y_i - \frac{c_1}{2} > 0$ :

This assumption implies that the project is socially valuable.

Finally, we assume that effort levels are not observable to outsiders. An entrepreneur, however, can use his management skill to find out the true probability of success of a project run by another entrepreneur. We assume that if the entrepreneur spends  $m$  units of effort on monitoring a project, he will find out with probability  $m$  the expected return of the project. The effort cost of monitoring is assumed to be the same as the effort cost of running a project.<sup>10</sup> The key assumption, however, is that monitoring more than one project is increasingly costly for the same reason as running more than one project.

We would like to study the incentives of owners of firms to diversify and delegate the running of projects to managers and how this incentive is affected by the financial structure of the firm. Let us first consider, as a benchmark, the incentives of entrepreneurs who have enough inside capital to be able to run their projects without seeking external finance.

### 3 The incentive to delegate in self-financed firms

As management skill is a scarce resource in the economy, entrepreneurs can earn rents on running projects. Therefore, an entrepreneur may want to run more than

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<sup>10</sup>There are two justifications for this. First, if there was to be a difference between the two costs, running a project would be presumably more costly than monitoring somebody else running the project. But since the paper wants to discuss the benefits of delegating the running activity to managers, our assumption is conservative. Secondly, to monitor a project the agent must have had some experience in running some other projects himself to be able to understand the quality of a specific project and make forecast on the cash flow. Thus, monitoring a project embodies some initial learning cost which is likely to be larger than the monitoring cost.

one project although it involves overload costs. Since there is an unlimited number of projects in the economy, an entrepreneur can carry out as many projects as he wants. In this section we discuss the benchmark case of an entrepreneur who is going to finance the projects himself. We will also discuss whether self-financed entrepreneurs prefer to run the projects on their own or to delegate the task of running the projects to managers. Given the assumed cost structure, each single entrepreneur might find too costly to run several projects on his own. Thus he might find profitable to delegate the running of projects to managers in order to avoid overload costs. On the other hand however delegation involves agency costs as the manager faces a moral hazard problem due to the private cost of effort. Therefore the answer will depend upon the balance between overload costs and agency costs.

### 3.1 The self-financed entrepreneur

We first define as a benchmark the optimal number of projects that a wealthy entrepreneur would like to undertake given that he is going to finance and run the projects himself. From Assumption 3 it follows that the entrepreneur will at least run one project. Since there are many more projects than entrepreneurs, it could be optimal for the entrepreneur to run more than one project in spite of overload costs. The entrepreneur chooses the optimal number of projects in order to maximize

$$\sum_{i=1}^n p_i(e_i)R_i - ny_i - c(\underline{e});$$

where  $\underline{e} = (e_1, \dots, e_n)$  is the vector of efforts of running projects and  $p_i(e_i) = p_H - (1 - e_i)\Phi p$ . The optimal effort that the entrepreneur will put into project  $i$ , when running  $n$  projects, is given by the following first order condition (FOC):

$$\Phi p R_i - c'_i(\underline{e}) \leq 0; \quad (1)$$

In the symmetric equilibrium<sup>11</sup>, i.e. when  $e_i = e$  for all  $i$ , the FOC becomes:

$$\Phi p R_i - c \leq 0; \quad (2)$$

where  $c = c_1 + (n - 1)c_2$  is the marginal cost of an additional unit of effort. Running more than one project will eventually reduce the optimal effort into each project. Substituting the optimal symmetric effort,  $e^n(n)$ , into the total profits of the entrepreneur, we get the equilibrium profit function:

$$\pi_n(e^n) = n \left[ p(e^n)R_i - y_i - \frac{c}{2}(e^n)^2 \right] = n \left[ \frac{1}{4n}(e^n) \right]; \quad (3)$$

<sup>11</sup>We show in the Appendix that for  $c_1 > c_2$  the only equilibrium for the choice of the efforts is the symmetric one.

where  $\frac{1}{4}n(e^a) = \frac{1}{4} \frac{n(e^a)}{n}$ ; the per-project profit, is decreasing in the number of projects, directly, through  $n$ , and, indirectly, through the effort  $e^a$ ; which is decreasing in the number of projects whenever eq.(2) is satisfied with equality.

By applying the Envelope Theorem, we can compute the net gain from running an additional project for the entrepreneur's profits:<sup>12</sup>

$$\frac{d \pi_n(e^a)}{dn} = \frac{1}{4}n(e^a) - \frac{nc_2}{2}(e^a)^2. \quad (4)$$

The derivative in eq.(4) can be positive or negative for  $n = 1$  depending on the size of overload costs. From Assumption 3 it follows that, for sufficiently small  $c_2$ , the entrepreneur may want to run more than one project. However, since  $e^a$  eventually decreases with  $n$ , it follows from Assumption 1 that there is a limit to the number of projects that the entrepreneur wants to run ( $\frac{1}{4}n(0) = p_L R - y$ ). Denote this number by  $n^a$ : We have that  $n^a$  decreases with  $c_2$  and that as  $c_2$  approaches zero,  $n^a$  goes to infinity.

### 3.2 The incentive to delegate

When overload costs are large, is it better to delegate the task of running the projects to different managers in order to limit the costs? The benefits of delegation have to be counterbalanced by the costs, because delegation introduces agency costs.

Let's analyze the case of a wealthy entrepreneur, called the owner, undertaking  $n$  projects. The owner hires  $n$  entrepreneurs (without capital), called the managers, to run the projects. Hence, each manager runs only one project.<sup>13</sup>

Managers must be compensated for running projects. Assume that the owner promises to pay the same wage,  $w$ , to every manager. In order to maximize the incentives of the manager to exert effort, the manager should not get any return if the project fails or if the owner finds out that he has shirked, that is if the owner finds out that the manager has chosen an effort level,  $e$ , smaller than 1. Hence, the manager is promised a salary  $w$ , but the owner is allowed to fire him without paying anything if the project fails or if he finds out that the manager has shirked.<sup>14</sup> Given this contract, manager  $i$  chooses his effort to maximize his utility

$$U_i = q_i w - \frac{c_1}{2} (e_i)^2;$$

<sup>12</sup>Note that this equation holds true even when the FOC for the optimal effort choice is not binding, since in that case  $de^a(n)/dn = 0$ :

<sup>13</sup>This hierarchical structure minimizes overload costs. We discuss further this assumption in the conclusions.

<sup>14</sup>We assume that the principal can fire the manager without verifiability of the efforts. This assumption fits with the fact that managers are given much more risky contracts than simple workers and thus there is no need for a good cause to fire a manager, while this is necessary in the case of a worker.

where  $q_i = e_i p_H + (1 - e_i)(1 - m_i)p_L$  and  $m_i$  is the effort of the owner when monitoring the manager. If the manager chooses the effort level  $e_i$ , with probability  $e_i$  the project will have a high expected return and the manager will get his salary if the project succeeds. With probability  $(1 - e_i)$  the project will have a low expected return and the manager gets the salary when the project succeeds only if the owner does not find out the true expected return of the project. Whether or not the owner learns the expected return of the project depends on how much effort,  $m_i$ , he puts into monitoring this project. With probability  $(1 - m_i)$  the owner will not be able to verify that the expected return of the project is low, and the manager gets his salary if the project succeeds. The FOC for the manager's effort choice, that is his incentive compatibility (IC) constraint is:

$$(\Phi p + m_i p_L)w - c_1 e_i = 0: \quad (5)$$

Hence, monitoring by the owner will increase the incentive of the manager to put effort into the project.<sup>15</sup> Whether the IC constraint of the manager is binding will depend on the salary. The profit of the owner in the delegation case will always be lower if the IC constraint of the manager does not bind than if it binds, since a non-binding constraint means that the salary could be reduced without reducing the expected return of the project. We will consider the case in which the manager's IC constraint is binding.<sup>16</sup>

Since each manager is paid out of the return of his project, there is no cross-subsidization between projects. This means that the managers could either run independent firms or be division managers within the same firm; there is no difference between these two cases. Hence, the owner can either own  $n$  small firms or one large firm. In other words, the owner has no incentive to set up a conglomerate, although there are no costs from doing it. This, as we will show, is different with respect to the case of an owner who needs to raise external finance. In that case the owner will indeed have incentive to build a conglomerate, even under the assumption that he pays all managers the same salary.

