Mergers and CEO power

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August 2, 2006

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Abstract

In this paper a simple model of mergers in which synergies, private benefits and CEO power play a crucial role is proposed. A merger is modeled as a bargaining process between the acquiring and target board with the gains from a merger divided according to Rubinstein's alternating-offer game with inside options. Boards consider both firm value and CEOs' payoff when deciding whether or not to merge. The more powerful CEOs are, the more board members consider the consequences of a merger on CEOs' payoffs.

The model determines the optimal firm scope and yields predictions that are consistent with several empirical regularities about mergers such as: (i) inefficient mergers take place when acquiring CEOs are powerful and units are not related; (ii) target shareholders are better-off after a merger, acquiring shareholders are sometimes worse-off, and combined value is positive; and (iii) in the presence of credit constraints, acquiring firms are more likely to merge with low-productivity firms and with firms in which CEOs are less powerful.

1 Introduction

Mergers have been the subject of considerable debate in the last two decades. Early researchers argue in favor of them based on greater operating efficiency and debt capacity, creation of efficient internal capital markets, and greater risk diversification. However, several empirical studies done during the 1990s provide evidence on value loss due to mergers[1]. More recently, however, new evidence has been presented showing that mergers on average do not destroy value, and arguing that earlier results suffered from endogeneity problems and measurement error[2]. So far, the only robust conclusion across all studies is that mergers create value for some firms and destroy value for others.

Three major motives have been suggested for mergers; synergy, agency problems, and hubris[3]. In this paper I focus on the first two. The synergy motive assumes that target and acquire management maximize shareholder wealth and would engage in a merger only if it results in gains to shareholders of both firms. The agency motive suggests that mergers are primarily motivated by the self-interest of the acquirer management. The crucial idea is that acquisitions results in a transfer of value from acquiring shareholders to acquiring management. Several reasons have been provided to explain this behavior. For example, managers diversify their idiosyncratic risk resulting from having undiversified positions in their own firms (Amihud and Lev, 1981), or they derive private benefits of control from managing more diversified firms (Jensen, 1986; Stulz, 1990). Reasons for this range from prestige coming from managing larger firms, entrenchment through specific human capital investments (Shleifer and Vishny, 1989) to the idea that larger firms provide larger pay, power, and prestige (Jensen and Murphy, 1990).

This paper proposes a model that combines ideas from the synergy motive with those from the agency motive to study a firm's decision to acquire another firm. In particular, the model is based on the premise that when a firm makes an acquisition or any other investment, it considers the consequences for both top managers and market value of the firm. This assumption is rooted on the empirical evidence and casual observation showing that top managers of large corporations influence boards' decisions and boards do not consider negative stock market reactions to those decisions (e.g., acquisition announcements) as definitive indicators of a long-run value loss. For instance, Grinstein and Hribar (2004) find that

[1]This literature finds that on average there is a diversification discount; *i.e.,* on average diversified firms trade at a discount relative to a portfolio of stand-alone firms in the same business segments. For instance, Berger and Ofek (1995) find that diversified firms are valued 13 % to 15 % below the sum of the imputed values of their segments. Rajan, Servaes and Zingales (2000) reports that around 40 % of the firms they study trade at a premium but on average they are traded at a discount. Similar evidence can be found on Lang and Stultz (1994), Servaes (1996), Wernerfelt and Montgomery (1988) and Comment and Jarrell (1995).

[2]Villalonga (2004), Campa and Kedia, (2002). Chevalier (2000), Whited (2001) among others show that the discount is the result of uncontrolled endogeneity arising from the fact that firms differ systematically in multiple characteristics.

[3]The hubris hypothesis maintains that acquisitions are motivated by managers' mistakes and there are no synergy gains

merger deals with high CEO power are associated with large abnormal returns and argue that CEO power is the main determinant of merger and acquisition bonuses. Hartzell, Ofek and Yermack (2004) study benefits received by target company CEOs in completed mergers and acquisitions. They find that executives obtain wealth increases with a median of $4 to $5 million and a mean of $8 to $11 million, roughly in line with the permanent income streams that they sacrifice. CEOs receive lower financial gains from those transactions in which they become executives of the buyer, suggesting that tradeoffs exist between the financial and career-related benefits they extract.

A stand-alone firm or unit is determined by its activities and can be bought and sold. Ownership of a firm confers the right to delegate control to a CEO and a board of directors. In particular, delegation of control rights implies that: (i) a CEO chooses a non-contractible ex-ante and ex-post project in each unit that yields positive private benefits as well as a positive return. A project choice requires the CEO to learn projects payoffs, which in turn implies that he has to spend costly time and effort investigating projects; and (ii) board members choose the CEO's wage contract and decide whether or not to merge with another firm. A merger creates productivity gains if and only if coordination in project choice and project implementation is successful. Coordination in project implementation is impossible to agree contractually, which means that coordination or internalization of cross-units externalities can be achieved only by a transfer of ownership or merger between two units.

A merger is modeled as a bargaining process between the acquiring and target board with the gains from a merger divided according to Rubinstein's alternating-offer game with inside options[4]. Crucial to the outcome of the game are boards' objective functions, which are assumed to be given by firm value plus the CEO's expected utility weighted by a parameter meant to capture the CEO's power to influence the board members' objective function in a way that favor his goals. CEOs have long been recognized as the principal architects of corporate strategy and major catalysts of organizational change (Child, 1972), and the extent to which CEOs can effect change in corporate strategy is thought to be determined largely by the power they possess and how they decide to manage it (Child, 1972). In addition, empirical evidence shows that firm performance depends on CEO power in a way that is consistent with the idea that power fulfills self-serving goals (Hermalin and Weisbach, 2003; Bruener, 2004a,b).

It is shown first that a CEO's incentive to investigate projects steams from two reasons: the sensitivity of the wage payment to the choice of a project, and the sensitivity of private benefits to the project choice. Wage and private benefit sensitivities in a stand-alone firm are different from those

[4]By a merger I refer to the case in which negotiations are carried out by the board of the acquirer and target firm in relative secrecy through private negotiations. This is different from tender offers, where the acquiring firm makes a public bid for target shareholders' stocks. A major difference is that in the former is the target board who responds to an offer, while in the latter is target shareholders who respond to an offer.

in an integrated firm since in the latter research effort in one unit increases (weakly) the productivity gain from research in the other division. This together with the fact that wage and private benefit sensitivities are substitutes result in that the CEO of an acquiring firm is better-off after a merger when the probability of successful coordination is small. For, an increase in it (cetteris-paribus) implies that research effort is more productive and expected private benefits are greater. The former means that a lower wage is needed to induce a CEO to investigate projects in both divisions and the latter that for a given wage a CEO has more incentives to investigate projects.

From shareholders' point of view a merger is efficient when the expected productivity gain due to coordination in project choice and implementation exceeds the difference in incentive costs. Because post-merger incentive cost falls with the probability of successful coordination, while expected productivity gain rises with it, a merger is more likely to be efficient as coordination is more likely to succeed. CEO power has a non-trivial impact on the merging decision. In particular, the consequences of CEO power on this decision emerge from two effects: the decrease in the importance of incentive costs since boards' objective functions consider a share of the wages as a wealth transfer from shareholders to CEOs, and power results in a positive weight on CEOs' net private benefits. Whether CEO power favors or hurts a merger depends on the relative size of incentive costs and net private benefits in an integrated firm with respect to those in a pool of stand-alone firms. The more powerful CEOs are, the less relevant incentive costs and the more important net private benefits become.

Because bargaining takes place under symmetric information, in equilibrium a merger takes place when the expected productivity gain due to coordination in project choice and implementation exceeds the share of the difference in incentive costs that boards do not consider as a transfer of wealth from shareholders to CEOs and the difference in net private benefits between a pool of stand-alone CEOs and an integrated CEO. In addition, in equilibrium, the gains from a merger are shared between the negotiating parties and thus the acquiring board overpays to the target firm regardless of CEO power. This together with the fact that the equilibrium price rises as coordination is more likely to succeed result in the following empirical predictions: (i) inefficient mergers are more likely to take place when successful coordination is less likely to occur, when the acquiring CEO's power is high, and the target CEO's power is low; (ii) target shareholders' post-merger value is always higher, while acquiring shareholders' post-merger value could be either higher or lower. The latter may occur despite of fact that combined value is positive; (iii) in the presence of credit constraints, acquiring firms are more likely to merge with low-productivity firms and with firms in which CEOs are less powerful, and high-productivity firms are more likely to be acquired than low-productivity firms; (iv) related mergers are more likely to be efficient, to lead to higher announcement returns, and to higher acquiring shareholders' value; (v) post-merger wages are likely to be lower than pre-merger wages. In particular, they are lower when

successful coordination is more likely to occur; and (vi) as predicted by the management of strategy literature, post-merger value is more likely to be higher than pre-merger value when the acquiring firm is endowed with excess resources beyond what are required for a normal and efficient operation and the acquired firm is in a related business.

