

# Mergers and Incentives to Create Synergies

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## Abstract

Many mergers are motivated by the existence of synergies between the merging firms, yet they fail to achieve any synergies after merger completion. This paper presents a model of endogenous synergy creation and shows that expected synergies from a merger are realized only if the managers from the two merging firms are willing to collaborate towards the creation of synergies. We show that incentives to collaborate are stronger in mergers combining firms with complementary assets and resources, and firms from complementary industries. Importantly, this result arises not because greater complementarities imply greater merger gains, but because greater complementarities lead to stronger incentives for managers to work together, increasing the endogenous success probability of achieving the expected synergies. Our model predicts that the likelihood of generating expected synergies is greater in mergers motivated by scope economies than in mergers motivated by scale economies. In addition, vertical mergers are more likely to succeed relative to horizontal mergers to the extent that merging firms are likely to have greater asset and industry complementarity in vertical mergers. These predictions are consistent with the empirical evidence in Rhodes-Kropf and Robinson (2008) and Hoberg and Phillips (2011) that asset complementarities and industry complementarities play an important role in value creation from mergers. Our paper also shows that the level of diversification discount is smaller in conglomerates combining firms from complementary industries, consistent with the recent evidence in Hoberg and Phillips (2011).

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## Abstract

Many mergers are motivated by the existence of synergies between the merging firms, yet they fail to achieve any synergies after merger completion. This paper presents a model of endogenous synergy creation and shows that expected synergies from a merger are realized only if the managers from the two merging firms are willing to collaborate towards the creation of synergies. We show that incentives to collaborate are stronger in mergers combining firms with complementary assets and resources, and firms from complementary industries. Importantly, this result arises not because greater complementarities imply greater merger gains, but because greater complementarities lead to stronger incentives for managers to work together, increasing the endogenous success probability of achieving the expected synergies. Our model predicts that the likelihood of generating expected synergies is greater in mergers motivated by scope economies than in mergers motivated by scale economies. In addition, vertical mergers are more likely to succeed relative to horizontal mergers to the extent that merging firms are likely to have greater asset and industry complementarity in vertical mergers. These predictions are consistent with the empirical evidence in Rhodes-Kropf and Robinson (2008) and Hoberg and Phillips (2011) that asset complementarities and industry complementarities play an important role in value creation from mergers. Our paper also shows that the level of diversification discount is smaller in conglomerates combining firms from complementary industries, consistent with the recent evidence in Hoberg and Phillips (2011).

# 1 Introduction

One of the primary motivations for merger and acquisition (M&A) activity is to create and exploit synergies between the merging firms. While researchers argue at length regarding the definition and measurement of merger synergies and merger success, they often agree about one point: far too few M&A deals deliver their expected synergies. In this paper, we argue that a high level of expected synergies *ex ante* may not be sufficient for successful creation and implementation of the expected synergies *ex post*. Expected synergies can be realized only if the merging firms have the incentives to collaborate and work together towards the creation of the synergies. We show that incentives to collaborate, and the endogenous likelihood of achieving expected synergies depend on asset complementarities as well as industry complementarities between the merging firms. This is not because of an assumption that greater complementarities imply greater synergies. It is because in mergers combining firms with complementary assets, involvement of each merging firm is essential to synergy creation. This reduces the expropriation concerns and enhances the incentives of the two firms to collaborate in order to increase the success probability of achieving anticipated synergies from the merger. This result is consistent with the evidence in Rhodes-Kropf and Robinson (2008) and Hoberg and Phillips (2011) that asset and industry complementarities are an important driver of mergers and value creation from mergers.

In our model, we consider a two-divisional firm formed through a merger where each division is run by a divisional manager. The managers either can choose to work independently with no information and knowledge sharing between them, or can choose to collaborate by combining and sharing their information and knowledge with each other. If each division works independently, no synergies are created and gained from the merger. If they collaborate, they can create synergies if their collaboration effort succeeds. Conditional on collaboration, there are two stages for achieving expected synergies. In the first stage, managers exert effort for creating synergies. If both managers' collaboration effort succeeds, synergies can be realized in the second stage with the active participation of both managers. Collaborating for synergies has both costs and benefits for the managers. It is costly in the sense that if at least one of the manager's collaboration

effort fails, not only it is not possible to realize any synergy surplus, but also each manager experiences a dilution in the value of his own division. This is because working towards synergy creation with the other division requires each manager to divert resources and attention from his own division. The benefit of collaboration is that, if both managers are successful in their collaboration effort, it results in an increase in firm value through a synergy surplus. However, the existence of a synergy surplus is not sufficient for the managers to be willing to collaborate. Their collaboration incentives critically depend on the extent to which each manager can internalize the surplus. Their ability to internalize the surplus, in turn, depends on how essential the participation of each manager is to the realization of the synergies during the second stage. If the merging firms complement each other in terms of their human capital, skills and resources, the post-merger firm needs both firms and managers for the implementation of the synergies. Put differently, the firm experiences a larger loss in synergy surplus from retaining only one manager at the implementation stage and firing the other one, the more complementary the two firms are to each other. The greater need for each divisional manager leads to stronger incentives for them to collaborate and work towards synergies. Interestingly, from the firm's perspective, stronger collaboration incentives come at a cost: the dependence on both managers for realizing the synergies reduces the portion of the synergy surplus extracted by the firm. However, as long as collaboration incentives are sufficiently strong, the firm benefits from the collaboration effort of the managers through a higher success probability of achieving the synergy surplus.

Alternatively, if the merger combines homogenous firms with low asset and industry complementarity, each merging firm and manager would be less essential and critical in implementing the synergies, and would be more easily expropriated by the post-merger firm. This is because the firm's ability to realize the synergies by keeping only one manager and firing the other one is greater the less complementary the managers are in terms of skill and knowledge they possess. Lower complementarity leads to ex ante weaker incentives for managers to collaborate since each manager anticipates that his marginal value and contribution in the merged firm will drop once the collaboration effort succeeds and synergies are created. Hence, in such a merger, managers

will not find it desirable to collaborate for synergies, and the merger will fail to achieve any synergies. Although this strategy leads to no synergy surplus, from the managers' perspective, there is no dilution in the value of each manager's own division. Focusing exclusively on his own division may be the optimal strategy for each manager especially when they anticipate that once they collaborate and create synergies, they will be expropriated by the firm during the implementation of the synergies. Interestingly, it is possible that the managers choose to work independently without any collaboration even if the merger has a significant synergy potential *ex ante*. This result implies that although some mergers are desirable from the shareholders' perspective conditional on the realization of expected synergies, it may not be possible to motivate the managers to work together, and the synergy potential of the merger remains unrealized.