Let us now examine the incentive of the owner to monitor the managers. We assume that the owner, once he has monitored the project, is in full control of the new manager hired to continue the project after the first has been fired. In order to simplify formulas we assume that this new manager is paid the same wage of all other managers.<sup>17</sup> The expected return of the owner running  $n$  projects can thus be

<sup>15</sup>This framework borrows from Aghion and Tirole (1997) the idea that the efforts of the owner and the manager influence each others and that both efforts are essential for the project. In our model however the two efforts are complements, while in their model they are substitutes.

<sup>16</sup>The salary depends on the market for managers. The manager's IC constraint will bind if there are sufficiently many managers around for there not to be any competition for managers. Delegation could of course be more expensive if there is shortage of managers so that managers have some bargaining power.

<sup>17</sup>This assumption is actually making delegation more costly. One could just assume that this

written as:

$$\sum_{i=1}^n p_i^d(e_i; m_i)(R_i - w) - ny - c(\underline{m}); \quad (6)$$

where  $\underline{m} = (m_1, \dots, m_n)$  is the vector of monitoring efforts and  $p_i^d(e_i; m_i) = p_H (1 - e_i)(1 - m_i) + p_L e_i m_i$  is the probability of success of project  $i$ , that depends upon the efforts of both the manager and the owner.

For a given salary,  $w$ , the owner chooses the monitoring effort for each project to maximize profits in eq.(6). The FOCs are given by

$$(1 - e_i) + e_i m_i \Phi p(R_i - w) - c'_i(m_i) = 0; \quad i = 1, \dots, n; \quad (7)$$

For delegation to be feasible,  $w$  must be positive. If  $w = 0$ , it follows from eq.(5) that  $e_i = 0$  for all  $i$  and the FOC of the owner is equivalent to that in the non-delegation case, that is eq.(1). Hence,  $w = 0$  can be thought of as the owner running the project by himself. For a larger salary the owner reduces his effort. The interesting case is when the FOCs of the owner are satisfied with equality. In this case, the owner, who delegates the project to a manager, exerts less effort compared to the owner running the project himself. Delegation is thus appealing for the owner only if he manages to reduce his effort, otherwise he would prefer to save on the salary  $w$  and run the project himself. If  $e_i = 1$ , the owner has no incentive to monitor the manager. In other words, when  $w$  is large enough, the manager runs the project with maximum effort, although the owner does not monitor him at all.

Let us define the symmetric equilibrium efforts  $(e^*(n); m^*(n))$ . Thus the system of FOCs becomes<sup>18</sup>:

$$(p_H + p_L m^*)w - c_1 e^* = 0; \quad (8)$$

$$(1 - e^*) + e^* m^* \Phi p(R_i - w) - c_2 m^* = 0; \quad (9)$$

where  $c = c_1 + (n - 1)c_2$ : Using Cramer's rule to solve for the equilibrium efforts, we get:

$$m^* = \frac{\Phi p(R_i - w)(c_1 - \Phi p w)}{H}; \quad (10)$$

$$e^* = \frac{w \Phi p(c + p_L(R_i - w))}{H}; \quad (11)$$

where  $H = c_1 c + p_L w \Phi p(R_i - w)$ : In equilibrium the effort levels depend upon the salary; the effort of the owner decreases with the salary, while the effort of the manager increases with the salary. A higher salary means that the owner can rely more on the manager behaving, and therefore can reduce his monitoring effort.

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manager is paid just the alternative salary, but then it could look like we were biasing the result towards delegation.

<sup>18</sup>We focus on symmetric equilibria. It is easy to show that when  $c_1 > c_2$ , there is only a symmetric equilibrium.

Substituting the equilibrium efforts, we derive the equilibrium profits of the owner who delegates the running of  $n$  projects to managers, in a self-financed firm:

$$\pi_n^d(\theta; \kappa) = n \left[ p^d(\theta; \kappa)(R - w) - y - \frac{c}{2}(\kappa)^2 \right] = n \pi_n^d(\theta; \kappa); \quad (12)$$

where  $p^d(\theta; \kappa) = p_H - (1 - \theta)(1 - \kappa)\Phi p$  is the equilibrium probability of success:

### 3.2.1 The focused firm ( $n=1$ )

We will first discuss the incentives to delegate by the owner of a focused firm. When  $n = 1$ ; the profit of the owner is given by

$$p^d(e; m)(R - w) - y - \frac{c_1}{2}m^2;$$

where  $p^d(e; m) = p_H - (1 - e)(1 - m)\Phi p$ : The owner chooses his monitoring effort according to

$$(1 - e)\Phi p(R - w) - c_1m = 0; \quad (13)$$

while the manager according to

$$(\Phi p + mp_L)w - c_1e = 0; \quad (14)$$

There are agency costs when delegating the running of the project to a manager. This can be illustrated as follows. Assume that the owner does not monitor the manager, the IC constraint of the manager then would be:

$$\Phi pw - c_1e = 0:$$

Assume further that the owner pays the manager a salary which induces the same effort level as that of the owner, if he were running the project himself, that is

$$w = \frac{c_1}{\Phi p}e^s(1):$$

From Assumption 2 it follows that  $e^s(1) = 1$ : Substituting this into the profit function, we get:

$$\pi_1^d(e^s; 0) - \pi_1(e^s) = -pw + \frac{c_1}{2}; \quad (15)$$

Substituting  $w$  gives

$$- \frac{(p_L + \Phi p)}{\Phi p}c_1 + \frac{c_1}{2} < 0:$$

Due to agency costs, it is more costly for the owner to pay the manager in order to induce him to run the project, rather than running it himself. The owner can reduce the agency cost somewhat by monitoring the manager. We have thus the following result:

**Proposition 1** The owner of a focused firm does not want to delegate to a manager at a salary for which the manager chooses the same effort of the owner, when running the project himself.