This paper is related to a number of ideas that have appeared elsewhere in the literature. Berkovitch and Khanna (1991) also model a merger as bargaining process between an acquiring and target firm. Yet, their model sets aside agency problems and focuses on a different issue, which is the choice of a takeover mechanism. Basically, they argue that when the gains from a takeover are small, a merger mechanism is used since it does not reveal any information to the market, while when they are large, a tender offer method is used. Hart and Holmstrom (2005) show as this paper does that an integrated firm can internalize some external effects such as the impossibility of coordinating through the market. In fact, in our paper is the delegation of the right to implement projects in an integrated firm which makes coordination possible. Their framework is similar to the one here in the sense that decisions are non-contractible, managers enjoy private benefits, and consider both his benefits as well as the consequences for market value of the firm when deciding whether to merge or not. Stein (1997), Brusco and Panunzi (2004), Inderst and Laux (2004) also emphasize the idea that the CEO of a diversified firm, despite of the fact that he may have empire building preferences, is interested in the overall profit of the firm. Yet, the model in this paper stresses other benefits and costs of integration such as the importance of coordination, the effect of private benefits on the design of incentives contracts, and the role of bargaining. Rotemberg and Saloner (1994) is also related in the sense that he provides a rationale for narrow scope. He argues that firms may wish to avoid being too broad in scope and conclude that innovative firms must remain narrow, while less innovative firms can be broad. None of these papers, however, is concerned with the implications of integration on target and acquiring shareholders' value before and after a merger.

The remainder of the article is as follows. In the next, Section 2, the model is presented. Section 3 derives the conditions for an efficient merger from shareholders' point of view, the conditions under which mergers take place, and the equilibrium price that the acquiring firms pay for a target firm. In the next section, Section 4, the empirical implications of the model are derived and briefly discussed. Given how spare the model is in other dimensions, in Section 5, the relationship between information and resource sharing and the implications of the model are studied. In the last section concluding remarks are presented.

2 The Model

Two divisions or units, denoted by $i, j \in \{1, 2\}$, that can be operated either as stand-alone firms or as an integrated firm are considered.

Each firm is run by a board of directors and a risk-neutral CEO, and within each firm (division) there is the need to implement a non-contractible ex-ante and ex-post project or strategic decision. The board's main task is to choose the CEO's wage contract and decide whether or not to integrate, while the CEO's task is to choose a project for each unit. Delegation of these decision rights is standard in the literature.

Each unit i faces $N > 1$ unknown projects, $n \in \{1, 2, 3, ..., N\}$ and one known project, called the default project, that yields zero private benefits and cash-flows. Of the remaining N projects only project 1 yields positive returns and private benefits, the rest yield negative returns and private benefits. Although project choice is observable ex-post, it is non-verifiable and thus non-contractible ex-ante and ex-post.

In a stand-alone firm i, project 1 yields a return π_i that cannot be diverted by the CEO and $\lambda\pi_i$ in private benefits to CEO (thus private benefits are measured in money and do not come from shareholders' pockets). For instance, private benefits could be job-satisfaction, reputational benefits, on-the-job-consumption, and/or on-the-job training. Observe that shareholders and the CEO's incentives are fully aligned with respect to the project choice since both prefer project 1 to any other project.

In an integrated firm things are a bit different since coordination issues become important. In particular, it is assumed that exploiting synergies successfully requires coordination and communication across business units. In order to capture this in the simplest way possible, I introduce two types of coordination problems. The first, called project matching, requires that the same project is implemented in both divisions so that projects yield positive returns. In particular, if project 1 is implemented in one division and the status-quo project on the other division, project 1 yields zero cash-flows. For example, if project 1 consists on implementing a new production software and the status-quo project to remain with the current software, then the implementation of a new software in one division will create incompatibility problems that will destroy projects' returns. Similarly, for any other project combination. The second relates to projects' implementation. In particular, it is assumed that implementation requires specific capabilities in each division that facilitate information and resource sharing. If these capabilities are in place, the probability that successful implementation occurs is assumed to be q, otherwise that probability is zero. With $q \leq 1$, implementation fails with positive probability due to lack of communication and resource sharing. Failure in the implementation will lead to no creation of no synergies. Focusing on implementation difficulties has an empirical justification based on a growing stream of research in management suggesting that implementation mechanisms may be crucial for the

success of strategies motivated by potential synergy benefits[5]. In addition, the evidence from mergers and acquisitions research increasingly suggests that realizing potential synergy benefits requires appropriate implementation processes (Larsson and Finkelstein, 1999; Pablo, 1994). A similar theme has emerged from diversification research, with researchers suggesting that firms often adopt diversification strategies by focusing primarily on the potential benefits, without sufficient consideration of implementation difficulties . As a result, many diversified firms find that synergy and/or business growth do not materialize, and then divest recently acquired businesses (Markides, 1997).

Implementation is assumed to be non-contractible ex-ante and ex-post. This implies that contracts in which one stand-alone firm agrees to implement project 1 in a particular way, say, in return for a side-payment from the other unit cannot be enforced. That is, Coasian bargaining will not ensure proper implementation across independently owned firms and therefore the synergies cannot be realized through the market. In the absence of this assumption, coordination through the market by mean of side-payments will be possible and thus integration would not be needed (cetteris-paribus) to exploit synergies.

When units coordinate in project 1 and implementation is successful, projects' returns are $(\pi_i + \pi_j)$ and private benefits are $\lambda(\pi_i + \pi_j)$, while when project coordination fails, projects yield no return and private benefits[6]. Observe that as in the stand-alone case, private benefits and projects' returns are such that the CEO and the shareholders' incentives are fully aligned since the CEO's project choices maximize aggregated returns.

In order to make the CEO's project choice non-trivial, it is assumed that the N projects cannot be distinguished from each other without further investigation. In particular, the CEO of a focused firm can choose a non-verifiable research effort or intensity $e_i \in \{0,1\}$, $i = 1,2$, at a private cost k_{e_i}, which enables him to learn the payoffs of all projects available to firm i with probability r_{e_i} and to learn nothing with probability $1 - r_{e_i}$, with $1 > r_1 > r_0 \geq 0$. The CEO of a integrated firm chooses non-verifiable research efforts $(e_i, e_j) \in \{0,1\}^2$ at a private cost $k_{e_i+e_j}$, which enables him to learn the payoffs of all available projects to the firm with probability $r_{e_ie_j}$ and to learn nothing with probability $1 - r_{e_ie_j}$, with $r_{11} + r_{00} \geq 2r_{10}$ –that is, $r_{e_ie_j}$ is weakly supermodular, which means that the CEO's research effort increases (weakly) his productivity gain (measured by the probability of success) from research in the other division.

The following assumptions are made.

- (A1): If the CEO's research fails, he is better-off choosing the default project than randomly

[5]See, for instance, the well-known book Making Strategy Work by Lawrence Hrebianiak.

[6]The model results are robust to a situation in which the payoffs to partial coordination are different from those to no coordination. However, the algebra gets messier with no gain in intuition.

choosing a project[7].

- (A2): Project's returns are contractible and private benefits are not.
- (A3): The CEO's reservation utility is zero and he has a limited liability constraint that is normalized to zero.
- (A4): $k_2 = 2k_1$, $k_1 > k_0 = 0$.
- (A5): Projects' expected returns are such that it is always efficient to implement a high research effort level in each unit.

Assumptions (A1), (A2) and (A3) are standard in the literature. Assumption (A4) implies that there are neither economies nor dis-economies of scope with respect to private costs when a CEO oversees multiple projects[8]. Assumption (A5) simplifies the analysis.

The timing of decisions is as follows. First, the acquiring board and the target board bargaining over the price of the target according to the Rubinstein's alternating-offers bargaining game with inside options. It is assumed that when a firm makes an acquisition, board members consider both the CEO's benefits from integration and the consequences for the market value of the firm in a manner that will be discussed in detail below. Third, the CEO chooses research effort. Then, nature decides whether research is successful or not and then the CEO decides which projects to carry out. After that, projects returns are realized and compensation takes place.

3 The Analysis

3.1 A Focused Strategy

First, suppose that firms remain as stand-alone units. Then, a contract $w_i^F \equiv (w_{si}, w_{fi})$, where w_{si} is the bonus payment when the project yields π_i and w_{fi} is the bonus payment when the project yields 0, induces the CEO to investigate projects if and only if

$$r_1 (w_{si} + \lambda\pi_i) + (1 - r_1) w_{fi} - k_1 \geq r_0 (w_{si} + \lambda\pi_i) + (1 - r_0) w_{fi}. \quad (1)$$

Board members choose the contract w_i^F to maximize their objective function. Following Hermalin and Weisbach (1998), it is assumed that board members' preferences can be aggregated in such a way that the board acts as if it has single objective function that positively weights firm value and the CEO's utility. In particular, the board's objective function is given by $\Pi_i^F (r_1) + \alpha_i U_i^F (r_1)$, where $\Pi_i^F (r_1)$ is

[7] See, Aghion and Tirole (1997) and Burkart et al. (1999) for the same assumption.

[8] The results are robust to the existence of either economies or dis-economies of scope.

firm's value, $U_i^F(r_1)$ is the CEO's expected utility, and $\alpha_i \leq 1$ is meant to capture the CEO's power. The parameter α_i might be determined by quality of corporate governance, board members' monitoring capability, free-rider problems arising from diluted ownership, number of inside board members, board size, board members' incentives to "rock the boat", social ties between board members and CEOs, and CEOs' formal titles. This is also consistent with the institutional literature on boards, which suggests that CEOs, both in the United States and abroad, have considerable say on who is nominated for board positions. It also consistent with the empirical evidence showing that more powerful CEOs have more say on decisions and that to some extent decisions serve their own interests (see, for instance, Hermalin and Weisbach, 2003).