The level of asset and industry complementarity in our model has implications for diversification discount. For sufficiently high values of complementarity, the two stand-alone firms will find it optimal to merge, and the value of the post-merger firm will be greater than the total value of the stand-alone firms. Hence, the post-merger firm will be valued at a premium relative to the stand-alone firms. This result is consistent with the recent finding in Hoberg and Phillips (2011) that conglomerates combining operations from complementary industries exhibit a lower diversification discount and sometimes trade at a premium relative to stand-alone firms.

Our model also shows that stand-alone firms with greater profitability and growth prospects are less likely to undertake a merger. This is because the merger spreads the amount of scarce resources of the firm too thinly over two divisions and affects managerial incentives to work hard, and this inefficiency turns out to be most costly when the profitability of the stand-alone firm is greater. This result is consistent with the empirical findings related to diversification discount. In our model, firms which choose to remain stand-alone are endogenously different from firms choosing to undertake a merger in terms of their growth prospects, and they have a higher value compared to firms undertaking a merger, without necessarily implying that mergers are inefficient. Hence, our paper provides a rational explanation for the diversification discount puzzle, and consistent with the self-selection arguments in Campa and Kedia (2002), and Villalonga (2004).

Our paper is related to the property rights theory of the firm (Grossman and Hart (1986), Hart and Moore (1990) and (1994)). One of the important messages from the property rights theory of the firm is that when contracts are incomplete, complementary assets should be owned by the same firm to minimize the negative effect of the hold-up problem on incentives to undertake relation specific investment. In our paper, combining firms with complementary human capital and resources leads to a greater success probability for the merger to realize its synergy potential. This is because the manager of each party in the merger is essential to the realization of synergies, and is less concerned about being held-up by the post-merger firm once merger synergies are created.

Our paper is also related to the theory of the firm and internal capital markets. Existing work in these areas considers the advantages and disadvantages of firms with a large number of divisions (see, among others, Gertner, Scharfstein and Stein, 1994). We present a new benefit of having divisions with complementary assets in terms of improving divisional incentives to collaborate. In our model, whether one division complements another division is a key driver of whether the divisions find it optimal to collaborate and whether having two divisions in a firm is value-enhancing or not.

The paper is organized as follows. In Section 2, we describe our basic model. In Section 3 we analyze the basic model where we examine managerial incentives to collaborate. In Section 4, we analyze the firm's merger decision based on managerial incentives to work towards synergy creation. 5 concludes. All proofs are in the Appendix.

## **2 The Model**

We have a two-divisional firm formed through a merger where each division is managed by a divisional manager. Firm value depends on managerial effort. Value creation takes place over two periods. During the first period, each manager exerts effort which determines his success probability. Conditional on managers' being successful in their effort, the corporate headquarters (CHQ) makes a resource allocation decision which determines value creation. Both the firm and

the managers are risk-neutral and, the managers are wealth-constrained. There are four dates in our economy, with no discounting.

At  $t = 0$ , divisional managers can choose to work together towards creation of synergies or to work independently from each other with no potential for synergies.

If the managers choose to work independently with no potential for synergy creation, at  $t = 1$ , manager  $i$  exerts effort  $p_i^I$ , at a cost of  $\frac{k}{2}(p_i^I)^2$ , which determines his success probability. The parameter  $k$  measures the cost of exerting effort, with  $k > 1$ . There are three possible states of the world. The first one is where both managers succeed. The second one is where one manager succeeds and one fails. The third one is where both managers fail. If both managers succeed and if both of them are successful at the end of the first period, they need resources from the Corporate Headquarters (CHQ) to create value. Conditional on the CHQ allocating its scarce resources to each division, each division generates payoff  $x > 0$ . The CHQ also has the option to close down one of the divisions and continue with only one division by allocating all its resources to that division. In such a situation, the division divested generates payoff 0 while the division which receives all the resources from the CHQ generates payoff  $2x$ . If only one of the managers succeed in the first stage, the CHQ allocates all its resources to the successful division which generates payoff  $2x$ , and the division of the manager who fails generates 0 payoff. Finally, if both managers fail, both divisions generate payoff 0.

If the managers choose to collaborate and work together, at  $t = 1$ , manager  $i$  exerts effort  $p_i^S$ , at a cost of  $\frac{k}{2}(p_i^S)^2$ , which determines his success probability. There are three possible states of the world as before. If both managers succeed in their effort and if the CHQ decides to allocate its resources over the two divisions, both divisions together generate payoff  $s > 0$ . We assume that  $s > 2x$  implying that the two divisions create more value together if their managers choose to collaborate and succeed. As in the case where the managers choose to work independently without any collaboration, the CHQ can still choose to keep only one division if both managers succeed. Specifically, if the CHQ continues only one division and closes down the other division, the value generated is given by  $\theta s$  with  $0 \leq \theta \leq 1$ . This implies that the extent to which the

CHQ can create synergies with keeping only one division depends on the value of  $\theta$ . If  $\theta = 0$ , for instance, both managers/divisions are essential to the realization of synergies, and the CHQ has to keep both divisions alive in order to realize the full value of synergies.

If only one of the managers succeeds and if his division receives all the resources from the CHQ, his division generates payoff  $2dx$  with  $d < 1$ . The assumption that  $d < 1$  captures the notion that collaborating with the other division and working towards synergies is costly for each division in the sense that in case the collaboration effort does not work for both managers, that is, one manager fails, the successful manager's division generates a lower value than if the manager chooses to focus only on his division and does not follow the collaboration option. Hence, compared to the case where the managers work independently, collaboration is profitable in case both managers are successful given that  $s > 2x$ , it is costly if one of the managers fails in his collaboration effort. Put differently, realization of synergies is conditional on both managers being successful together, and the possibility that one of the managers may fail imposes a cost on the successful manager as well.