**Proof:** Define  $\hat{e}; \hat{m}$  the effort levels of the owner and the manager in equilibrium, that is the solution to the system of equations (14) and (13). We will show that the profits in delegation,  $\pi_1^d$ ; are lower than the profits without delegation,  $\pi_1$ ; for  $\hat{e} > \hat{m}$ : The difference between the profits can be written as:

$$\pi_1^d(\hat{e}; \hat{m}) - \pi_1(e^a) = (p_L + \hat{e}\Phi p + \alpha(1 - \hat{e})\Phi p)(R - w) - y - \frac{c_1}{2}\alpha^2 - (p_L + e^a\Phi p)R - y - \frac{c_1}{2}(e^a)^2 :$$

The right hand side (RHS) can be rewritten as

$$(p_L + \hat{e}\Phi p)(R - w) + \alpha(1 - \hat{e})\Phi p(R - w) - \frac{c_1}{2}\alpha^2 - (p_L + e^a\Phi p)R - \frac{c_1}{2}(e^a)^2 :$$

From eq.(13) it follows that the second term is equal to  $\frac{c_1}{2}\alpha^2$ : Using this and rearranging terms gives

$$\hat{e}\Phi pR - (p_L + \hat{e}\Phi p)w + \frac{c_1}{2}\alpha^2 - e^a(\Phi pR - \frac{c_1}{2}e^a) :$$

We will now show that

$$(p_L + \hat{e}\Phi p)w > c_1\hat{e}^2 :$$

Hence,

$$w = \frac{c_1\hat{e}}{(\Phi p + \alpha p_L)} ;$$

and we should show that

$$(p_L + \hat{e}\Phi p)\frac{c_1\hat{e}}{(\Phi p + \alpha p_L)} > c_1\hat{e}^2 :$$

By multiplying both sides by  $\frac{\Phi p + \alpha p_L}{c_1\hat{e}}$  and subtracting  $\hat{e}\Phi p$  we get

$$p_L > \hat{e}\alpha p_L$$

which indeed holds true, since  $\hat{e}$  and  $\hat{m}$  cannot be both equal to one simultaneously.

Hence we have that

$$\pi_1^d(\hat{e}; \hat{m}) - \pi_1(e^a) < \hat{e}\Phi pR - c_1\hat{e}^2 + \frac{c_1}{2}\alpha^2 - e^a(\Phi pR - \frac{c_1}{2}e^a) :$$

Rewriting the RHS, we have that

$$\pi_1^d(\hat{e}; \hat{m}) - \pi_1(e^a) < \hat{e}(\Phi pR - \frac{c_1}{2}\hat{e}) - e^a(\Phi pR - \frac{c_1}{2}e^a) + \frac{c_1}{2}\alpha^2 - \frac{c_1}{2}e^a^2 : \quad (16)$$

We have that the first term of the RHS is non-positive, since  $e(\Phi p R_j - \frac{c_1}{2}e)$  is increasing in  $e$  for all  $e < e^a$  and equal to zero for  $e = e^a$ , and indeed  $\hat{e} > e^a$ : Also the second term is negative if  $\hat{e} > \hat{m}$ : Q.E.D

Hence, we can conclude that the owner of a focused firm does not want to pay a manager for doing most of the job running the project. This is not surprising, since delegation introduces an agency cost for the owner. However, we can show that the benefits of delegation are potentially larger in a firm that undertakes many projects when the owner faces overload costs. As pointed out, delegation allows the owner to reduce the effort into each project and to substitute his own effort with the manager's effort. This may indeed reduce costs, since the manager does not face any overload costs. Let us therefore consider the case in which the firm invests in several projects, that is when  $n > 1$ :

### 3.2.2 The unfocused firm ( $n > 1$ )

Let us discuss whether an owner of an unfocused firm would like to delegate. We will first show that the incentive to delegate is larger in a unfocused firm compared to a focused firm. We will also show that there are cases in which the owner actually wants to delegate despite internal agency costs arising from the delegated structure. Then we will argue that a hierarchial structure allows the owner to increase the size of the firm, therefore exploiting better his management skill.

**Proposition 2** The owner of a unfocused firm has larger incentives to delegate compared to the owner of a focused firm.

**Proof:** Assume that the owner gives the managers a salary such that

$$w = \frac{c_1}{\Phi p} e^a(n); \quad (17)$$

where  $e^a(n)$  is the effort level chosen by the owner when running the projects himself given in eq.(2). Assume that  $n$  is large enough for eq.(2) to be fulfilled with equality. Then we have

$$e^a(n) = \frac{\Phi p R_j}{c}$$

If the owner does not monitor the managers, substituting the salary in eq.(17) into the IC constraint of the manager, eq.(5), implies that each manager will choose the effort level  $e^a$ . Then the difference in profits per-project can be written as

$$\pi_n^d(e^a; 0) - \pi_n(e^a) = \int p w + \frac{c}{2} (e^a)^2;$$

Substituting  $w$ ; gives

$$\pi_n^d(e^a; 0) - \pi_n(e^a) = \int \frac{(p_L + \Phi p e^a)}{\Phi p} c_1 e^a + \frac{c}{2} (e^a)^2;$$

which is equal to

$$e^{\pi} \geq \frac{p_L}{\Phi p} c_1 + c_2 e^{\pi} + \frac{1}{2} c e^{\pi} \quad (18)$$

The owner has incentive to delegate whenever the term within the parentheses is positive. Since, according to eq.(2),  $c e^{\pi} = \Phi p R$  for any  $n$  sufficiently large for the FOC of the owner to be binding, and since  $e^{\pi}$  decreases with  $n$ ; the term within the parentheses increases with  $n$ . Q.E.D.

Through delegation, the owner can save on overload costs. This benefit increases with the size of the firm. Now, we will show that there are parameter values for which the owner indeed wants to delegate.

Let us discuss whether the owner would like to delegate, when the number of projects is the optimal number of projects,  $n^{\pi}$ ; in the previous section. If he would like to delegate in that case, a fortiori he certainly would like to delegate if he were allowed to freely choose the number of projects. We postpone the discussion about the optimal number of projects in this case. Before we have assumed that the owner does not monitor at all the managers. However, the owner might want to monitor the managers, although monitoring involves overload costs, as he could reduce the salary.

Now we will show that there are conditions under which delegation dominates non-delegation.

**Proposition 3** There are parameter values for which an entrepreneur would find optimal to delegate the running of projects to managers.

*Proof:* Consider the following numerical example:

$$R = 3; p_H = 0.7; p_L = 0.3; y = 1; c_1 = 0.25; c_2 = 0.05; n = 20:$$

Substituting the parameter values into the FOC of an owner who runs the projects himself given by eq.(2) gives, for a binding condition,  $e^{\pi} = 1$ : This in turns implies a probability of success for each project  $p^{\pi} = 0.7$ . The portfolio return is  $p^{\pi} R = 2.1$ ; larger than  $y$ , so the entrepreneur would prefer to run projects rather than investing in the safe alternative asset. Notice that  $n^{\pi} = 20$  is the optimal number of projects that maximizes profits in eq.(4). The maximum profits of the owner are then  $\pi_{20}(e^{\pi}) = 10$ :

However, if the owner delegates the running of projects he could do better. For instance, this is true when the salary is 0.25. Substituting the parameter values into eq.(10) and (11) for  $n^{\pi} = 20$ ; gives  $\bar{m} = 0.22034$  and  $\bar{b} = 0.74576$ ; which in turns implies a probability of success  $p^d = 0.62071$ : This means that the average portfolio return net of salaries,  $p^d(R - w) = 1.6139$ ; is larger than  $y$ : Furthermore, if the owner delegates the running of the projects to 20 managers he can earn  $\pi_{20}^d(\bar{b}, \bar{m}) = 11.694 > 10$ . Since the manager gets at least his reservation utility, that is  $U_i(\bar{b}) = 0.16308 > 0$ ; this solution is feasible and the owner would prefer it to running the  $n^{\pi} = 20$  projects on his own. Q.E.D.