The board chooses contract w_i^F to maximize its objective function subject to that w_i^F induces the CEO to investigate projects. That is,

$$\max_{w_i^F \geq 0} \left\{ \Pi_i^F(r_1) + \alpha_i U_i^F(r_1) \right\} \text{ s.t. } (1).$$

This is a relaxed program since it ignores the CEO's participation constraint. However, this is trivially satisfied since $w_i^F \geq 0$, by the limited liability constraint.

Because of limited liability and since $\alpha_i < 1$, it is optimal to set $w_{fi}^F = 0$ and

$$w_{si}^F = \max\left\{ \frac{k_1}{\triangle r} - \lambda \pi_i, 0 \right\},$$

where $\triangle r \equiv r_1 - r_0$.

This leads to the following lemma.

Lemma 1 *The optimal wage contract in a stand-alone firm is* $\mathbf{w}_i^F \equiv \left(w_{si}^F, 0\right)$*, where* $w_{si}^F = \max\left\{ \frac{k_1}{\triangle r} - \lambda \pi_i, 0 \right\}$.

This lemma says that the board grants the CEO a contingent incentive contract ex-ante to align his interests with those of the board. Observe that a CEO's incentive to investigate projects steams from two reasons: the sensitivity of the wage payment to the project's choice, $w_{si}^F - w_{fi}^F$, and the sensitivity of private benefits to the project choice. Clearly, the wage sensitivity and the private benefits sensitivity are substitutes. The higher the private benefits sensitivity, the higher are the CEO's incentives to investigate projects and the lower is the necessary wage payment (w_{si}^F) to induce research.

Let the incentive cost under the optimal contract be $C\left(w_{si}^F\right)$. Then, it readily follows lemma (1) that

$$C_i\left(w_{si}^F\right) = \begin{cases} r_1\left(\frac{k_1}{\triangle r} - \lambda \pi_i\right) & \text{if } \lambda \pi_i \leq \frac{k_1}{\triangle r}, \\ 0 & \text{otherwise.} \end{cases} \tag{2}$$

Thus, the CEO's utility when a focused strategy is adopted is given by:

$$U_i^F(r_1) = C_i\left(w_{si}^F\right) + r_1 \lambda \pi_i - k_1, \tag{3}$$

and a stand-alone firm value is given by:

$$\Pi_i^F(r_1) = r_1\pi_i - C\left(w_{si}^F\right). \tag{4}$$

3.2 A Diversified Strategy

Next consider the case in which a merger takes place–that is, the two firms are combined under the same roof and they become two different divisions of the same firm.

Because projects succeed if and only if the same project is implemented across both divisions and the CEO carries on the correct implementation, the wage payment can be conditioned only on success, which occurs with probability $r_{e_ie_j}q$, and failure, which occurs with probability $1 - r_{e_ie_j}q$. A wage contract $\mathbf{w}^D \equiv (w_s, w_f)$, where w_s is the wage payment when projects yield $2(\pi_i + \pi_j)$, and w_f is the wage payment when projects yield 0, induces the CEO to investigate projects in both of divisions if and only if

$$r_{11}qw_s + (1 - r_{11}q)w_f + r_{11}q\lambda(\pi_i + \pi_j) - 2k_1 \geq r_{10}qw_s + (1 - r_{10}q)w_f + r_{10}q\lambda(\pi_i + \pi_j) - k_1, \tag{5}$$

$$r_{11}qw_s + (1 - r_{11}q)w_f + r_{11}q\lambda(\pi_i + \pi_j) - 2k_1 \geq r_{00}qw_s + (1 - r_{00}q)w_f + r_{00}q\lambda(\pi_i + \pi_j). \tag{6}$$

Incentive constraint (5) requires that the CEO prefers doing research in both divisions than in either one of them, while incentive constraint (6) ensures that the CEO is better-off doing research in both divisions than slacking-off in both of them.

Board members' goal is to choose w^D to maximize their objective function subject to w^D induces the CEO to investigate projects in both divisions. That is,

$$\max_{w^D \geq 0} \left\{\Pi^D(q, r_{11}) + \alpha_i U^D(r_{11})\right\}$$
$$\text{s.t. (5), (6),}$$

where $\Pi^D(q, r_{11})$ is firm's value and $U^D(r_{11})$ is the CEO's expected utility.

This is a relaxed program since it ignores the CEO's participation constraint. However, this is trivially satisfied since $w^D \geq 0$, by the limited liability constraint.

Lemma 2 *The optimal wage contract when in an integrated firm is* $\mathbf{w}^D \equiv \left(w_s^D, 0\right)$*, where* $w_s^D = \max\left\{\frac{2k_1}{q(\triangle r_1 + \triangle r_0)} - \lambda(\pi_i + \pi_j), 0\right\}$ *and* $\triangle r_{e_j} = r_{1e_j} - r_{0e_j}$ *for* $e_i \in \{0, 1\}$.

Proof. After a few steps of simple algebra incentive constraints (5) and (6) can be written as follows,

$$q(w_s - w_f) \geq \frac{k_1}{\triangle r_1} - q\lambda(\pi_i + \pi_j), \tag{7}$$

$$q\left(w_s - w_f\right) \geq \frac{2k_1}{\triangle r_1 + \triangle r_0} - q\lambda\left(\pi_i + \pi_j\right). \tag{8}$$

The left-hand side of incentive constraints (7) and (8) is decreasing in w_f, while the objective function is decreasing in it since $\alpha_i < 1$. Thus, it is optimal to set $w_f = 0$, and thus $w_s = \max\left\{\frac{2k_1}{q(\triangle r_1+\triangle r_0)} - \lambda\left(\pi_i + \pi_j\right), \frac{k_1}{q\triangle r_1} - \lambda\left(\pi_i + \pi_j\right)\right\}$.

Observe that $\frac{2k_1}{q(\triangle r_1+\triangle r_0)} - \lambda\left(\pi_i + \pi_j\right) > \frac{k_1}{q\triangle r_1} - \lambda\left(\pi_i + \pi_j\right)$ if and only if $\left(r_{11} + r_{00} - 2r_{10}\right)k_1 \geq 0$, which holds by the supermodularity of $r_{e_ie_j}$. ■

This lemma says that the principal grants the CEO a contingent incentive contract to align his interests with those of the principal. As in the stand-alone case, the CEO's incentive to investigate projects steams from the sensitivity of the wage payment to the project's choice and the sensitivity of private benefits to the project choice. This means that the principal takes advantage of the substitution of these two sensitivities to lower the incentive costs that accrue to her. Thus, the higher the private benefits sensitivity, the higher are the CEO's incentives to investigate projects and the lower is the necessary wage payment $\left(w_s^D\right)$ to induce research.

Let the incentive cost under the optimal contract be $C\left(w_s^D\right)$. Then, it readily follows from lemma (2) that

$$C\left(w_s^D\right) = \begin{cases} r_{11}\left(\frac{2k_1}{\triangle r_1+\triangle r_0} - q\lambda\left(\pi_i + \pi_j\right)\right) & \text{if } \lambda\left(\pi_i + \pi_j\right) \leq \frac{2k_1}{q(\triangle r_1+\triangle r_0)}, \\ 0 & \text{otherwise.} \end{cases} \tag{9}$$

Thus, the CEO's utility when a diversified strategy is adopted is given by:

$$U^D\left(r_{11}\right) = C\left(w_s^D\right) + qr_{11}\lambda\left(\pi_1 + \pi_2\right) - 2k_1, \tag{10}$$

and a diversified firm's value is given by:

$$\Pi^D\left(q, r_{11}\right) = r_{11}q\left(\pi_1 + \pi_2\right) - C\left(w_s^D\right). \tag{11}$$

3.3 Efficient Mergers

In this sub-section preliminary results are derived that will help us to explain the main result of the paper which is stated in the next sub-section. In particular, conditions under which a merger is efficient and the CEO prefers an integrated firm are derived[9].

To save on case analysis, it is assumed from here onwards that each CEO's incetive constraint is binding so that a positive wage is necessary. That is,

- (A6): (i) $r_{11} \geq r_1$ and $r_{00} \leq r_0$; and (ii) $k_1 > \max\left\{\triangle r\lambda\pi_i, \frac{q\lambda(\pi_i+\pi_j)(\triangle r_1+\triangle r_0)}{2}\right\}$.

[9]Here, efficiency is defined with respect to shareholders. The impact of mergers on managers and consumers are ignored. Thus, anti-trust issues while important are of no concern here.

Part (i) says that the CEO of a diversified firm is more productive than the CEO of a focused firm, assuming that CEOs undertake research in both cases, and that shirking in one division has a negative externality on shirking productivity on the other division. Part (ii) says that private benefits and cost are so that the CEO will not undertake research in the absence of a wage contract.