Finally, if both managers fail, both divisions generate 0 payoff.

We assume that contracts are incomplete in the sense that it is not feasible to contract ex-ante on the participation of either the managers or the CHQ to the second period of the value creation cycle.<sup>1</sup>The division of the total surplus between the CHQ and the managers is determined through bargaining at the interim stage at  $t = 2$ .

We characterize the payoffs that result from bargaining between the CHQ and the manager(s) by using the notion of Shapley value (see Myerson, 1991, and Winter, 2002). Based on this solution concept, each player obtains the expected value of his marginal contribution to all coalitions that can be formed with all other players engaged in bargaining.

To obtain the Shapley value, we first need to define the set of players engaged in the bargaining process denoted by  $N$ . The Shapley value is then obtained as follows. Let  $C$  be a possible (sub)coalition of players from the set of all players engaged in bargaining  $N$ , that is,  $C \subseteq N$ . Let

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<sup>1</sup>Thus, contracts are incomplete in the sense of Grossman and Hart (1986) and Hart and Moore (1990, 1994).

$\Pi_T(C)$  be the total payoff that can be obtained by the players in  $C$  if they cooperate, that is, by the (sub)coalition  $C \subseteq N$ , with  $\Pi_T(\emptyset) = 0$ . The Shapley value for player  $i \in N$ , denoted by  $v_i$ , is then given by

$$v_i = \sum_{C \subseteq N-i} \frac{|C|!(|N| - |C| - 1)!}{|N|!} (\Pi_T(C \cup i) - \Pi_T(C)). \quad (1)$$

Intuitively, the Shapley value reflects the notion that each player's payoff from bargaining depends on the player's marginal contribution to the total payoff, given what the other players can obtain by themselves or by forming subcoalitions.

At  $t = 3$ , the payoff from the project is realized and distributed between the CHQ and the manager(s).

## 2.1 Model Analysis

### 2.1.1 No collaboration between divisions

When the managers choose to work independently, bargaining payoffs for the CHQ and the managers depend on whether only one or both managers have a successful outcome at the first period,  $t = 2$ . There are three different possible cases (states of the world): (i) both managers are successful in the first period  $SS$ , (ii) one manager is successful while the other one fails, state  $SF$ , (iii) both managers fail, state  $FF$ .

In the simplest case where both managers fail, state  $FF$ , both divisions are terminated and all agents obtain zero payoffs. Define then the Shapley value in state  $SS$  and  $SF$  for the CHQ and manager  $i$ ,  $i = 1, 2$  as  $\{v_{CHQ}^I(SS), v_{CHQ}^I(SF)\}$  and  $\{v_{M_i}^I(SS), v_{M_i}^I(SF)\}$ , respectively. The CHQ's expected profit,  $\pi_{CHQ}^I$ , is then given by

$$\pi_{CHQ}^I \equiv p_i^I p_j^I v_{CHQ}^I(SS) + p_i^I (1 - p_j^I) v_{CHQ}^I(SF) + p_j^I (1 - p_i^I) v_{CHQ}^I(SF); \quad i, j = 1, 2; i \neq j, \quad (2)$$

and manager  $i$ 's expected profit,  $\pi_{M_i}^I$ , is given by

$$\pi_{M_i}^I \equiv p_i^I p_j^I v_{M_i}^I(SS) + p_i^I (1 - p_j^I) v_{M_i}^I(SF) - \frac{k}{2} (p_i^I)^2; \quad i, j = 1, 2; i \neq j. \quad (3)$$

The surplus allocation between the CHQ and the manager(s), that is, their Shapley value, is then determined as follows. If the CHQ has only one successful division, state  $SF$ , the set of bargaining players is given by the CHQ and the successful manager, say manager  $i$ , yielding  $N = \{CHQ, M_i\}$ . In this case, the CHQ can allocate all its resources to division  $i$ , which generates  $2x$ . Thus, the total payoff of the coalition formed by the CHQ and manager  $i$  is  $\Pi_T^{I,SF}(CHQ, M_i) = 2x$ . If the division is closed down, the CHQ and the manager obtain zero payoff, yielding  $\Pi_T^{I,SF}(CHQ) = \Pi_T^{I,SF}(M_i) = 0$ . This implies that the Shapley values for the CHQ and manager  $i$ ,  $v_{CHQ}^I(SF)$  and  $v_{M_i}^I(SF)$ , are

$$v_{CHQ}^I(SF) = \frac{\Pi_T^{I,SF}(CHQ, M_i) - \Pi_T^{I,SF}(M_i)}{2} = x, \quad (4)$$

$$v_{M_i}^I(SF) = \frac{\Pi_T^{I,SF}(CHQ, M_i) - \Pi_T^{I,SF}(CHQ)}{2} = x. \quad (5)$$

If both managers are successful at  $t = 2$ , state  $SS$ , the CHQ engages in a process of (multilateral) bargaining with both managers. In this case, the set of bargaining players is given by the CHQ and the two managers, yielding  $N = \{CHQ, M_1, M_2\}$ . If the CHQ keeps both divisions, the coalition of the CHQ and the managers yields  $x + x = 2x$ , implying that  $\Pi_T^{I,SS}(CHQ, M_1, M_2) = 2x$ . If the CHQ forms a coalition with one of the managers only, it will allocate all its resources to his division which will generate payoff  $2x$ . Hence, the payoff of the coalition formed by the CHQ with only one manager is  $\Pi_T^{I,SS}(CHQ, M_i) = 2x$ , for  $i = 1, 2$ . This implies that the Shapley values for the CHQ and the managers,  $v_{CHQ}^I(SS)$  and  $v_{M_i}^I(SS)$ , are

$$v_{CHQ}^I(SS) = \frac{2\Pi_T^{I,SS}(CHQ, M_1, M_2) + 4\Pi_T^{I,SS}(CHQ, M_i)}{6} = \frac{4x}{3} \quad (6)$$

$$v_{M_i}^I(SS) = \frac{2\left(\Pi_T^{I,SS}(CHQ, M_1, M_2) - \Pi_T^{I,SS}(CHQ, M_j)\right) + \Pi_T^{I,SS}(CHQ, M_i)}{6} \quad (7)$$

$$= \frac{x}{3}. \quad (8)$$

Comparing CHQ's payoff in the  $SS$  and in the  $SF$  states reveals that the CHQ obtains a greater payoff when both managers are successful due to his ability to allocate all his resources to only one division. This ability gives him a stronger bargaining position and allows him to obtain

a greater payoff in the SS state than in the SF state although in both states the total payoff obtained remains the same.