This result depends upon the fact that effort costs are increasing in the number of projects and that delegating allows the owner to reduce overload costs. However, delegation introduces agency costs so that this result holds true whenever overload costs overcome internal agency costs.

Notice that in this specific example, when  $n = 1$  it turns out that the effort of the manager is larger than the monitoring effort of the owner, that is  $e = 0.87987 > m = 0.49973$ : In the previous subsection, we have shown that the owner would not like to delegate when running only one project. Still, the above Proposition holds true; thus the gains from delegation increase with the number of projects.

In the numerical example, the benefits of delegation come through the savings on overload costs, since the owner monitors less compared to the effort he has to exercise when he runs the project himself. Delegation could also be beneficial as, under some conditions, it increases the overall probability of success of each project.

**Proposition 4** When the entrepreneur, running the project himself, chooses an effort level smaller than 0.5, delegation increases the probability of success of the project.

*Proof:* When delegating, the probability of success is  $p^d(e; m) = p_H i (1 i e)(1 i m) \Phi p$ : Substituting from eq.(9), it follows that the equilibrium probability of success for each project can be written as:

$$p^d(e; m) = p_H i \frac{c}{\Phi p(R i w)} m(1 i m) \Phi p:$$

We have that  $m = e^*$  for  $w = 0$ , that is when  $w = 0$  the owner chooses the same effort level as if he were running the project himself. Since  $m$  decreases with the salary, and  $m(1 i m)$  reaches its maximum for  $m = \frac{1}{2}$ ; it follows that  $p^d$  increases monotonically with the salary when the owner, running the projects himself, exercises an effort level smaller than 0.5. Q.E.D

Thus, when the owner runs several projects, putting little effort into each of them due to overload, he would have even stronger incentives to delegate. Moreover, the owner might want to finance a larger number of projects compared to the non-delegation equilibrium. We have in fact that:

$$\frac{d i_n^d(e; m)}{dn} = \frac{1}{4} \frac{d i_n^d(e; m)}{dn} i \frac{nc_2}{2} m^2 + n(1 i m) \Phi p(R i w) \frac{de}{dn}: \quad (19)$$

The sum of the first two terms in eq.(19) is larger than the derivative of the profits in the non-delegation case given by eq.(4), whenever the owner prefers to delegate, for a given number of projects. The last term in eq.(19), however, is negative. Increasing the number of projects reduces monitoring by the owner and therefore the effort of the manager. Hence we cannot generally conclude that the owner would like to finance more projects when delegating. However, in the numerical example in Proposition 3

the owner would indeed like to do so. For instance if the owner hires one thousand managers, his profits will be equal to 450:65 compared to 11:694; the profits when running 20 projects. Actually, in this case the projects are so profitable that the owner could pay the managers a salary high enough for each of them to put maximum effort into the project, even if the owner is not monitoring at all, and still earn a positive profit for each project. In this case the last two terms in eq.(19) are equal to zero so that the derivative is positive for any  $n$ :

To conclude this section, without external finance, the benefits of delegation are in the reduction of overload costs, due to the fact that the effort of the owner is lower than in the non-delegation case. In addition in some cases delegation increases the probability of success of the project. Hence, separation of ownership and control arises endogenously as optimal response to overload costs, although it involves agency costs.

However, when a firm has to raise external finance, we can show that delegation adds a further benefit in that it reduces the moral hazard between the owner and his financiers. Furthermore, we will show that externally financed firms might have to diversify more in order to be able to attract outside capital, reinforcing thus the incentive to delegate as the number of projects increases. Hence, external financing might force the owner to give up some degree of control to managers.

## 4 The scope for diversification and delegation in externally financed firms

Assume that entrepreneurs have no capital at all, while investors do, and that there are many investors. Entrepreneurs who do not have capital on their own, will try to use their essential management skill to raise funds from investors. However, since efforts are non observable to investors, managerial effort is non contractible. Because of limited liability<sup>19</sup> and unobservability of efforts, there is moral hazard between the entrepreneur and investors, although observability and verifiability of project returns. In other words, external finance reduces the incentive of the entrepreneur, since part of the benefits of increased effort accrues to investors.

In Cerasi and Daltung (2000) we have shown that diversification reduces the moral hazard problem when the firm is debt financed. In the next section we will show that externally financed entrepreneurs might want to diversify more compared to self-financed entrepreneurs. In the previous section we have shown that delegation may help increasing the overall performance of the entrepreneur's portfolio of projects by

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<sup>19</sup>Since the entrepreneur has no capital of his own, he cannot promise to return to investors more income than what his project returns. He cannot commit to deliver anything in the future, given that all the agents live for one period alone, and physical punishments are not allowed. Hence, the entrepreneur has limited liability.

reducing overload costs. Delegation can be helpful in externally financed firms in two ways: first of all, because diversification, although it strengthens the incentive problem of the owner, it is costly to achieve due to overload costs, delegation can be beneficial as the overload costs of the owner are reduced; secondly, because delegation, as we will show in section 4.2, reduces the moral hazard of external finance, it adds a further benefit in addition to those already discussed in the section on self-financed firms. Could then be that delegation alone helps alleviating the incentive problem of external financing? In section 5 we show that both diversification and delegation can be necessary ingredients for the firm to become viable.

#### 4.1 The scope for diversification

From Cerasi and Daltung (2000) we know that if overload costs are not too high the entrepreneur can commit to a higher effort by increasing the diversification of the portfolio by adding non-correlated projects, given that the contract with the investors is a debt contract. For this result to hold true the debt contract must be conditioned on the return of the portfolio of projects, allowing thus cross-subsidization among projects. Let us therefore consider the case in which the entrepreneur establishes one firm which issues one-period debt contracts. The entrepreneur is in fact the owner of this firm, since he is entitled to the residual income. This provides him with incentives to exert effort.

The profits of an entrepreneur, who owns and runs a debt-financed firm consisting of  $n$  projects can be written as:

$$\sum_{i=1}^n p(e_i) R_i - [nr_D - S_n(\underline{e})] - c(\underline{e}); \quad (20)$$

where  $r_D$  is the promised gross return per unit of capital and  $S_n$  are the expected shortfalls on the total debt, that is the difference in expected terms between the promised amount,  $nr_D$ , and the amount recovered by the financiers when the entrepreneur fails to repay  $nr_D$ . The expected shortfalls depend upon the promised return on debt and upon the vector of efforts by the entrepreneur,  $\underline{e}$ , through the expected returns of the projects.

For each project, the entrepreneur chooses the effort so as to maximize profits:

$$\frac{\partial p R_i}{\partial e_i} + \frac{\partial S_n}{\partial e_i} - c'(e_i) \leq 0; \quad i = 1; \dots; n; \quad (21)$$

The moral hazard problem comes through the impact of a change in the effort level on the expected shortfalls. This term is negative, as a reduction in the effort increases the expected shortfalls. The entrepreneur exploits the fact that investors cannot observe an increase in the expected shortfalls due to lower effort, as effort levels are not observable.