Comparing (4) and (11), it is clear that relatedness across units, measured by $r_{11} - r_1$, and the probability of successful implementation (q) will determine when a diversified firm's value is higher than the value of a pool of focused firms (i.e., when a merger is efficient). In fact, $\Pi^D(q, r_{11}) \geq \Pi_i^F(r_1) + \Pi_j^F(r_1)$ if and only if $r_{11}q - r_1$ is greater than

$$\frac{C\left(w_s^D\right) - C_i\left(w_{si}^F\right) - C_j\left(w_{si}^F\right)}{\pi_i + \pi_j}. \tag{12}$$

The intuition behind this result is best understood in the special case in which $r_{11}q = r_1$. In this case, the CEO's productivity in a diversified firm when he investigates projects in both divisions is the same as the pool of two CEOs' productivities, each investigating projects in his own firm. Then, diversification is efficient when incentive costs in a diversified firm are lower than the sum of the incentive costs in a pool of focused firms–that is, $C\left(w_s^D\right) < C_i\left(w_{si}^F\right) + C_j\left(w_{si}^F\right)$– and the opposite occurs otherwise. Thus, next lemma compares $C\left(w_s^D\right)$ with $C_i\left(w_{si}^F\right) + C_j\left(w_{si}^F\right)$ for different parameters, and derives the conditions for a merger to be efficient.

Lemma 3 *(i) If $q \geq q^C$, then $C\left(w_s^D\right) \leq C_i\left(w_{si}^F\right) + C_j\left(w_{si}^F\right)$, while the opposite occurs otherwise; (ii) a merger is efficient if and only if $q \geq q^*$, with $\frac{r_1}{r_{11}} \geq q^* \geq q^C$; and (iii) the CEO of the acquiring firm is better-off after a merger takes place if and only if $r_{11} \leq r_{11}^*$.*

Proof. Because of assumption (A6) $C\left(w_s^D\right) = r_{11}\left(\frac{2k_1}{\triangle r_1 + \triangle r_0} - q\lambda\left(\pi_i + \pi_j\right)\right)$ and $C_i\left(w_{si}^F\right) + C_j\left(w_{si}^F\right) = r_1\left(\frac{2k_1}{\triangle r} - \lambda\left(\pi_i + \pi_j\right)\right)$. Because $C\left(w_s^D\right)$ decreases with q, the minimum incentive cost in a diversified firm is reached at $q = 1$. Because of assumption (A6) part (i), $C\left(w_s^D\right) < C_i\left(w_s^F\right) + C_j\left(w_s^F\right)$ at $q = 1$, and $C\left(w_s^D\right) > C_i\left(w_s^F\right) + C_j\left(w_s^F\right)$ at $q = 0$, there exists a $q \in [0, 1)$, denoted by q^C, such that $C\left(w_s^D\right) \leq C_i\left(w_s^F\right) + C_j\left(w_s^F\right)$ for all $q \leq q^C$. In fact q^C is given by

$$q^C \equiv \frac{r_1}{r_{11}} + \frac{2k_1}{\lambda r_{11}\left(\pi_i + \pi_j\right)\left(\triangle r_1 + \triangle r_0\right)\triangle r}\left(r_{00}r_1 - r_{11}r_0\right) < \frac{r_1}{r_{11}},$$

where the inequality follows from part (iii) in assumption (A6).

Then, the result in part (i) obtains.

It follows from equation (12) and assumption (A6) that a merger is efficient if and only if

$$(1 + \lambda)\left(r_{11}q - r_1\right)\left(\pi_i + \pi_j\right) > \frac{2k_1}{\left(\triangle r_1 + \triangle r_0\right)\triangle r}\left(r_{00}r_1 - r_{11}r_0\right).$$

Observe that: (i) the left-hand side increases monotonically with q, while the left-hand side remains constant; and (ii) the left-hand side is non-negative for all $r_{11}q \geq r_1$, while the right-hand side is

negative by assumption (A6) part (i). These two things together imply that a merger is efficient for all $q > q^*$, where

$$q^* \equiv \frac{r_1}{r_{11}} + \frac{2k_1}{(1+\lambda)\, r_{11}\, (\pi_i + \pi_j)\, (\triangle r_1 + \triangle r_0)\, \triangle r}\, (r_{00} r_1 - r_{11} r_0) < \frac{r_1}{r_{11}}$$

and $q^* > q^C$ for all λ.

Lastly, observe that $U^D(r_{11}) - U^F(r_1)$ is

$$k_1 \left(\frac{2r_{00}}{\triangle r_1 + \triangle r_0} - \frac{r_0}{\triangle r} \right). \tag{13}$$

Thus, the CEO is better-off by merging if and only if $r_{11} \leq r_{11}^* \equiv r_{00} \left(1 + 2\frac{\triangle r}{r_0}\right)$. ■

This proposition shows the following: First, incentive costs in an integrated firm are lower when the probability that successful implementation takes place q is high. The reason is twofold. The wage needed to motivate the CEO to exert one unit of research will have an spillover effect on the second unit of research, whereas there is a fixed cost associated with providing incentives for each independent CEO, and expected private benefits increase as q rises, which implies, since wage and private benefit sensitivities are substitutes, that a lower wage is needed to induce research. Second, from shareholders' point of view, a merger is efficient when the productivity gain measured by $(\pi_i + \pi_j)(r_{11} q - r_1)$ exceeds the difference in incentive costs, $C\left(w_s^D\right) - C_i\left(w_s^F\right) - C_j\left(w_s^F\right)$. Because the productivity gain increases monotonically with q, but the difference in incentive costs falls with it, a merger is efficient when q is sufficiently high. It also says that as units are more related, mergers are more likely to be efficient since the integrated CEO's productivity rises and incentives costs fall. Third, the CEO of the acquiring firm is better-off after a merger when r_{11} is small. The reason is two-fold: First, an increase r_{11} (cetteris-paribus) implies that research effort is more productive and thus a lower wage is needed to induce a CEO to investigate projects in both divisions; second, an increase in r_{11} rises expected private benefits and thus the CEO has more incentives to investigate projects. These two things together imply that the optimal wage when research succeeds is smaller and thus the expected utility is also smaller. Observe also that q plays no role in determining whether or not a CEO is better-off after a merger than before one. The reason is that q affects the wage and private benefit sensitivities in the same way and thus an increase in private benefits due to a rise in q results in a decrease in the expected wage in exactly the same amount.

3.4 Merging Decision

In this sub-section, I consider a board's decision to merge with another a firm. It is being assumed that the price at which a firm is acquired is determined by bargaining between the board of the acquiring

firm and that of the target firm[10]. In particular, a merger is modeled as a sequential bargaining game in which the target board can either accept or reject a merger offer made by the acquiring firm. If the target board rejects the offer, it may submit the next period a counter-offer of its own merger terms. The acquirer can either reject or accept this counter-offer. If it rejects, it can submit next period a new merger offer, and so on and so forth. Thus, rejecting a merger offer causes a delay of one period during which each board gets its inside option given by the payoff from remaining focused, which is $\Pi_i^F(r_1) + \alpha_i U_i^F(r_1)$. Thus, by well-known results about Rubinstein's alternating offers game, the equilibrium is unique and an agreement is reached immediately[11]. Mainly, the unique equilibrium results in a merger if and only if

$$\Pi^D(q, r_{11}) - \Pi_i^F(r_1) - \Pi_j^F(r_1) \geq \alpha_j U_j^F(r_1) + \alpha_i U_i^F(r_1) - \alpha_i U^D(r_{11}), \tag{14}$$

and conditional on a merger occurring, the equilibrium price is

$$\begin{aligned} P_i^* = \tfrac{1}{2}\left[\Pi^D(q, r_{11}) - \Pi_i^F(r_1) - \Pi_j^F(r_1) + \alpha_i U^D(r_{11}) - \alpha_i U_i^F(r_1) - \alpha_j U_j^F(r_1)\right] + \\ \Pi_j^F(r_1) + \alpha_j U_j^F(r_1). \end{aligned} \tag{15}$$

for $i, j = 1, 2$ and $i \neq j$[12].

Equation (14) says that boards go ahead with a merger when shareholders' gains from merging more than compensate CEOs' weighted gains from remaining focused. It is clarifying to state this as follows. In equilibrium, a merger takes place if and only if $r_{11}q - r_1$ is greater than

$$\begin{aligned} &\tfrac{(1-\alpha_i)\left[C\left(w_s^D\right) - C_i\left(w_{si}^F\right)\right] - (1-\alpha_j)C_j\left(w_{si}^F\right)}{\pi_i + \pi_j} + \\ &\tfrac{\alpha_i(qr_{11}\lambda(\pi_1+\pi_2) - 2k_1) - \alpha_i(r_1\lambda\pi_i - k_1) - \alpha_j(r_1\lambda\pi_j - k_1)}{\pi_i + \pi_j}. \end{aligned} \tag{16}$$

It readily follows from equation (16) that CEO power has a non–trivial impact on the merging decision. In particular, the consequences of CEO power on this emerge from two effects: the decrease in the importance of incentive costs since wages are transferred from shareholders to CEOs, and power results in a positive weight on CEOs' private benefits and costs. Whether power favors or hurts a

[10] This means that I am focusing on one of many possible takeover mechanisms. In particular, I consider a merger instead of a tender offer since the latter does not required target management to be sympathetic to the acquisition. Mainly tender offers are made directly to target shareholders who decide the outcome by either tendering the required number of shares or rejecting the offer by not tendering.

[11] I could also work with an alternative model in which target and acquiring boards bargain as if they were the owners, but with the restriction that after a merger, CEOs cannot be worse-off than before a merger. This may require the payment of bonus (platinum parachutes) at the time a deal is struck.