We now analyze the effort choice of the managers. Manager  $i$  determines his effort level  $p_i$  by maximizing his expected profit  $\pi_{M_i}^I$ . By substituting the Shapley values (5) and (7) into the manager's expected profit given by (3), we obtain that the effort level  $p_i$  is determined by

$$\max_{p_i} p_i^I p_j^I \frac{x}{3} + p_i^I (1 - p_j^I) x - \frac{k}{2} (p_i^I)^2; \quad i, j = 1, 2; i \neq j. \quad (9)$$

Similarly, by substituting the Shapley values 4) and (6) into the CHQ's expected profit (2), we obtain

$$\pi_{CHQ}^I = p_i^I p_j^I \frac{4x}{3} + p_i^I (1 - p_j^I) x + p_j^I (1 - p_i^I) x; \quad i, j = 1, 2; i \neq j. \quad (10)$$

The first-order condition of (9) is

$$p_i(p_j) = \frac{3x - 2px}{3k}. \quad (11)$$

Setting  $p_j^I = p_i^I$ , and solving the first order condition for  $p_i^I$  yields equilibrium level of effort denoted by  $p^{I*}$ :

$$p^{I*} = \frac{3x}{2x + 3k}. \quad (12)$$

Substituting  $p_j^I = p_i^I = p^{I*}$  into (9) and (10) yields the expected profits of the divisional managers and the CHQ as follows:

$$\pi_{M_i}^{I*} = \frac{9x^2k}{2(2x + 3k)^2}, \quad i = 1, 2; \quad (13)$$

$$\pi_{CHQ}^{I*} = \frac{6(x + 3k)x^2}{(2x + 3k)^2}. \quad (14)$$

### 2.1.2 Collaboration between divisions

If the two managers choose to collaborate to create synergies, manager  $i$  exerts effort  $p_i^C$ . If both managers succeed in their effort and if the CHQ allocates resources to each division, the firm value is given by  $s$  with  $s > 2x$ . The assumption  $s > 2x$  implies that conditional on both managers being successful, collaboration generates higher payoff due to synergies compared to each manager working independently. As before, there are three different possible cases (states of

the world): (i) both managers are successful in the first period  $SS$ , (ii) one manager is successful while the other one fails, state  $SF$ ,<sup>2</sup> (iii) both managers fail, state  $FF$ .

In the simplest case where both managers fail, state  $FF$ , both divisions are terminated and all agents obtain zero payoffs. Define the Shapley value in state  $SS$  and  $SF$  for the CHQ and manager  $i$ ,  $i = 1, 2$  as  $\{v_{CHQ}^C(SS), v_{CHQ}^C(SF)\}$  and  $\{v_{M_i}^C(SS), v_{M_i}^C(SF)\}$ , respectively. The CHQ's expected profit,  $\pi_{CHQ}^C$ , is then given by

$$\pi_{CHQ}^C \equiv p_i^C p_j^C v_{CHQ}^C(SS) + p_i^C (1 - p_j^C) v_{CHQ}^C(SF) + p_j^C (1 - p_i^C) v_{CHQ}^C(SF); \quad i, j = 1, 2; i \neq j, \quad (15)$$

and manager  $i$ 's expected profit,  $\pi_{M_i}^C$ , is given by

$$\pi_{M_i}^I \equiv p_i^C p_j^C v_{M_i}^C(SS) + p_i^C (1 - p_j^C) v_{M_i}^C(SF) - \frac{k}{2} (p_i^C)^2; \quad i, j = 1, 2; i \neq j. \quad (16)$$

The surplus allocation between the CHQ and the manager(s), that is, their Shapley value, is determined as follows. In  $SF$  where only one of the managers is successful, the set of bargaining players is given by the CHQ and the successful manager, say manager  $i$ , yielding  $N = \{CHQ, M_i\}$ . In this case, the CHQ can allocate all its resources to division  $i$ , which generates  $2dx$ . Thus, the total payoff of the coalition formed by the CHQ and manager  $i$  is  $\Pi_T^{I,SF}(CHQ, M_i) = 2dx$ . Note that compared to the case where the managers do not collaborate for synergies, there is a loss in value in their own division in case the other manager fails and no synergies is created. This cost captures the notion that when the managers choose to work together, this reduces the effort and time that they spend on their own division. Hence, in case synergy creation effort fails, the value of their own division is lower. If the successful division is closed down, the CHQ and the manager obtain zero payoff, yielding  $\Pi_T^{C,SF}(CHQ) = \Pi_T^{C,SF}(M_i) = 0$ . This implies that the Shapley values for the CHQ and manager  $i$ ,  $v_{CHQ}^C(SF)$  and  $v_{M_i}^C(SF)$ , are

$$v_{CHQ}^C(SF) = \frac{\Pi_T^{C,SF}(CHQ, M_i) - \Pi_T^{C,SF}(M_i)}{2} = dx, \quad (17)$$

$$v_{M_i}^C(SF) = \frac{\Pi_T^{C,SF}(CHQ, M_i) - \Pi_T^{C,SF}(CHQ)}{2} = dx. \quad (18)$$

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<sup>2</sup>Note that, given that the two entrepreneurs are identical, it is irrelevant which one of the two projects is successful. Thus, we will treat these two separate but symmetric cases effectively as a single case.