For the entrepreneur to be able to fund the projects, the promised return to investors per unit of capital must satisfy the individual rationality (IR) constraint:<sup>20</sup>

$$r_D \leq \frac{1}{n} S_n(e) = y \quad (22)$$

Hence, if there is an equilibrium, the equilibrium profit function of the owner looks like the profit function of the self-financed entrepreneur. Define the symmetric equilibrium effort  $e^0$  for all  $e$ : The profits of the owner can be written as:

$$\pi_n(e^0) = n \left[ p(e^0) R - y - \frac{c}{2} (e^0)^2 \right] = n \phi \frac{1}{4} (e^0)^3 \quad (23)$$

According to the Law of Large Numbers, the probability that the average portfolio return is equal to the expected project return approaches one, as  $n$  goes to infinity. Hence, if the expected project return is larger than the promised return to investors, the probability that the average portfolio return will be smaller than the promised return, per unit invested, approaches zero. That is, the expected shortfalls approach zero as  $n$  goes to infinity. Intuitively the derivative of the expected shortfalls with respect to the effort approaches zero as well. The amount by which an increase in the effort level could reduce the probability of default is limited by the size of the probability of default, as the probability cannot be less than zero. Hence, as the probability of default approaches zero, so does the derivative of the expected shortfalls.<sup>21</sup> Therefore, if the average expected portfolio return is larger than the promised return on debt, the IC constraint of a perfectly diversified owner corresponds to eq.(1). Furthermore, the FOC for optimal effort choice of the self-financed entrepreneur, and the promised return,  $r_D$ , will be equal to the alternative return,  $y$ . By establishing a single perfectly diversified firm the owner can always fulfill his promise to repay the debt. If he instead were to own  $n$  independent firms, he would fail to pay his debt in about  $(1 - p^0)^n$  firms.

We will now show that in a symmetric equilibrium, the owner of an externally financed firm might want to diversify more compared to the self-financed entrepreneur.<sup>22</sup> Taking the derivative of the profit function in eq.(23) with respect to  $n$  gives

$$\frac{d \pi_n(e^0)}{dn} = \frac{1}{4} (e^0)^3 - n \frac{c_2}{2} (e^0)^2 + n (\phi p R - c e^0) \frac{de^0}{dn} \quad (24)$$

The first two terms correspond to the terms in eq.(4). However, since the owner, due to moral hazard, is not choosing the efforts to maximize the profits in eq.(23), the

<sup>20</sup>We assume that the supply of capital exceeds the demand so that there is no competition for capital. Hence, investors will only earn the alternative return.

<sup>21</sup>This is shown for the case of the normal distribution in Cerasi and Daltung (2000).

<sup>22</sup>It could be that there are other solutions rather than the symmetric one, when the firm is externally financed and not perfectly diversified. We are however restricting the analysis to the symmetric equilibrium.

Envelope Theorem does not apply, and there is an additional term. Due to moral hazard the equilibrium effort of the externally financed entrepreneur,  $e^0$ , is less than the effort of the self-financed entrepreneur,  $e^a$ ; as long as the entrepreneur is not perfectly diversified. The derivative of the first two terms in eq.(19) is equal to

$$\Phi pR_i - ce^0 - nc_2e^0;$$

which is negative for  $nc_2$  sufficiently large. In that case, the first two terms are larger than  $\frac{d_i n(e^a)}{dn}$ , as  $e^0 < e^a$ : According to the IC constraint of the owner, eq.(21)  $\Phi pR_i - ce^0$  is positive, if the firm is not perfectly diversified. If overload costs are positive, but not too high, also  $\frac{de^0}{dn}$  will be larger than zero, since the derivative of the expected shortfalls decreases with  $n$ . In this case, the owner of an externally financed firm has incentive to choose number of projects larger than  $n^a$ , as diversification reduces his moral hazard problem. However, for larger overload costs an increase in the number of projects may actually reduce the effort of the owner. In that case diversification alone cannot resolve the moral hazard problem of the owner.

## 4.2 Benefits of delegation in externally financed firms

We have seen that diversification can be a way to reduce moral hazard of the owner. From section 3 we know that the incentive to delegate increases with the size of the firm. However, we would like to show that there is an additional incentive to delegate when the firm is debt financed, namely that delegation reduces the moral hazard connected to external financing. In order to disentangle the two benefits of delegation, we first study an entrepreneur who tries to raise funds from investors in order to finance just one project.

### 4.2.1 The focused firm ( $n=1$ )

Consider first the case in which the entrepreneur runs the project himself. The entrepreneur promises to pay  $r_D$  to his financiers when the project succeeds. We can think of  $r_D$  as a gross return on the debt issued by the firm. However, for the focused firm, because of the simple distribution of the returns of the project it could as well be the gross return on shares. For the unfocused firm, however, debt and equity contracts are not equivalent.

Investors accept to finance the project if and only if the expected return is larger than the safe return of the alternative technology, that is if the following IR condition is satisfied:

$$p(e)r_D = y:$$

Investors are assumed to have rational expectations. Hence, they expect the entrepreneur to choose the effort level that maximizes his expected profits,

$$p(e)(R_i - r_D) - \frac{c_1}{2}e^2:$$

The FOC is given by

$$\Phi p(R - r_D) - c_1 e = 0; \quad (25)$$

The moral hazard comes through the term  $\Phi p r_D$ . Once  $r_D$  is given, the entrepreneur has lower incentives to increase his effort in the project as the gains are partly appropriated by the financiers, while the cost is only on the entrepreneur shoulders. We have that if

$$p_H R - y - \frac{p_H}{\Phi p} c_1 < 0; \quad (26)$$

the moral hazard problem will lead an externally financed entrepreneur to choose an effort level smaller than 1: In this case, the information problem gives rise to a moral hazard problem.

When delegating the task of running the project to a manager, the profits of the owner are given by:

$$p^d(e; m) R^N - \frac{c_1}{2} m^2;$$

where  $p^d(e; m) = p_H - (1 - e)(1 - m)\Phi p$  and  $R^N = (R - w - r_D)$ : Given the face value of debt,  $r_D$ , the owner chooses his monitoring effort according to the FOC:

$$(1 - e)\Phi p R^N - c_1 m = 0; \quad (27)$$

We can now show that the incentives to delegate are larger in the externally financed firm compared to the case of self-financed firm.

**Proposition 5** In a focused firm an externally financed entrepreneur has more incentive to delegate than a self-financed entrepreneur.

**Proof:** Consider a self-financed owner of a focused firm. From Assumption 2 it follows that this owner will choose the maximum effort level, that is  $e^s(1) = 1$ : An owner of an externally financed focused firm will however, due to moral hazard, choose an effort level smaller than 1. Let the owner of the externally financed firm hire a manager and pay him a salary such that the manager chooses to exert maximum effort. If the owner does not monitor the manager the difference in per project equilibrium profits can be written as

$$\frac{1}{2} p^d(e^s; 0) - \frac{1}{2} p^0(e^0) = (p_H - p^0)R - p_H w + \frac{c_1}{2} (e^0)^2;$$

where  $p^0 = p_L + e^0 \Phi p$ ; and  $e^0$  is the effort level chosen by the externally financed entrepreneur when there is a moral hazard problem. The right hand side can be rewritten as

$$- p_H w + \frac{c_1}{2} + (p_H - p^0)R + \frac{c_1}{2} (e^0)^2 - \frac{c_1}{2} :$$

The first two terms are the same as in eq.(15), that is in the case of a self-financed focused firm. We will now show that the sum of the last two terms is positive, in which case the incentive to delegate is larger in the externally financed firm.