[12] It is being assumed that CEOs power is the same in the pre- and post-merger stage and thus merging neither increase nor decrease CEO's power.

merger depends on the relative size of incentive costs and private benefits in an integrated firm with respect to those in a pool of stand-alone firms. The more powerful CEOs are, the less relevant incentive costs and the more important private benefits and costs become.

Regarding the equilibrium price, equation (15) implies the following: First, prices P_i^* and P_j^* are generally not the same since $\Pi_i^F(r_1) + \alpha_i U_i^F(r_1)$ is different from $\Pi_j^F(r_1) + \alpha_j U_j^F(r_1)$. Second, the greater the expected utility obtained by the CEO of a target firm, the lower the expected utility obtained by an acquiring CEO, and the greater the expected utility obtained by an acquiring CEO after a merger, the higher the price. These follow from the following known facts about bargaining with alternating offers: the bargaining parties share the total surplus generated by merging and no bargaining party gets less than its inside option.

Equations (14) and (15) lead to the following result.

Proposition 4 *(i) A merger takes place if and only if $q \geq q^{**}$; (ii) if $\alpha_j = \alpha_i = 0$, $q^{**} = q^*$, otherwise $q^{**} \geq q^*$ if $r_{11} \geq r_{11}^{**}$ and $q^{**} < q^*$ if $r_{11} < r_{11}^{**}$; and (ii) the acquiring firm overpays for a target firm.*

Proof. Recall that the left-hand side in equation (14) is positive if and only if $q \geq q^*$, while the right-side is given by

$$(\alpha_j + \alpha_i)\frac{r_0 k_1}{\triangle r} - \alpha_i \frac{r_{00} 2k_1}{\triangle r_1 + \triangle r_0}.$$

It follows from this equation that the right-hand side is positive if and only if

$$r_{11} \geq r_{11}^{**} \equiv r_{00}\left(1 + \frac{2\alpha_i}{\alpha_j + \alpha_i}\frac{\triangle r}{r_0}\right).$$

Observe also that the left-hand side in equation (14) increases monotonically with q. This implies that there exists q, denoted by q^{**}, such that a merger takes place if and only if $q > q^{**}$. Furthermore, if either $\alpha_j = 0$ and $\alpha_i > 0$, or $\alpha_j > 0$ and $\alpha_i = 0$, or $\alpha_j > 0$ and $\alpha_i > 0$, $q^{**} \geq q^*$ if $r_{11} \geq r_{11}^{**}$ and $q^{**} < q^*$ otherwise, while if $\alpha_j = \alpha_i = 0$, $q^{**} = q^*$, where

$$q^{**} \equiv \frac{r_1}{r_{11}} + \frac{k_1\left[\alpha_j(r_{11} - r_{00})r_0 + (2 - \alpha_i)(r_{00}r_1 - r_{11}r_0) - \alpha_i(r_1 - r_0)r_{00}\right]}{(1 + \lambda)r_{11}(\pi_i + \pi_j)(\triangle r_1 + \triangle r_0)\triangle r}.$$

Next observe that $P_i^* - \Pi_j^F(r_1)$ is given by:

$$\frac{1}{2}\left[\Pi^D(q, r_{11}) - \Pi_i^F(r_1) - \Pi_j^F(r_1) + \alpha_i\left(U^D(r_{11}) - U_i^F(r_1)\right) - \alpha_j U_j^F(r_1)\right] + \alpha_j U_j^F(r_1).$$

Because a merger takes place if and only if the term in square brackets is non-negative, an acquiring principal always overpays for a target firm. ■

First, observe that when CEOs do not influence board members' decisions (i.e., $\alpha_j = \alpha_i = 0$), a merger is always efficient. This follows from the fact that bargaining takes place under symmetric and

complete information. When only the target board positively weighs the CEO's expected utility (i.e., $\alpha_j > 0$ and $\alpha_i = 0$), mergers are always efficient since the net productivity gain from merging not only has to outweigh the net productivity gain of a pool of stand-alone firms, but also the expected utility of the target CEO weighted by his power parameter, α_j. In this case, however, there are unrealized efficient mergers; i.e., some efficient mergers from shareholders' point of view are not undertaken. In contrast, when only the acquiring board considers its CEO's expected utility (i.e., $\alpha_j = 0$ and $\alpha_i > 0$), inefficient mergers may occur when the acquiring CEO's post-merger expected utility exceeds his pre-merger expected utility. According to lemma (3), this is possible only when the $r_{11} \leq r_{11}^*$, which in turn implies that inefficient mergers are possible only when units are not highly related and the acquiring CEO is relatively powerful. Lastly, when both firms care about CEOs' expected utility, mergers could be either efficient or inefficient depending on how different are CEOs' power parameters and the acquiring CEO's gain from merging.

This result shows that CEO power is a necessary condition for inefficient mergers, but not a sufficient one. In fact, when the right-hand side of equation (14) is positive, mergers are always efficient since they are undertaken when shareholders' gain from merging outweighs the CEOs' loses from it, while when it is negative, inefficient merger occur for low qs since CEOs are better-off after merging than before it regardless of shareholders' value.

The second part of this proposition states that an acquiring firm overpays for a target. Because a target board can always reject an offer and ensure its inside option. This forces the acquiring firm to share the gains from merging with the target firm. While the price paid does not affect whether or not a merger occurs, it does determine how the gains from merging are shared and thus acquiring and target shareholders' net worth before and after a merger. The implication of this is studied in the next section.

4 Implications

There are several implications that are worthwhile to highlight and that follow directly from the results in proposition (4).

Corollary 1 *(i) Inefficient mergers takes place if and only if $q^{**} \leq q < q^*$; (ii) inefficient mergers are more likely the higher is α_i and the lower is α_j.*

This corollary establishes that inefficient mergers takes place when the probability of successful implementation and the degree of relatedness across units are both small. In addition, it says that inefficient mergers are more likely to take place when the acquiring CEO is more powerful and the

target CEO is less so. The former is due to the fact that inefficient mergers occurs only if the acquiring CEO's post-merger utility is higher than his pre-merger utility (i.e., $r_{11} \leq r_{11}^*$), while the latter is due to the fact that a lower price must be paid to the target firm.

This is consistent with a considerable amount of evidence that comes mainly from reactions of capital markets to merger announcement. Mainly, this literature argues that if the stock price falls when firms announce a particular action, this action must to certain extent serve the interests of managers rather than those of shareholders. This literature is surveyed in Shleifer and Vishny (1997), who conclude that bad acquisitions are driven mainly by managerial objectives. In addition, there is evidence that prevalence of inefficient mergers is at least partially determined by the ability of firms' corporate governance structures to curb agency problems. For instance, Palia (1999) finds that the diversification discount increases with the board size and decreases with the shares and options in the management compensation package. Grinstein and Hribar (2004) finds that more powerful CEOs tend to engage in larger deals relative to the size of their own firms and the market responds more negatively to their acquisition announcements. In addition, they find that CEO power is the main driver of merger and acquisitions bonuses. Wulf (2004), in a sample of merger of similar size firms, finds that target CEOs trade premium in exchange for a position in the post-merger firm. Harford (2003) shows independent outside target directors face both severe financial and non-financial repercussions subsequent to merger, while Hartzell, Ofek and Yermack (2004) find evidence CEOs negotiate in their own interests during merger negotiations. Further, target directors and executives are unlikely to be offered similar positions in the successor firm, resulting in a loss of future compensation (Agrawal and Walkling, 1994; Brickley, Coles, and Linck, 1999; Cotter, Shivdasani and Zenner, 1997; Harford, 2003). Becher and Campbell (2005) finds in sample of bank mergers that merger premiums are significantly lower when the target CEO is retained on the post-merger board. They also find that some target bank directors accept personal benefits at the expense of lower premiums for their shareholders. Specifically, few target directors remain on the successor board, but the target's merger premium is inversely related to the number of target directors retained. The average merger premium is roughly double in mergers in which two or more target directors are retained on the post-merger board compared to those in which none or one director are retained. Premiums are also lower when either multiple outside or inside directors are retained when compared to the sample of firms retaining no target directors. Similar to studies focusing on CEO retention, merger premiums are significantly lower when the target CEO is retained on the post-merger board.

Next corollary compares acquiring shareholders' value after a merger ($\Pi^D(q, r_{11}) - P_i$) with that before a merger, $\Pi_i^F(r_1)$.

Corollary 2 *(i) Acquiring shareholders' value after a merger is lower than that before a merger if and*

only if $r_{11} \leq r_{11}^*$ *and* $q \leq \tilde{q}$*, with* $\tilde{q} \geq q^*$*; and (ii)* $\tilde{q}$ *increases with* α_i *and* α_j*.*

Proof. Acquiring shareholders' value after a merger is given by:

$$\frac{1}{2}\left(\Pi^D\left(q, r_{11}\right) + \Pi_i^F\left(r_1\right) - \Pi_j^F\left(r_1\right)\right) - \frac{1}{2}\left[\alpha_i U^D\left(r_{11}\right) - \alpha_i U_i^F\left(r_1\right) + \alpha_j U_j^F\left(r_1\right)\right].$$

It follows from this that $\Pi^D\left(q, r_{11}\right) - P_i - \Pi_i^F\left(r_1\right) \leq 0$ if and only if

$$\Pi^D\left(q, r_{11}\right) - \Pi_i^F\left(r_1\right) - \Pi_j^F\left(r_1\right) \leq \alpha_i U^D\left(r_{11}\right) - \alpha_i U_i^F\left(r_1\right) + \alpha_j U_j^F\left(r_1\right). \tag{17}$$

If $\alpha_j \geq \alpha_i$, the right-hand side in equation (17) is positive, while if $\alpha_i > \alpha_j$, it is negative if and only if

$$r_{11} > \hat{r}_{11} \equiv r_{00}\left(1 + \frac{2\alpha_i}{\left(\alpha_i - \alpha_j\right)}\frac{\triangle r}{r_0}\right),$$

with $\hat{r}_{11} > r_{11}^*$.