In state SS both managers are successful, and the CHQ engages in a process of (multilateral) bargaining with both managers. In this case, the set of bargaining players is given by the CHQ and the two managers, yielding  $N = \{CHQ, M_1, M_2\}$ . If the CHQ keeps both divisions, the coalition of the CHQ and the managers yields  $s$ , implying that  $\Pi_T^{C,SS}(CHQ, M_1, M_2) = s$ . If the CHQ forms a coalition with one of the managers only, it will allocate all its resources to his division which will generate payoff  $\theta s$ . Hence, the payoff of the coalition formed by the CHQ with only one manager is  $\Pi_T^{C,SS}(CHQ, M_i) = \theta s$ , for  $i = 1, 2$ . This implies that the Shapley values for the CHQ and the managers,  $v_{CHQ}^C(SS)$  and  $v_{M_i}^C(SS)$ , are

$$v_{CHQ}^C(SS) = \frac{2\Pi_T^{I,SS}(CHQ, M_1, M_2) + 4\Pi_T^{I,SS}(CHQ, M_i)}{6} = \frac{(1 + 2\theta)s}{3}, \quad (19)$$

$$\begin{aligned} v_{M_i}^C(SS) &= \frac{2\left(\Pi_T^{C,SS}(CHQ, M_1, M_2) - \Pi_T^{C,SS}(CHQ, M_j)\right) + \Pi_T^{C,SS}(CHQ, M_i)}{6} \\ &= \frac{(1 - \theta)s}{3}. \end{aligned} \quad (20)$$

Note that while the CHQ's payoff increases in  $\theta$ , the managers' payoff decreases in it. This is because  $\theta$  is a measure of the CHQ's ability to realize synergies created in the first period with only one division manager. Hence, as his ability to do so increases, he extracts a greater portion of the synergy value created.

We now analyze the effort choice of the managers. Manager  $i$  determines his effort level  $p_i^C$  by maximizing his expected profit  $\pi_{M_i}^C$ . By substituting the Shapley values (18) and (20) into the manager's expected profit given by (16), we obtain that the effort level  $p_i$  is determined by

$$\max_{p_i^C} p_i^C p_j^C \frac{(1 - \theta)s}{3} + p_i^C(1 - p_j^C)dx - \frac{k}{2}(p_j^C)^2; \quad i, j = 1, 2; i \neq j. \quad (21)$$

Similarly, by substituting the Shapley values (17) and (19) into the CHQ's expected profit (15), we obtain

$$\pi_{CHQ}^C = p_i^C p_j^C \frac{(1 + 2\theta)s}{3} + p_i^C(1 - p_j^C)dx + p_j^C(1 - p_i^C)dx; \quad i, j = 1, 2; i \neq j. \quad (22)$$

The first-order condition of (21) is

$$p_i^C(p_j^C) = \frac{3dx + (s(1 - \theta) - 3dx)p_j^C}{3k}. \quad (23)$$

5It is interesting to note that when  $s(1 - \theta) > 3dx$ , manager  $i$ 's effort is increasing in manager  $j$ 's effort. This is in contrast to what we have when the managers choose to work independently with no collaboration where manager  $i$ 's effort level is always decreasing in manager  $j$ 's effort level.

Setting  $p_j^C = p_i^C$ , and solving the first order condition for  $p_i^C$  yields equilibrium level of effort denoted by  $p^{C*}$ :

$$p^{C*} = \frac{3dx}{3(k + dx) - s(1 - \theta)}.^3 \quad (24)$$

Substituting  $p_j^C = p_i^C = p^{C*}$  into (21) and (22) yields the expected profits of the divisional managers and the CHQ as follows:

$$\pi_{Mi}^{C*} = \frac{9kd^2x^2}{2(3(k + dx) - s(1 - \theta))^2}, i = 1, 2; \quad (25)$$

$$\pi_{CHQ}^{C*} = \frac{3(6k - s(1 - 4\theta))d^2x^2}{(3(k + dx) - s(1 - \theta))^2}. \quad (26)$$

From (24) and (25), it is straightforward to see that both managerial effort and the managers' expected profits are decreasing in  $\theta$ . This is not surprising since  $\theta$  measures the CHQ's ability to realize the synergies with participation of only one divisional manager. Since the managers anticipate that they will be expropriated at the bargaining stage when  $\theta$  is high, they exert lower effort and obtain lower expected profits for higher values of  $\theta$ . What is less immediate is the effect of  $\theta$  on the CHQ's expected profits. On one hand, the CHQ can extract a greater portion of the synergy surplus for higher values of  $\theta$ . On the other hand, however, a higher  $\theta$  implies a lower probability for the creation of synergies given that managerial effort decreases in  $\theta$ . Trading of these two effects, it is possible that the expected profits of the CHQ may decrease in  $\theta$ , as presented in the following lemma.

**Lemma 1**  $\pi_{CHQ}^{C*}$  decreases in  $\theta$  for  $\theta \geq \frac{3dx}{s} - \frac{1}{2}$ .

An interesting implication of this lemma is that mergers combining firms with different and complementary set of assets and skills may be more desirable from the shareholders point of view.

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<sup>3</sup>To make sure we have interior solutions, we assume  $\theta > \frac{s-3k}{s}$  throughout the paper.

In such mergers, each merging firm is essential not only to the creation but also the realization of synergies. This reduces their concern about being expropriated during the realization stage of the synergies once they work towards creating the synergies. Hence, this result suggests that horizontal mergers combining homogenous firms are less likely to succeed in terms of synergy creation compared to vertical mergers combining firms with distinct and complementary resources and skills.

We now turn our attention to understand managerial incentives to collaborate or work independently with no collaboration between their divisions by comparing their expected profits from each strategy.

**Proposition 1** *Suppose that  $s > 3k - (3k - x)d$ . The managers choose to collaborate if and only if  $\theta \leq \theta_C^M$  where  $\theta_C^M$  is defined in the Appendix.*

Proposition 1 suggests that the managers will be willing to collaborate for synergies only if the value of  $\theta$  is sufficiently low. Recall that  $\theta$  measures the extent of the synergies that the CHQ can achieve with only one of the managers conditional on the managers being successful on the creation of synergies. In other words, high value of  $\theta$  implies that once the managers are successful in creating synergies by working together, each manager's contribution to the realization of the synergies is lower. Anticipating that they will be expropriated by the CHQ for high values of  $\theta$ , the managers would be willing to collaborate and work towards creation of synergies only if  $\theta$  is sufficiently low.