We have that

$$(p_H - p^0)R + \frac{c_1}{2} (e^0)^2 (1 - \alpha) = (1 - e^0) \Phi p R (1 - \alpha) + (e^0)^2 \frac{c_1}{2} = (1 - e^0) \Phi p R (1 + e^0) \frac{c_1}{2};$$

that is positive when Assumption 2 holds true. Q.E.D.

The reason why the externally financed entrepreneur has a larger incentive to delegate is because delegation reduces the moral hazard of the owner. This effect can be seen from the IC constraint of the owner. The moral hazard of the owner is captured by the derivative of the expected shortfall with respect to effort,

$$- \alpha \Phi p R_D$$

in eq. (25). The corresponding derivative with delegation is

$$- \alpha (1 - e) \Phi p R_D:$$

Delegation reduces the moral hazard, since the impact of a reduction in effort by the owner on the expected shortfall is now mitigated by the fact that the probability of success now also depends on the effort of the manager. Notice, however, that when eq.(26) is satisfied, that is when the owner faces a moral hazard problem,  $R$  is not large enough for a salary to exist, such that the manager chooses to put maximum effort into the project. Hence, the moral hazard problem of external financing cannot be eliminated through delegation.

#### 4.2.2 The unfocused firm ( $n > 1$ )

Let us now analyze the benefits of delegation when the firm undertakes  $n > 1$  projects. Because of overload costs, it is costly for one entrepreneur alone to run several projects. In section 3 we have shown that delegating the running of projects to other agents can be a way to keep costs down. In section 4.1 we showed that the externally financed entrepreneur has incentive to diversify more than the self-financed entrepreneur, and hence should have stronger incentive to delegate than the self-financed entrepreneur. Then we showed in the previous section that the externally financed entrepreneur has additional reasons to delegate, as delegation reduces his moral hazard problem with investors.

The stronger incentive to diversify of the externally financed entrepreneur only arises if the entrepreneur establishes one diversified firm. When the entrepreneur is self-financed there are no benefits from setting up a conglomerate. The entrepreneur could equivalently own  $n$  independent firms. When the firm is externally financed, the entrepreneur may indeed have incentive to set up a conglomerate.

Consider an entrepreneur who owns a single firm. The firm hires  $n$  managers to run  $n$  projects paying each manager a salary  $w$ .<sup>23</sup> The owner monitors the managers. As before, the firm is assumed to issue debt. Let us assume that managers are senior with respect to investors.<sup>24</sup> The owner will be residual claimant of the firm's returns, which provides him with the incentive to monitor the managers.

Let us now examine the incentive of the owner to monitor the managers. Given the above assumptions the expected return of the owner can be written as:

$$\sum_{i=1}^n p_i^d(e_i; m_i)(R - w) - nr_D - S_n^d(\underline{e}; \underline{m}) - c(\underline{m}); \quad (28)$$

where  $p_i^d(e_i; m_i) = p_H - (1 - e_i)(1 - m_i)\Phi p$  is the probability of success of project  $i$ , and  $S_n^d(\underline{e}; \underline{m})$  are the expected shortfalls on debt, that is the difference in expected terms between the promised amount,  $nr_D$ , and the amount recovered by the financiers when the entrepreneur fails to repay  $nr_D$ . The expected shortfalls depend now on both the vector of efforts by the entrepreneur and the vector of efforts by managers,  $(\underline{e}; \underline{m})$ , as both are affecting the expected returns on projects.

For a given salary, the owner chooses the monitoring effort to maximize profits in eq.(28) for each project. The FOCs are given by

$$(1 - e_i)\Phi p(R - w) + \frac{\partial S_n^d}{\partial m_i} - c_1 m_i + c_2 \sum_{j \neq i} p_j m_j = 0; \quad i = 1; \dots; n; \quad (29)$$

As before the derivative of the expected shortfalls with respect to efforts captures the moral hazard problem of the owner. This term is negative, as a reduction in the effort increases the expected shortfalls. The entrepreneur exploits the fact that investors cannot observe an increase in the expected shortfalls, as the effort level is not observable. However, as for the focused firm, the effect on the shortfall is mitigated by the fact that also the manager puts effort into the project, that is the absolute value of  $\frac{\partial S_n^d}{\partial m_i}$  decreases with  $e$ :

From eq.(5) we get the FOCs of the managers:

$$(\Phi p + m_i p_L)w - c_1 e_i = 0; \quad i = 1; \dots; n; \quad (30)$$

<sup>23</sup>The contract with the manager implies that the owner pays a salary  $w$  whenever the project is successful and whenever he, when monitoring, does not find out that the manager has chosen an effort level smaller than 1: When the owner finds out, after having spent some monitoring effort, that the manager has shirked, he can fire him, without paying him the salary. He will instead hire a new manager, pay him  $w$ , and make sure that he chooses the maximum effort. This assumption does not require that the level of effort is verifiable to third parties. It only requires to assume that the outcome of the monitoring, whether the effort of the manager is smaller than 1; is verifiable.

<sup>24</sup>Making managers senior to investors means that the wage has to be paid, before any other creditor, out of the return of each successful project. Actually one would have to show that seniority of the managers is the optimal contract from the owner's point of view.

For given size of the firm,  $n$ , and salary,  $w$ , the equilibrium is given by the solution to the above system of equations (29),(30) and by the IR condition for investor:

$$r_D \leq \frac{1}{n} S_n^d(\underline{m}; \underline{e}) = y: \quad (31)$$

Assume that  $n$  is sufficiently large for the firm to be perfectly diversified. This means that there are no shortfalls on debt, if the average return of the firm's portfolio is larger than the alternative return. This requires that overload costs are not too high.<sup>25</sup> If there is an equilibrium in which the overall effort levels are high enough for the firm to be able to reimburse its debt, this is determined by<sup>26</sup>

$$(\Phi p + mp_L)w \leq c_1 e = 0; \quad (32)$$

$$(1 - e)\Phi p(R - w) \leq cm = 0; \quad (33)$$

$$r_D = y: \quad (34)$$

The above system of equations is equivalent to that of a self-financed entrepreneur that delegates to managers, that is to eq.(8) and eq.(9). In Proposition 3 we have proved that there are parameter values for which the solution to the above system is preferred by the owner to the optimal solution without delegation. We also showed that, for the same set of parameters, the owner wanted to undertake a larger number of projects when delegating, so that the firm indeed would be approximately perfectly diversified.<sup>27</sup>Hence, we know that there are parameters for which the owner can do better by delegating than in the non-delegation equilibrium.

However, the benefits of delegation are potentially larger in a non-perfectly diversified firm. First of all, in a less than perfectly diversified firm, moral hazard would reduce the effort of the entrepreneur. From Proposition 4, we now that if the effort of the entrepreneur is smaller than 0.5, delegating will increase the overall effort put into each project. Moreover, in the previous section we have proved that a focused externally financed firm has more incentives to delegate than a self-financed firm as delegation improves the incentives of the owner to exert effort. Thus externally financed firms might have additional benefits from delegation compared to self-financed firms, when the firm is not perfectly diversified.

In this section we have shown that, in the limit for a perfectly diversified firm, we can replicate the result in Proposition 3, namely that there are parameters value for

<sup>25</sup>From Cerasi and Daltung (2000) one can show that there exists a  $\hat{c}_2 > 0$ ; such that for any  $c_2 \in [0; \hat{c}_2]$  the incentives of a debt-financed owner are equivalent to that of a self-financed entrepreneur.