The left-hand side in equation (17) is negative for all $q < q^*$ and increases with q. Therefore, there exists a $\tilde{q}$ such that acquiring shareholders' value is lower after a merger if and only if $q < \tilde{q}$, where

$$\tilde{q} \equiv \frac{r_1}{r_{11}} + \frac{k_1\left[\left(2 + \alpha_i\right)\left(r_{00}r_1 - r_{11}r_0\right) + \alpha_i\left(r_1 - r_0\right)r_{00} + \alpha_j\left(r_{11} - r_{00}\right)r_0\right]}{\left(1 + \lambda\right)r_{11}\left(\pi_i + \pi_j\right)\left(\triangle r_1 + \triangle r_0\right)\triangle r}.$$

Because a merger takes place when the inequality in equation (14) holds, the inequality in equation (17) holds only if $r_{11} < r_{11}^*$. This means that the right hand-side in equation (17) is positive and thus $\tilde{q} > q^*$.

The second part follows from the fact that the right-hand side in equation (17) is increasing in α_j and in α_i, where the latter is due to that $r_{11} \leq r_{11}^*$. ■

This corollary says that acquiring shareholders' post-merger value is lower than the pre-merger value when two conditions are met: first, the acquiring CEO must be better-off after merging than before it, and second, the probability that successful coordination takes place is not too high. The first condition is needed since this induces the acquiring firm to pay more to a target firm, and the second guarantees that the acquiring shareholders' gains from merging are not high enough to outweigh the wealth loss due to overpricing. This result also suggests that acquiring shareholders are worse-off only when units are not sufficiently related.

Observe also that $\tilde{q} \geq q^*$. This means that while a merger could be efficient from shareholders' viewpoint, acquiring shareholders may be worse-off after the deal since the acquiring firm paid too much to the target firm. This is more likely to be so when CEOs are more powerful (higher α_i and α_j) and the acquiring CEO's post-merger expected utility is higher. The reason is that as the acquiring CEO's power increases, the decision on whether or not to merge depends more heavily on the CEO's post-merger utility, which is higher than the pre-merger utility, and as the target CEO's power rises, more is paid to the target firm.

Corollary 3 *Target firm's stock increases after the announcement, while acquiring firm's stock may either increase or decrease with it. In particular, if* $r_{11} \leq r_{11}^*$ *and* $q \leq \tilde{q}$*, acquiring firm's stock value decreases after the announcement. The combined value increases whenever* $q \geq q^*$*, where* $q^* < \tilde{q}$*.*

Andrade, Mitchell and Stafford (2001) look at a three-day period around the announcement. They find that the combined announcement returns over that period are economically and statistically significant and positive. The combined values of the acquirer and target increase by 2% of the total initial value of the acquirer and target. This is equivalent to an increase that is roughly 10% of the initial value of the target alone. This result is consistent across all three decades, the '70s, the '80s and the '90s. Bruner (2000a) and Holmstrom and Kaplan (2001) surveys a number papers and reach similar conclusion. Returns to target firms are clearly positive, returns to acquirers are mixed, and the combined returns are positive in every study. If one were to judge acquisition success only by the acquirer return, one would conclude mistakenly that acquisitions did not create value on average[13]. This result also shows that acquiring firm's stock is more likely to decrease after the announcements the more powerful are the acquiring and target CEOs, which is consistent with the evidence provided above.

Next corollary relates the presence of credit constraints with firms productivity and the likelihood of being acquired relative to be an acquirer. Let define a high-productivity firm as one in which π_i is high and a low-productivity firm as one in which π_i is low. Then the following result obtains from equation 15.

Corollary 4 *In the presence of credit constraints, (i) acquiring firms are more likely to merge with low-productivity firms and firms with less powerful CEOs; and (ii) high-productivity firms are more likely to acquire a firm than low-productivity firms.*

To see this, suppose that focused firm i is a high-productivity firm, while focused firm j is a low-productivity firm–that is, $\Pi_i^F(r_1) > \Pi_j^F(r_1)$, firm i pays a lower price for firm j than this for firm i. Thus, if an acquiring CEO has a limited access to capital and the maximum amount of capital he has access is lower than P_i^*, but higher than P_j^*, he will acquire a low-productivity firm instead of a high-productivity firm. Furthermore, if access to capital is determined in part by a firm's productivity, then low-productivity firms have a more restricted access to capital and thus they are less likely to acquire another firm than high-productivity firms.

[13]The evidence on accounting-based studies are all over the map. Andrade, Mitchell, and Stafford (2001) and Healy, Palepu, and Ruback (1990) find positive results, i.e., accounting performance improves. Maksimovic and Phillips (2001), Kaplan and Weisbach (1992), McGuckin and Nguyen (1995), and Schoar find neutral or mixed results while Ravenscraft and Scherer (1987) find negative results. In other words, in contrast to the announcement return results, there is not clear-cut evidence that acquisitions lead on average to accounting-based or productivity-based improvements.

As far as I know there is no empirical evidence that speaks directly to this implication of the model. However, in their survey paper, Holmstrom and Kaplan (2001), argue that corporate governance issues led to the merger waves in the 1980s and 1990s, and in particular, their arguments are implicitly consistent with the idea that in general high-value firms acquire low-value firms. Furthermore, there are papers that found that acquired firms sell at a discount prior to be acquired. For instance, Graham et al. (1999) report that acquired firms sell at an average discount of approximately 15% in their last year of operations as stand-alone firms.

The next implication relates to the wage payments before and after the merger for the acquiring CEO.

Corollary 5 *Post-merger wages are higher if and only if* $r_{11} \leq r_{11}^C$.

Proof. Comparing the bonus after a merger with that before a merger, it is easy to show that the bonus is higher when

$$r_{11} \leq r_{11}^C \equiv r_{00} + \frac{2k_1}{q\left(k_1 + \lambda \pi_j \triangle r\right)}.$$

■

This lemma says that post-merger wage payment is higher when units are not highly related. The reason is two-fold: first, an increase r_{11} (all else equal) implies that research effort is more productive and thus a lower wage payment is needed to induce the CEO to investigate projects in both divisions; second, an increase in r_{11} rises expected private benefits and thus the CEO has more incentives to investigate projects in the absence of a positive wage payment.

It is also interesting to observe that the post-merger wage payments are more likely to be higher when a low-productivity firm is acquired since private benefits from merging are lower. The evidence here is scarce and usually does not speak directly to the implication here since it compares average wages and bonuses of CEO of diversified firms with those for CEO of stand-alone firms. However, Rose and Shepard (1997) test this prediction directly and found that on average a change from a stand-alone status to an integration status results in substantial and significant negative effect on both salary and bonuses and total compensation, which is more likely outcome according to the model.

5 Information and Resource Sharing

5.1 Information Sharing

Information sharing is crucial for a successful implementation. The author of the well-known book Making Strategy Work argues that "whatever the structure is, successful execution depends on coordination

and information sharing across organizational units...". The parameter q, which was interpreted as the probability that successful implementation occurs, was meant to capture to some extent the importance of information sharing. In this sub-section, the role of information sharing is taken a step further by mean of studying a simple model of information sharing that links that to q.

Suppose that each division i, $i = 1, 2$, is run by a manager that has the ability to learn the state of the world (s_i) or the particular circumstances that identifies the optimal course of action in unit i absent of coordination and synergies, where s_i is distributed $f(\bullet)$ with mean $\bar{s}_i$ and variance σ_i^2. For the sake of simplicity, in a stand-alone firm the manager is the CEO, while in a diversified firm each unit is run by a divisional manager and the firm as a whole by the CEO.

In a focused firm project i's return is π_i with probability q_i and 0 otherwise, where the probability that successful implementation takes place (q_i) depends on environment that each unit faces and on an action or implementation decision d_i taken by the CEO after a project is chosen, but before returns are realized. In particular,

$$q_i(d_i) = 1 - \frac{1}{2}(d_i - s_i)^2. \tag{18}$$

In a integrated firm, projects' returns are $\pi_i + \pi_j$ when successful implementation takes and 0 otherwise, where the probability that successful implementation takes place (q) depends on environment that each unit faces and on implementation decisions d_i and d_j as follows

$$q(d_i, d_j) = \frac{1}{2}\left(q_i(d_i) + q_j(d_j) - \frac{\beta}{2}(d_i - d_j)^2\right),$$

where the parameter $\beta \geq 0$ captures the importance of coordinating implementation decisions.

Managers are assumed to be symmetric and to observe each other realized states. In contrast, the CEO cannot observe realized states, but divisional managers can communicate that information to the CEO prior to make decisions. Such communication will be often imperfect due to language problems, ineffective use of informal contacts, managers communication skills, and coordinating schedules problems between managers and the CEO. As a result of this, the information received by CEO can be incorrect or useless. In particular, it is assumed that with probability ϕ, managers communicate correctly the state of the world to the CEO and with probability $1 - \phi$ they do it incorrectly, where by that it is meant that the CEO learns nothing about the realized states. I will refer to ϕ as the quality of communication channel in place. Observe that in this simple setting communication is not strategic and communications errors are mainly due human fallibility or environmental conditions.