**Proposition 2**  *$\theta_C^M$  is increasing in  $s$  and  $d$ , and decreasing in  $x$ .*

Proposition 2 implies that managerial incentives to collaborate are stronger in mergers with a greater synergy potential. In addition, the managers are more willing to collaborate towards synergies when the cost of doing so in terms of dilution in their own divisions in case they fail at their collaboration effort is lower, that is, when  $d$  is higher. Finally, collaboration incentives are weaker when payoff  $x$  the managers can generate from their own division is higher. This is because the extent of dilution the managers experience in their own division in case they fail to generate

synergies is greater for higher values of  $x$ . This may suggest that in mergers combining stand-alone firms with higher growth opportunities, it will be more difficult to motivate collaboration effort from the merging parties.

Since in our model, the managers decide to collaborate for synergies only if they obtain greater expected profits from doing so compared to working independently, one may expect that this decision has important efficiency implications. For instance, it may be possible that for high values of  $\theta$ , managerial incentives to collaborate could be weaker even though collaboration has a great synergy potential and it is efficient in terms of the maximization of the expected profits of the managers and the CHQ. In other words, it could be possible that although from the shareholders' perspective the merger creates value, from the managers' perspective collaboration would not be the desired choice. The following proposition presents the conditions under which the managers do not collaborate for synergies and the CHQ experiences no synergy gains.

**Proposition 3** *If  $\theta \geq \frac{1}{4}$  and  $s(4\theta - 1) \geq 2x$ , although collaboration is desirable from the shareholders' perspective, the managers choose not to collaborate and no synergies is created.*

As Proposition 3 shows, the managers do not find it desirable to collaborate when  $\theta$  is sufficiently high given that a high  $\theta$  implies that although they are essential at the synergy creation stage, they are less essential at the synergy implementation place. From the shareholders' perspective the collaboration outcome is desirable when the potential for synergies and the CHQ's ability to implement the synergies are large. However, the lack of incentives for the managers would lead to no synergy gains for the CHQ.

Having examined managerial incentives to collaborate and create synergies, we now turn our attention to the merger decision ex ante. In the next section, we analyze a stand-alone firm's incentives to merge with another firm based on its expectations about whether the managers will have sufficient incentives to collaborate and hence, the merger will lead to synergy creation.

### 3 The Merger Decision

In this section, we examine the incentives of a stand-alone firm to merge with another firm and become a two divisional firm where each division is run by a manager. As before, the value of the firm depends on managerial effort and resources contributed by the CHQ of the firm in case managerial effort succeeds. The manager exerts effort  $p^S$  in the first stage, and if successful and receives resources from the CHQ, firm value is given by  $2x$ . Note that, as opposed to the case where we have a two-divisional firm in the previous sections, when the firm has only one division, the CHQ allocates all its resources to its only division, and the division generates payoff  $2x$ . In addition, since the CHQ has only one division, it does not have any bargaining power in terms of allocating its resources to another division. This allows the manager to extract a greater surplus, compared to each divisional managers in the two divisional firm.

If the managerial effort succeeds, using Shapley values, we obtain that the manager and the CHQ obtains payoff  $x$ . In anticipation of his expected payoff, the manager sets his effort to maximize his expected profits  $\pi_M^S$  given by

$$\pi_M^S \equiv p^S x - \frac{k}{2}(p^S)^2. \quad (27)$$

It is immediate to show that managerial effort is given by  $p^{S*} \equiv \frac{x}{k}$ . Similarly, the expected profits of the manager  $\pi_M^{S*}$  and the CHQ  $\pi_{CHQ}^{S*}$  are given respectively by

$$\pi_M^{S*} \equiv \frac{x^2}{2k}, \quad (28)$$

$$\pi_{CHQ}^{S*} \equiv \frac{x^2}{k}. \quad (29)$$

The firm takes its decision to undertake a merger by comparing its stand-alone profits given in (29) with those from the merger given in (14) or (26), depending on whether the merger leads to synergy creation or not. The following proposition characterizes the firm's optimal merger decision.

**Proposition 4** *a) The stand-alone firm finds it optimal to undertake a merger if and only if*

$$\begin{aligned}
x &\leq \begin{matrix} x_1^M & \theta > \theta_C^M, \\ x_2^M & \theta \leq \theta_C^M. \end{matrix} \text{ where } x_1^M \text{ and } x_2^M \text{ are defined in the Appendix. } b) \frac{\partial x_2^M}{\partial s} \geq 0. \quad \frac{\partial x_2^M}{\partial \theta} \leq 0 \text{ if} \\
\theta &\geq \frac{-6k+s+12d^2}{4s}.
\end{aligned}$$

As Proposition 4 shows, the stand-alone firm finds it optimal to undertake a merger only for sufficiently low values of  $x$ . The intuition for this result is that the having two divisions after the merger has a negative effect on managerial incentives for two reasons. First, when the CHQ allocates its fixed amount resources over two divisions, it dilutes the value potential of each division. Second, after managerial effort is observed, the CHQ has a bargaining advantage due to his ability to shift resources from one division to another. His ability to do is greater when the divisions are less complementary to each other and synergy loss is small from firing one of the divisional managers. Interestingly, these negative effects on incentives are the stronger when the value potential  $x$  of each division is greater. Hence, for high values of  $x$ , which may be interpreted as a proxy of how profitable the stand-alone firm's business is, the firm does not find it optimal to undertake a merger. When the profit and growth potential of the stand-alone business is lower, the firm finds it optimal to undertake a merger. The desire for the merger is greater when the synergy potential of the merger is greater, implied by  $\frac{\partial x_2^M}{\partial s} \geq 0$ . Interestingly, for sufficiently high values of  $\theta$ , that is, for  $\theta \geq \frac{-6k+s+12d^2}{4s}$ , the firm's willingness to undertake the merger increases as  $\theta$  decreases, implied by  $\frac{\partial x_2^M}{\partial \theta} \leq 0$ . This is because managerial incentives to collaborate are stronger, and the likelihood of synergy creation is higher for lower values of  $\theta$ . This result may suggest that firms' willingness to undertake mergers are greater for mergers motivated by scope economies where the assets and skills of the merging parties are complementary to each other and each party is critical for the creation and realization of the expected synergies.