<sup>26</sup>As before we focus on symmetric equilibria. The reason is that, when the firm is perfectly diversified, we are back to the system of equations (5) and (7). Thus it is easy to show that if Assumption 1 holds, there is only a symmetric equilibrium.

<sup>27</sup>We know that for the parameter values in Proposition 3, the entrepreneur would like to carry out 1000 projects when he delegates the running of projects. Applying the Central Limit Theorem one can show that a 1000 projects firm is approximately perfectly diversified.

which the owner would like to delegate. In the next section, we show that diversification without delegation can be too costly, so that the firm cannot even raise external finance. Delegation with diversification however increases the incentive to exert effort of the owner without increasing overload costs too much, so that the firm becomes viable.

## 5 The need for both diversification and delegation

In this section we want to show that delegation can be so beneficial that in fact it can be the only solution for a firm in search of external finance to become viable. We will show that, although a perfectly diversified firm cannot raise any external finance, delegation makes the firm viable. However, delegation alone is not sufficient for the firm to become viable; the firm must also be diversified. Hence, building a conglomerate could be the only way to overcome the asymmetry of information in the capital market.

To build this argument, let's first define the conditions under which a focused firm is non viable. Then we will show that delegation will not make the focused firm viable. After that we will show that there are cases in which, even though a perfectly diversified firm remains non-viable, delegating the task of running projects to managers makes this firm viable. Hence both diversification and delegation are necessary ingredients for the firm to become viable.

First of all, a focused firm cannot raise external finance, when the following condition applies:

**Proposition 6** If  $\Phi p R_i - 2 \frac{D}{y} c_1 + \frac{c_1 p_L}{\Phi p} < 0$ ; a focused firm without own capital cannot raise funds from investors.

**Proof:** A debt financed entrepreneur running just one project maximizes his profits under the IR condition for investors

$$p(e)r_D = y;$$

where  $e$  is the effort that investors believe the entrepreneur will put into the project. Investors expect the entrepreneur to choose the effort level by maximizing his expected profits,

$$p(e)(R_i - r_D) - \frac{c_1}{2}e^2;$$

where  $p(e) \sim p_H + (1 - p_H)e\Phi p$ . For a given face value of the debt contract,  $r_D$ ; the entrepreneur chooses the effort level such that:

$$\Phi p(R_i - r_D) - c_1 e = 0; \tag{35}$$

Substituting  $r_D$  from the IR of investors, we have that the entrepreneur cannot get funding if

$$\Phi p(R_i \frac{y}{p_H i (1_i e)\Phi p}) i c_1 e < 0; \quad (36)$$

for any  $e \in [0; 1]$ : The left hand side of eq.(36) reaches its maximum for

$$e = \frac{y}{c_1} i \frac{p_L}{\Phi p};$$

By substituting the maximum effort into eq.(36) we have that  $\Phi p R_i \frac{y}{c_1} < 0$ : Q.E.D.

In this case the moral hazard of the owner is so severe, that a focused firm is not able to raise external funds. Let us now show that delegation alone, in a focused firm, does not help raising funds:

**Proposition 7** Delegation cannot make a non-viable focused firm, viable.

**Proof:** We will show that there exists no salary  $w$  for which the one-project firm with delegation can raise debt when the non-delegated firm cannot. The equilibrium effort levels are given by the solution to the system of FOCs:

$$(\Phi p + m p_L)w i c_1 e \leq 0; \quad (37)$$

$$(1_i e)\Phi p R^N i c_1 m \leq 0; \quad (38)$$

where  $R^N \leq R_i w i r_D$  is the net return to the entrepreneur. For investors to be willing to finance the firm, they must be promised a return  $r_D$  which fulfills

$$p^d(e; m)r_D = y; \quad (39)$$

where  $p^d(e; m) = p_H i (1_i e)(1_i m)\Phi p$ : Notice that for a given  $r_D$ , the effort levels  $e$  and  $m$  fulfill respectively the FOC for the manager and the FOC for the owner. When  $w = 0$ ; the equilibrium is given by

$$e = 0;$$

$$\Phi p(R_i r_D) i c_1 m \leq 0;$$

$$[p_H i (1_i m)\Phi p]r_D = y;$$

Then we know from the proof of the previous Proposition that there is no equilibrium.

When  $w = R_i \frac{y}{p^d}$ , the equilibrium instead is given by

$$\begin{aligned} m &= 0; \\ \Phi p R_i \frac{y}{p_H i (1_i e)\Phi p} i c_1 e &\leq 0; \\ [p_H i (1_i e)\Phi p]r_D &= y; \end{aligned}$$

and again it follows directly from the proof of the previous Proposition that there is no equilibrium.

Now we will show that also for all  $w$  such that  $0 < w < R - \frac{y}{p^d}$ , there is no equilibrium. In this case both FOCs bind and the candidate equilibrium is given by

$$(\Phi p + m p_L) w - c_1 e = 0; \quad (40)$$

$$(1 - e) \Phi p R^N - c_1 m = 0; \quad (41)$$

$$[p_H - (1 - e)(1 - m) \Phi p] r_D = y \quad (42)$$

From equation (41) we get

$$(1 - e) = \frac{c_1}{\Phi p R^N} m;$$

and therefore  $p^d = p_H - \frac{c_1}{R^N} m(1 - m)$ : For given  $r_D$ ,  $p^d$  is minimized for  $m = \frac{1}{2}$  and maximized either for  $m = 0$  or  $m = 1$ : We know that there exists no equilibrium in which  $m = 0$  or  $m = 1$ : Since  $p^d$  is smaller for  $0 < m < 1$ ; given  $r_D$ , and the equilibrium  $r_D$  must be higher for lower  $p^d$ , there can neither be an equilibrium in which  $0 < m < 1$ : Q.E.D.

Hence, to conclude, delegation cannot resolve the moral hazard between the owner and investors in the focused firm.

However delegation can resolve the moral hazard problem in the unfocused firm, namely when diversification comes together with delegation. What we will show is that, although a perfectly diversified firm without delegation cannot raise external funds, a diversified firm with delegation can become viable. So, when diversification is costly to achieve, because overload costs are large, delegation can be the only way to raise external finance.

Consider a perfectly diversified firm in which the owner delegates the task of running the projects to managers. Thus if there is an equilibrium in which the overall effort levels are high enough for the firm to repay its debt, this is determined by the solution to the system of equations (32) to (34). Thus we have the following result:

**Proposition 8** There are parameter values for which a sufficiently diversified firm can raise debt if and only if the running of projects is delegated to managers.

**Proof:** Consider the following numerical example

$$R = 2.4; p_H = 0.8; p_L = 0.4; c_1 = 0.6; c_2 = 0.025; y = 1.02; n = 1001$$

For these parameter values a perfectly diversified firm cannot raise debt when the owner runs all the projects by himself. Substituting the parameter values into the

FOC of the owner who runs the projects himself given by<sup>28</sup>:

$$\Phi pR - \sum_i c_i = 0;$$

gives  $e^a = 0.0375$  which in turn implies  $p^a = 0.415$ . The portfolio return is  $p^a R = 0.996$ ; which is less than  $y$ , so no investor would lend money to this firm.