First, consider a stand-alone firm. Given the optimal contract in place the CEO's expected payoff after projects have been chosen is independent of q. Thus, it is assumed the CEO chooses d to maximize firm value. It is trivial to show that entails to choose $d_i^F = s_i$ and thus $q_i\left(d_i^F\right) = 1$.

Next, consider an integrated firm. Again because the optimal contract in place implies that the CEO's expected payoff is independent of q, it assumed that the CEO chooses $\mathbf{d} = (d_i, d_j)$ to maximize firm value. When communication is successful, then the CEO is faced with the following problem

$$\max_{\mathbf{d} \in \Re^2 \geq 0} \left\{ E\left(q\left(\mathbf{d}\right) \mid s_i, s_j\right) \lambda \left(\pi_i + \pi_j\right) \right\},$$

where $E\left(\bullet \mid s_i, s_j\right)$ is the expectation conditional on the fact that the CEO knows (s_i, s_j).

It is easy to show then that the optimal decisions, denoted by $\mathbf{d}^c \equiv \left(d_i^c, d_j^c\right)$, are given by

$$d_i^c = \frac{\left(1+\beta\right) s_i + \beta s_j}{1+2\beta} \text{ and } d_j^c = \frac{\left(1+\beta\right) s_j + \beta s_i}{1+2\beta}.$$

Next, suppose that communication fails, then the CEO faces the following problem

$$\max_{\mathbf{d} \in \Re^2 \geq 0} \left\{ E\left(q\left(\mathbf{d}\right)\right) \lambda \left(\pi_i + \pi_j\right) \right\}.$$

In this case it is easy to show that the optimal decisions are given by

$$d_i^c = \bar{s} \text{ and } d_j^c = \bar{s}.$$

Observe that optimal decisions when the CEO is informed are a convex combination of the business environment in division i and that in division j, where d_i^c weights more heavily s_i while d_j^c weights more heavily s_j. That is, in each unit the CEO gives relatively more importance to the specific environment of the unit.

After a few steps of simple algebra, it can be shown that

$$Eq\left(\mathbf{d}^c\right) = 1 - \frac{\beta}{4\left(1+2\beta\right)} \phi \left(\sigma_i^2 + \sigma_j^2 - \sigma_{ij}\right) - \left(1-\phi\right)\left(\sigma_i^2 + \sigma_j^2\right),$$

where σ_{ij} is the covariance between the two environments.

Observe that the ex-ante probability that successful implementation takes place depends negatively on the uncertainty of the environment and positively on the covariance in the business environments. Thus, the more related the business environments are as captured by σ_{ij}, the higher the probability that successful implementation takes place. Furthermore, the more important is the need for coordination as measured by β and the less efficient is the communication channel, the lower is the probability that successful coordination occurs.

Given optimal decisions an integrated firm value is

$$\Pi^D\left(q\left(\mathbf{d}^c\right), r_{11}\right) = r_{11} Eq\left(\mathbf{d}^c\right)\left(1+\lambda\right)\left(\pi_1 + \pi_2\right) - r_{11}\frac{2k_1}{\triangle r_1 + \triangle r_0},$$

while a stand-alone firm value is

$$r_1 (1 + \lambda) \pi_i - r_1 \frac{k_1}{\triangle r}.$$

Observe that a diversified firm value rises (weakly) the more related the two divisions are (higher σ_{ij}), the more efficient is the communication channel (higher ϕ), and the less important is the coordination in implementation decisions across units (lower β). The intuition in each case is straightforward and thus omitted.

Because a stand-alone firm value remains unchanged, this leads to the prediction that a merger is more likely to take place and be efficient, the more related the two divisions are, the more efficient is the communication channel, and the less important is need for coordination in implementation decisions across units.

The evidence showing that mergers are more likely to be value-creating, the more related the units is vast (see, for instance, Markides, 1995 and Morck et al., 1990). In addition, there is evidence that corporate culture also affects the probability that a merger succeeds. To the extent that the quality of communication is somehow affected by corporate culture, this suggests a channel by which corporate culture affects the probability that a successful merger takes place.

5.2 Resource-Sharing

Since Rumelt (1974) the management strategy literature have argued that opportunities for resource sharing across units underpin the potential operating synergy benefits, and these opportunities are driven by the extent or degree of relatedness among underlying resources. More related business units result in more opportunities for resource sharing. Sharing increases resource utilization and is expected to yield economies of scope. This assumes that the firm is endowed with excess resources beyond what are required for normal, efficient operations in the core business, and that the firm cannot trade its excess resources in the market. Under these conditions, theory suggests that the firms excess resources provide an economic justification to diversify into a new, related business (Teece, 1982; Williamson, 1985). To the extent that a firm's existing stock of resources can be shared or leveraged to enter a new business, utilization of these shared resources increases and the firm captures economies of scope and synergies resulting from a more efficient use of resources.

Examples of shared resources include the senior management team responsibility for financial budget decisions across businesses, a group of engineers or scientists using their expertise to advance new products in multiple businesses, or an experienced shared sales force cross-selling multiple products.

In this sub-section, a simple extension of the model is studied to link mergers to the issue of resource sharing. In order to do so in a simple fashion, it is assumed that the acquiring firm has an amount

of an intangible specific resource equal to R_c, where the subscript c stands for core business, and the target firm has an amount R_n of the same resource, where subscript n stands for new business. Thus, an integrated firm has an amount $R = R_c + R_n$ of this specific resource. Because this is intangible and specific, it cannot be traded in the market. The acquiring firm, which it is referred as the core business, requires an amount $\overline{L}_c$ of the specific resource to run an efficient and smooth operation, while the new business requires an amount $\overline{L}_n$ to do so. Any amount beyond the limit $\overline{L}_i$ does not affect firm i's productivity.

Project i's return in a focused firm i is $\theta_i \pi(L_i)$, where $\theta_i \pi\left(\overline{L}_i\right) = \theta_i \pi$ for all $L_i > \overline{L}_c$, $\pi'(L_i) > 0$ and $\pi''(L_i) \geq 0$ for $L_i \leq \overline{L}_i$. Convexity in L_i captures that specialization is beneficial. This together with the assumption that $\theta_c \geq \theta_n$ implies that specialization in the core business is better than specialization in the new business when resources are scarce–that is, $\theta_c \pi(R) \geq \theta_c \pi(L_c) + \theta_n \pi(R - L_c)$ for all $R \leq \overline{L}_c$. In addition, the probability that successful implementation takes place depends negatively on the imbalance of resources across units. In particular,

$$q(L_c, L_n) = 1 - \frac{\delta}{2}(L_c - L_n)^2,$$

where $q(R, 0) > 0$ for all R and δ is a parameter that capture the importance of resource imbalances across units.

It is trivial to show that in focused firm i's, the optimal use of the strategic resource is $L_i^F = R_i$ if $R_i \leq \overline{L}_i$ and $L_i^F = \overline{L}_i$ if $R_i > \overline{L}_i$. Thus, a focused firm's profit is given by

$$\Pi_i^F(r_1, R_i) = r_1 \theta_i \pi\left(L_i^F\right)(1 + \lambda) - r_1 \frac{k_1}{\triangle r}. \tag{19}$$

In contrast, the CEO of a integrated firm chooses the resource allocation to solve the following program

$$\max_{L_c + L_n \leq R} \left\{ q(L_c, L_n) \left[\theta_c \pi(L_c) + \theta_n \pi(L_n)\right] \right\}.$$

Assuming that the resource constraint binds, the first-order condition is given by

$$-\frac{\beta}{2}(2L_c - R)\left[\theta_c \pi(L_c) + \theta_n \pi(R - L_c)\right] + q(L_c, L_n)\left[\theta_c \pi'(L_c) - \theta_n \pi'(R - L_c)\right] \gtreqless 0.$$

Observe that the first term is the marginal benefit to successful implementation. This term is negative when more resources are allocate to the core business and positive otherwise. The second term captures the benefits to specialization, which is positive for all $L_c \leq \overline{L}_c$ since $\theta_c \geq \theta_n$. Thus, when deciding the resource allocation, the CEO must trade-off the benefits to specialization against the benefits to successful implementation. Next note that for all $L_c \leq \frac{R}{2}$, the marginal benefit to successful implementation is positive. This implies that it is never optimal to allocate an amount smaller than $\frac{R}{2}$

to the core business when $\frac{R}{2} \leq \overline{L}_c$. To save on case analysis two assumptions are made: (i) $\overline{L}_c \geq \overline{L}_n$; and (ii) it is optimal to allocate all the resources to the core business when $R \leq \overline{L}_c$. Let L_c^* be the amount of resources allocated to the core business that solves the first-order condition with equality. When L_c^* does no exist, it is set to infinity[14]. Then it can easily be shown that the optimal resource allocation, denoted by $\left(L_c^D, L_n^D\right)$, is as follows

$$\left(L_c^D, L_n^D\right) = \begin{cases} \left(\overline{L}_c, \min\left\{\overline{L}_c, R - \overline{L}_c\right\}\right) & \text{if } R \geq \overline{L}_c + \overline{L}_n, \\ \left(\min\left\{\overline{L}_c, L_c^*\right\}, R - \min\left\{\overline{L}_c, L_c^*\right\}\right) & \text{if } \overline{L}_c < R < \overline{L}_c + \overline{L}_n, \\ (R, 0) & \text{if } R \leq \overline{L}_c. \end{cases}$$

When an integrated firm has a surplus of the specific resource –that is, $R \geq \overline{L}_c + \overline{L}_n$– the optimal allocation is to assign the amount needed to run an efficient and smooth operation to the core business and allocate $\min\left\{\overline{L}_c, R - \overline{L}_c\right\}$ to the new business since this maximizes the probability of successful implementation. When the scarcity of resources is so severe as to make impossible to operate the core business efficiently, all the resources are allocated to it to take advantage of the benefits to specialization. Lastly, when there is neither a surplus nor a severe deficit ($R > \overline{L}_c$), the core business is allocated the amount needed to run an efficient and smooth operation when this does not result in a highly uneven distribution of resources across units since that makes implementation very unlikely to succeed. When the latter occurs, less than the optimal needed to run an efficient core operation is allocated to the core business–that is, $\overline{L}_c > L_c^D > \frac{R}{2}$.