### 3.1 Diversification Discount

Proposition 4 suggests that a stand-alone firm finds it optimal to merge only if its value potential given by  $x$  is sufficiently low. This is because adding a new division to the firm through a merger leads to weaker managerial incentives unless the synergy potential of the merger is sufficiently

large and managerial incentives to work towards creation of synergies are sufficiently strong. This observation implies that stand-alone firms with lower profitability would be more likely to undertake a merger than stand-alone firms with higher profitability, and hence, firms undertaking a merger would be endogenously different from firms choosing to remain stand-alone. This line of reasoning is consistent with the empirical findings that diversified firms trade at a discount relative to stand-alone firms. As our model implies, this finding may not necessarily suggest that undertaking a merger is inefficient, but can be explained by the possibility of a selection bias that only firms with sufficiently low profitability would find it desirable to undertake a merger. When we compare their value after the merger to the value of firms which remain stand-alone, it is possible that stand-alone firms will have a higher firm value without necessarily implying that the decision to merge for firms undertaking a merger is inefficient. The following proposition presents this intuition formally.

**Proposition 5** *Consider two stand-alone firms, firm A and firm B characterized respectively with parameters  $x_A$  and  $x_B$ . Suppose  $\theta \leq \theta_C^M$ ,  $x_A > x_2^M$  while  $x_B < x_2^M$  so that it is optimal for firm A to remain stand-alone while it is optimal for firm B to undertake a merger. The value of firm A will be greater than the value of firm B after its merger.*

## 4 Conclusions

In this paper, we examine managerial incentives in a two-divisional firm to collaborate and create merger synergies. Creation of synergies is possible only if the divisions find it desirable to work together. The desire to do so critically depends on how essential each division is for implementing the synergies once they are created. A greater need for each division to realize merger synergies yields a greater merger surplus for each division, and hence increases divisional incentives to collaborate for synergy creation. If, on the other hand, divisions are substitutes to each other and each division is less needed in the presence of the other similar division, incentives to collaborate will be weaker as well as the potential for the merger to generate merger synergies.

Our model predicts that the success probability of generating expected synergies is greater in mergers motivated by scope economies than in mergers motivated by scale economies. In addition, vertical mergers are more likely to succeed relative to horizontal mergers to the extent that merging parties are more likely to be complements than substitutes in such mergers. Finally, our paper provides a rational explanation for the diversification discount found in empirical studies. In our model, there is self-selection in the sense that firms with greater profitability remain to stay stand-alone while firms with lower profitability and growth prospects choose to undertake a merger. Although the decision to merge is not inefficient, stand-alone firms have higher value than firms undertaking a merger.

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## Appendix

**Proof of Lemma 1.** Taking the partial derivative of  $\pi_{CHQ}^{C*}$  with respect to  $\theta$  yields  $\frac{\partial \pi_{CHQ}^{C*}}{\partial \theta} = \frac{6s(6dx-s(2\theta+1))d^2x^2}{(3(k+dx)-s(1-\theta))^3}$ . Since the denominator is always positive,  $\frac{\partial \pi_{CHQ}^{C*}}{\partial \theta} \leq 0$  if  $\theta \geq \frac{3dx}{s} - \frac{1}{2}$ .

**Proof of Proposition 1.** Comparing the expected profits of the managers when they choose to collaborate given in (26) to those when they do not collaborate given in (10), we obtain that they obtain greater expected profits from collaborating if and only if

$$P \equiv -2s^2\theta^2 + (-4s(3(k+dx)-s))\theta + (2d^2(3k+2x)^2 - 2(3(k+dx)-s)^2) \geq 0.$$

Since  $s > 0$ ,  $P$  is a concave parabola in  $\theta$  with two roots given by

$$\begin{aligned} \theta_1^M &\equiv \frac{-3k+s-(3k+5x)d}{s}, \\ \theta_2^M &\equiv \frac{s-3k+(3k-x)d}{s}. \end{aligned}$$

This implies that  $P \geq 0$ , and hence, the managers choose to collaborate if and only if  $\theta_1^M \leq \theta \leq \theta_2^M$ . Given that we have  $\theta > \frac{s-3k}{s}$ , it is immediate to show that  $\frac{s-3k}{s} > \frac{-3k+s-(3k+5x)d}{s}$  for all parameter values. Since  $\theta_2^M > 0$  if  $s > 3k - (3k-x)d$ , the managers will not collaborate if  $s \leq 3k - (3k-x)d$ . If  $s > 3k - (3k-x)d$ , then the managers will collaborate for  $\theta \leq \theta_2^M$ . Defining  $\theta_C^M \equiv \theta_2^M$  completes the proof.

**Proof of Proposition 2.** It is immediate from the definition of  $\theta_C^M = \frac{s-3k+(3k-x)d}{s}$  that it is increasing in  $s$  and  $d$ , and decreasing in  $x$ .

**Proof of Proposition 3.** If the expected profits of the CHQ when the manager collaborate exceed those when the managers choose to work independently, and if the expected profits of the managers with collaboration are lower than those when they work independently, no synergies will be generated although they would benefit the CHQ. Setting  $\beta \equiv \frac{d}{(3(k+dx)-s(1-\theta))}$  and comparing  $\pi_{CHQ}^{C*}$  with  $\pi_{CHQ}^{I*}$  yields that  $\pi_{CHQ}^{C*} \geq \pi_{CHQ}^{I*}$  if and only if

$$\beta \geq \frac{\sqrt{2(x+3k)}}{(2x+3k)\sqrt{(6k-s(1-4\theta))}}.$$

Similarly, comparing  $\frac{9kd^2x^2}{2(3(k+dx)-s(1-\theta))^2}$  with  $\frac{9x^2k}{2(2x+3k)^2}$  yields that  $\pi_{Mi}^{C*} \leq \pi_{Mi}^{I*}$  if and only if  $\beta \leq$

$\frac{1}{(2x+3k)}$ . Hence, when

$$\frac{\sqrt{2(x+3k)}}{(2x+3k)\sqrt{(6k-s(1-4\theta))}} \leq \beta \leq \frac{1}{(2x+3k)}$$

the managers do not collaborate for synergies although CHQ profits are higher under collaboration. It is straightforward to show that we have  $\frac{\sqrt{2(x+3k)}}{(2x+3k)\sqrt{(6k-s(1-4\theta))}} < \frac{1}{(2x+3k)}$  if  $\theta > \frac{1}{4}$  and  $s(4\theta - 1) \geq 2x$ .