However, if the owner delegates the running of projects, the firm could be viable. For instance, this is true for a salary equal to 0.4. Substituting the parameter values into eq.(10) and (11) gives  $\alpha = 0.022727$  and  $\beta = 0.27273$  which in turn implies  $p^d = 0.5157$ : This means that the average portfolio return net of salaries,  $p^d(R - w)$ ; is larger than  $y$ : Hence, if the owner delegates the running of projects to managers, a perfectly diversified firm is able to raise debt.

Applying the central limit theorem we get that for  $n = 1001$  the firm is approximately perfectly diversified. We have that neither  $n$  nor  $c_2$ , but only  $c$  is of importance for the solution. Hence, it is possible to choose any degree of diversification by correspondingly adjusting  $c_2$ . In order for the firm to be perfectly diversified the number of projects must in principle be infinitely large, which means that  $c_2$  must be infinitely small for  $c$  to be equal to 25.6 as it is in the example. However, since  $p^d(R - w)$  is strictly larger than  $y$ ; the firm would be viable even if there is a small probability of default. Q.E.D.

This Proposition shows that delegation can be crucial in order to exploit the gains from diversification, that is when, due to diversification, overload costs are high.

The comparison in the Proposition is made for a given number of projects. It could well be that the effort levels would be higher in a less diversified firm both in the non-delegation case and in the delegation case. In both cases there will be a number of projects  $n$  for which, increasing further diversification, the overload effect will dominate the moral hazard effect: However, as pointed out, delegation reduces the moral hazard problem of the owner. Hence, the incentive to delegate could be even stronger in a less diversified firm.

## 6 Conclusions

We have shown that delegation can be a way to reduce overload costs, although delegation gives rise to agency costs. Hence, separation of ownership and control can arise as a response to overload costs. We also proved that a focused externally financed firm has more incentives to delegate than a self-financed firm as delegation

<sup>28</sup>The FOC of the owner who runs  $n$  projects and gets external funds in the form of a debt contract with face value  $r_D$  is given by:

$$\Phi pR + \frac{\partial S_n}{\partial e_i} - \sum_i c_i = 0$$

For a perfectly diversified firm as  $n \rightarrow \infty$ ,  $\frac{\partial S_n}{\partial e_i} \rightarrow 0$ : Thus we are back to the FOC of a self-financed entrepreneur, running the  $n$  projects by himself, given by eq.(2).

improves the owner's incentives to exert effort. Thus externally financed firms might have additional reasons to delegate compared to self-financed firms. Moreover, externally financed firms may be forced to diversify to reduce moral hazard related to external financing and we show, under some circumstances, delegation can be the key ingredient to be able to diversify. Hence, conglomerates can arise as a solution to the asymmetry of information in the capital market.

In this paper we have analyzed two extreme cases, one in which the entrepreneur has enough inside capital to fund as many projects as he would like and one in which the entrepreneur has no inside capital at all. If the entrepreneur had some little but positive capital instead, say one unit, he could choose between running just one project or become diversified enough to be able to raise external funds. His choice would depend on the size of overload costs compared to agency costs. If it takes time to increase the size of the firm, he would undergo troubled time, since neither he would have enough inside capital, nor he would be diversified enough to raise external finance. In this period time the entrepreneur would need to find an investor willing to monitor him. If this was too costly, he might prefer not to grow.

In order to focus on the benefits of debt financing we have not allowed for other types of cross-subsidization among projects, as for instance paying different salaries to different managers. It could be the case that the owner might be willing to pay some of the managers a higher salary than to others and then only monitor the managers with the lower salary. It could also be the case that a better allocation could be reached with the managers having lower seniority than investors in bankruptcy. This however requires further investigation.

Another issue that would require further research is a discussion of the optimal hierarchy in this context. We have shown that delegation might be profitable for a given hierarchy, namely the one that minimizes overload costs. However, there might be different types of hierarchies that makes delegation even more profitable.

Although the argument in this paper proves to be relevant for conglomerates, we think it may also apply to financial firms.<sup>29</sup> Just like the owner of the conglomerate, a financial intermediary monitors projects. As a matter of fact we think that our framework supports the idea of Gertner et al. (1994), that is that the difference between conglomerates and banks stems from the difference in the control rights associated with the asset used in the production. In a conglomerate firm, the ownership of the asset rests with the conglomerate. Hence the real control on the assets,

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<sup>29</sup>The paper is in fact related to the financial intermediation literature, see for instance Diamond (1984) or Cerasi and Daltung (2000), since the main result can be applied as well to the monitoring of projects. If we were to interpret the running of projects as monitoring of projects, then one could show that delegating the task of monitoring to a single investor, although well diversified, cannot be always viable when there are diseconomies of scale in monitoring. However delegation of monitoring to managers inside the financial intermediary can be the optimal solution. In Cerasi and Daltung (1996) we had a preliminary analysis of delegation inside the intermediary although managers were sensible only to private benefits and not to monetary incentives.

used for production, is in the hand of the formal authority, namely the owner of the conglomerate.<sup>30</sup> So, in case of disagreement between the manager and the owner, the decision is taken by the owner. A bank, on the other hand, does not have control rights on the assets of the borrowers, so that in case of disagreement, the banker can only advise the borrower about what to do with the asset, but the real authority on the asset rests with the borrower. Therefore, the banker has no guarantee that his preferred project will be chosen with certainty. As Gertner et al. (1994) show, control rights provide the owner of the conglomerate with higher incentives to monitor the managers. Thus, a conglomerate should have stronger incentives to monitor than a bank. In this paper, however, we have showed that in some cases also diversification increases the owner's incentive to monitor. This could then explain why banks are typically more diversified compared to conglomerates: the incentive of the intermediary to monitor borrowers comes from diversification instead of control rights. This issue however has to do with the difference between inside and external capital markets, which constitutes the topic of our future research agenda.

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<sup>30</sup>We follow the definition of Aghion and Tirole (1997) for real and formal authority.

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## 7 Appendix

We will show that there is only a symmetric solution in the benchmark case if  $c_1 > c_2$ . Consider the self-financed entrepreneur running  $n$  projects. His expected profits are:

$$\pi = \sum_{i=1}^n p_i R_i - n y_i - \frac{c_1}{2} \sum_{i=1}^n e_i^2 - \frac{c_2}{2} \sum_{i=1}^n \sum_{j \neq i} e_i e_j;$$

where  $p_i = p_L + e_i \Phi p$  and  $e_i$  is the level of effort in project  $i$ . The FOCs are given by

$$\Phi p R_i - c_1 e_i + c_2 \sum_{j \neq i} e_j = 0; \quad i = 1:::n;$$

We will show that  $e_i$  must be equal for all  $i$ : First of all the FOCs must either bind for all  $i$  or for any of the  $i$ . Assume that they were binding for some  $i$  and not for others. That the FOC binds, it means that the effort level is smaller than 1. Since  $c_1 > c_2$ ; reducing the effort level from 1 it will have a larger impact on the FOC of that specific project rather than on the FOCs of all the other projects. This means that the left hand side (LHS) of the other FOCs is smaller than the LHS of the project for which the effort is less than 1, but this implies that they also must bind. For the same reason the effort levels must be equal if all the FOCs bind. Assume instead different effort levels. The LHS of the FOC for the project with the lowest effort level will then have the highest value of the LHS of the FOC. Hence, not all FOCs can be binding at the same time, unless the effort levels are the same.