Given the optimal resource allocation policy, post-merger profits are

$$\Pi^D(q, r_{11}, R) = r_{11} q\left(L_c^D, L_n^D\right)\left(\theta_c \pi\left(L_c^D\right) + \theta_c \pi\left(L_n^D\right)\right)(1 + \lambda) - \frac{2k_1 r_{11}}{\triangle r_1 + \triangle r_0}. \tag{20}$$

It follows from equations (14), (19) and (20) that resource sharing affects the diversification decision if and only if it affects

$$r_{11} q\left(L_c^D, L_n^D\right)\left(\theta_c \pi\left(L_c^D\right) + \theta_n \pi\left(L_n^D\right)\right) - r_1\left[\theta_c \pi\left(L_c^F\right) + \theta \pi_n\left(L_n^F\right)\right]. \tag{21}$$

For the sake of brevity, I will focus only on those cases in which $R_c < \overline{L}_c$ and $R_n > \overline{L}_n$–that is the core business has a deficit of the specific resource, while the new business has a surplus of it– and $R_c > \overline{L}_c$ and $R_n < \overline{L}_n$–the core business has a deficit, while the new business a surplus. In addition, post-merger resources satisfy the following: $\overline{L}_c < R < \overline{L}_c + \overline{L}_n$.

If $R_c < \overline{L}_c$ and $R_n > \overline{L}_n$, then equation (21) is as follows

$$r_{11} q\left(L_c^D, L_n^D\right)\left[\theta_c \pi\left(\min\left\{\overline{L}_c, L_c^*\right\}\right) + \theta_n \pi\left(R - \min\left\{\overline{L}_c, L_c^*\right\}\right)\right] - r_1\left(\theta_c \pi\left(R_c\right) + \theta_n \pi\right), \tag{22}$$

[14] A solution to the first-order condition with equality exists if and only if the first-order condition evaluated at $L_c = \overline{L}_c$ is negative. This occurs when δ is large and R is small.

while if $R_c > \overline{L}_c$ and $R_n < \overline{L}_n$, equation (21) is as follows

$$r_{11}q\left(L_c^D, L_n^D\right)\left[\theta_c\pi\left(\min\left\{\overline{L}_c, L_c^*\right\}\right) + \theta_n\pi\left(R - \min\left\{\overline{L}_c, L_c^*\right\}\right)\right] - r_1\left(\theta_c\pi + \theta_n\pi\left(R_n\right)\right). \tag{23}$$

If the core business lacks the resources to be run efficiently, merging allows the core business to obtain the specific resources to reach that goal. This however comes at the cost of dismantling the new business since resources are taking away from it and thus it is no longer possible to run the new business efficiently, i.e., $\pi\left(R - \min\left\{\overline{L}_c, L_c^*\right\}\right) < \pi$. Nonetheless, the gains to specialization in the core business plus the gains due to an increased probability of successful coordination outweigh the efficiency loss in the new business. Thus, a merger makes possible to improve the efficiency of the core business and of the integrated firm by mean of sharing resources.

In contrast, when the core business has a surplus of resources, merging allows the core business to share this resources with the new business. In this case, the core business' return either remains unchanged or decreases, while the new business' post-merger return rises. However, the gains due to an increased probability of successful coordination counterweight the potential efficiency loss in the core business.

In both cases integration allows the acquiring firm to relax the resource constraint in the same way, yet the consequences on the inegration decision and price paid are different in each case. It readily follows from equations (22) and (23) that a merger is more likely to be undertaken when the core business lacks the resources to run a smooth and efficient operation than when it is the new business that faces this problem if and only if

$$\left(\theta_c - \theta_n\right)\pi > \theta_c\pi\left(R_c\right) - \theta_n\pi\left(R_n\right). \tag{24}$$

From this it is not clear cut whether or not a core-constraint motivated merger is more likely to be undertaken than a target-constraint motivated merger. When either the initial endowment of resource is similar across units or is higher in the new business, a merger is more likely to take place when the core business is resource constraint, while when initial endowments are unequal and the endowment is higher in the core business, the opposite occurs.

Whether is the core business or the new business credit constraint also has an effect on the equilibrium price. It follows from equation (15) that the effect of resource sharing on the equilibrium price depends on how that impact the following

$$r_{11}q\left(L_c^D, L_n^D\right)\left[\theta_c\pi\left(\min\left\{\overline{L}_c, L_c^*\right\}\right) + \theta_n\pi\left(R - \min\left\{\overline{L}_c, L_c^*\right\}\right)\right] + r_1\theta_c\pi_n\left(L_n^F\right) - r_1\theta_c\pi\left(L_c^F\right).$$

It is clear that the impact of resource sharing on the equilibrium price is different when the core business is resource constraint from the case in which the target business is resource constraint. In fact,

it is easy to show that the price is higher in the former case if and only if

$$(\theta_c + \theta_n)\,\pi > \theta_c \pi\,(R_c) - \theta_n \pi\,(R_n)\,.$$

Because this inequality holds always, the price paid to a target firm is higher when the core business is resource constraint than when the target firm is constraint. The reasons is that the target's inside option and the benefits to integration are higher. This together with the fact that when the pre-merger endowment of resource is higher in the core business, a merger is more likely to take place when the core business is not constraint, imply that it is more likely that acquiring shareholders are better-off when a merger is motivated by a surplus of resources in the core business than when it is motivated by surplus in the target firm. Thus, as predicted by the management of strategy literature, acquiring shareholders post-merger value is more likely to be higher than pre-merger value when the core business has accumulated a surplus of specific resources. Nonetheless, from the efficiency standpoint of view, target-constraint motivated mergers could be more efficient.

6 Conclusions

In this paper I extend the standard model of the firm defined by the things it does and the capabilities it has by dealing with private benefits, incentives and managerial power to provide a model rich enough to provide an explanation on how firm scope is decided. While the model proposed here is extremely simple, it has the benefit of making predictions that are consistent with the empirical work on mergers such as: on average the combined value of a merger is positive, target shareholders are better-off after the merger, while acquirer shareholders could be either better or worse than before the merger, and high-productivity firms tend to acquire low-productivity firms.

Given how spare the model is in many dimensions, there are several dimensions in which the paper can be extended. There are two that I believe are of particular interest. First, how the market structure affect CEOs power and a firm's decision to integrate. For instance, it is trivial to show that if firms are symmetric and compete a-la-Cournot, then mergers are more likely to take place in concentrated markets since the gains from coordination and the gains from market power are complementary and the latter is higher in more concentrated markets. This implies also that acquiring shareholders are more likely to be worse-off after a merger when the market is more competitive. For instance, this will allow us to study issues related to market regulation and merger waves. Second, it would be useful to study the relationship between coordination and the internal organization of the firm[15]. There is a large literature on the field of strategy arguing that exploiting synergies require a centralized organizational form, while

[15]See, Balmaceda (2006) for a repeated game model in which the same elements of the model here are considered together with the issue of which is the optimal organization structure for each strategy.

unrelated diversification requires a more decentralized organizational form. By centralization I mean that the power of many decisions resides on the hands of the CEO, while by decentralization I mean that these decisions rests in the hands of divisional managers. The model here can be used as an starting point to study the relationship between strategy and structure by adding a layer of divisional managers and then studying the optimal allocation of decision rights and choice of strategy. CEO power will also be crucial since it is usually the CEO who has the right to choose the internal allocation of decision rights. If delegation of decision rights to divisional managers results in a significant loss of control or incentives between the CEO and divisional managers are highly misaligned, the CEO will prefer a more centralized organizational form, while the opposite will occur if incentives are more aligned. This will depend partly on how much coordination is needed to successfully exploit synergies and partly on how much initiative is lost by not giving divisional managers decision rights. This type of extension will allow a better understanding of what other dimensions affect the scope of a firm. A concrete example of the failure of a fully decentralized organization in dealing with technological interdependencies (synergies) is the experience in the 1980s of General Motors (GM) versus International Business Machine (IBM). GM and IBM were trying to achieve divisional adherence to a particular technological standards. GM employed a decentralized governance during this episode, while IBM used a more centralized structure. In the IBM case coordination was successful, while at GM it was not.

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