**Proof of Proposition 4.** From the proof of Proposition 1, we have that the expected profits of the firm after the merger is given by  $\pi_{CHQ}^{I*}$  if  $\theta > \theta_C^M$ , and  $\pi_{CHQ}^{C*}$  if  $\theta \leq \theta_C^M$ . This implies that the stand-alone firm makes its merger decision by comparing its stand-alone profits  $\pi_{CHQ}^{S*}$  with  $\pi_{CHQ}^{I*}$  if  $\theta > \theta_C^M$ , and with  $\pi_{CHQ}^{C*}$  if  $\theta \leq \theta_C^M$ . Suppose first  $\theta > \theta_C^M$ . Comparing  $\pi_{CHQ}^{S*}$  with  $\pi_{CHQ}^{I*}$  yields that the firm undertakes the merger if and only if  $x \leq x_1^M \equiv \frac{3(\sqrt{5}-1)k}{4}$ . Now suppose that  $\theta \leq \theta_C^M$ . Comparing  $\pi_{CHQ}^{S*}$  with  $\pi_{CHQ}^{C*}$  yields that the firm undertakes the merger if and only if  $x \leq x_2^M \equiv \frac{-3k+s(1-\theta)+d\sqrt{3k(6k-s(1-4\theta))}}{3d}$ , completing part a) of the proof. For part b) we first take the partial derivative of  $x_2^M$  with respect to  $s$  and obtain

$$\frac{\partial x_2^M}{\partial s} = \frac{1}{3d} \left( 1 - \theta + \frac{\sqrt{3}dk}{2\sqrt{k(6k+s(4\theta-1))}} (4\theta - 1) \right).$$

It is immediate to see that  $\frac{\partial x_2^M}{\partial s} \geq 0$  for  $\theta \geq \frac{1}{4}$ . For  $\theta < \frac{1}{4}$ ,  $\frac{\partial x_2^M}{\partial s} > 0$  if and only if  $2(1-\theta)\sqrt{k(6k-s(1-4\theta))} \geq \sqrt{3}dk(1-4\theta)$ . For  $0 \leq \theta \leq 1$ , it always holds that  $2(1-\theta) > \sqrt{3}(1-4\theta)$ . The condition we have  $3k > s(1-\theta)$  implies  $3k > s(1-\theta) > s(1-4\theta)$ . Adding  $k$  to each side of the inequality, we obtain  $4k > k + s(1-4\theta)$ , which yields  $4k - s(1-4\theta) > k$ , and  $4k - s(1-4\theta) > d^2k$ , given  $d \leq 1$ . Next, we obtain  $6k - s(1-4\theta) > 4k - s(1-4\theta) > d^2k$ . Multiplying each side by  $k$ , noting that  $(6k - s(1-4\theta)) > 0$ , and taking the square root of each side yields  $\sqrt{k(6k - s(1-4\theta))} > dk$ . Hence,  $2(1-\theta) > \sqrt{3}(1-4\theta)$  and  $\sqrt{k(6k - s(1-4\theta))} > dk$  imply  $2(1-\theta)\sqrt{k(6k - s(1-4\theta))} \geq \sqrt{3}dk(1-4\theta)$ , giving  $\frac{\partial x_2^M}{\partial s} > 0$ .

Taking the partial derivative of  $x_2^M$  with respect to  $\theta$  yields  $\frac{\partial x_2^M}{\partial \theta} = -\frac{1}{3d} \left( s - \frac{2\sqrt{3}dks}{\sqrt{k(6k-s(1-4\theta))}} \right)$ . It is straightforward to show that  $\frac{\partial x_2^M}{\partial \theta} \leq 0$  if  $\theta \geq \frac{-6k+s+12d^2}{4s}$ .

**Proof of Proposition 5.** From (29), the value of firm A is given by  $\pi_{A,CHQ}^{S*} = \frac{x_A^2}{k}$ , and from (22), the value of firm B after its merger is given by  $\pi_{B,CHQ}^{C*} = \frac{3(6k-s(1-4\theta))d^2x_B^2}{(3(k+dx_B)-s(1-\theta))^2}$ . Given that it is

optimal for firm A to remain stand-alone, we have  $\pi_{A,CHQ}^{S*} = \frac{x_A^2}{k} > \pi_{A,CHQ}^{C*} = \frac{3(6k-s(1-4\theta))d^2x_A^2}{(3(k+dx_A)-s(1-\theta))^2}$ . Similarly, for firm B, we have  $\pi_{B,CHQ}^{C*} = \frac{3(6k-s(1-4\theta))d^2x_B^2}{(3(k+dx_B)-s(1-\theta))^2} > \pi_{B,CHQ}^{S*} = \frac{x_B^2}{k}$ , given firm B finds it optimal to undertake a merger. Since we have  $x_A > x_2^M > x_B$ , and  $\frac{3(6k-s(1-4\theta))d^2x^2}{(3(k+dx)-s(1-\theta))^2}$  is increasing in  $x$ , it follows that

$$\pi_{A,CHQ}^{S*} = \frac{x_A^2}{k} > \pi_{A,CHQ}^{C*} = \frac{3(6k-s(1-4\theta))d^2x_A^2}{(3(k+dx_A)-s(1-\theta))^2} > \pi_{B,CHQ}^{C*} = \frac{3(6k-s(1-4\theta))d^2x_B^2}{(3(k+dx_B)-s(1-\theta))^2},$$

hence,  $\pi_{A,CHQ}^{S*} > \pi_{B,CHQ}^{C*}$ .