Efficient Horizontal Mergers:  

The Effects of Internal Capital Reallocation and Organizational Form  

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Abstract

This paper shows that internal capital reallocation between merging partners can improve the profitability of horizontal mergers. We find that merged firms often optimally choose the multidivisional structure (the M-form) rather than the conventional structure of completely integrating merging partners. Under the M-form, mergers not only combine merging partners’ capital, but also allow the merged firm to reallocate that capital in an efficient way. Since the horizontal merger is profitable due to this efficiency-improving capital reallocation, the merger enhances market competition as well. We discuss the conditions under which the M-form is optimal for the merged firm.

JEL Classification No.: L41, L13, L21

Keywords: Internal capital reallocation, Horizontal mergers, The M-form.

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I. Introduction

Salant et al. (1983) have argued that, most anti-competitive mergers would not even be proposed, because they are, in general, unprofitable. This controversial argument has prompted many studies on what determines the profitability of horizontal mergers. Perry and Porter (1985) point out that, assuming constant marginal cost technology, Salant et al. (1983) confine the joint production possibilities of the merged firm to a range in which the merged firm does not differ from other non-merging firms. Considering mergers under convex cost technology, Perry and Porter (1985) show that horizontal mergers can be profitable, as the merged firm becomes larger by combining the production facilities of the merging partners.

In this paper, we show that internal capital reallocation can improve the profitability of horizontal mergers. Such a profit-enhancing capital reallocation is available when a merged firm operates under an organizational structure that preserves internal competition within the merging partners. Merging partners may not completely integrate; often, a merger induces a corporate structure that allows the partners to continue to compete, because this structure enables the merged firm to reallocate resources across the partners, creating cost reductions that would otherwise be unavailable. The merged firm’s production possibilities when it completely integrates its merging partners differ from the production possibilities when it keeps internal competition within the merging partners. After the merger, the merged firm faces an extensive set of production possibilities that encompass the entire range of organizational forms available. The merged firm must choose the organizational structure that optimizes its overall profitability. By assuming that a merger always completely integrates the merging partners’ assets and control, most of the previous works in the merger literature have ignored the possibility of utilizing a more efficient production structure that exists under other types of organizational structure.
Any newly merged firm faces the problem of restructuring the production of the merging partners. Restructuring involves resource reallocation, reorganizing production, and establishing an internal relationship between merging partners. This restructuring process determines how profitable the merger becomes, and how the merger affects market competition. This paper models the strategic restructuring problem of a merged firm. We consider an exogenous horizontal merger among firms competing à la Cournot.¹ A merger between two firms brings the total capital of the two participants under a single authority, the headquarters, which seeks to optimally redistribute the total capital to its constituent firms. For a given capital reallocation, whether the constituent firms cooperate or compete against each other affects the total output level and profits of the merged firm. That is, the effectiveness of capital reallocation depends on the corporate structure. We show that the optimal capital reallocation and the optimal corporate structure are jointly determined in the restructuring process.

Other merger theories assume an exogenous corporate structure for a merged firm; in this paper, the corporate structure is a variable to be chosen by the headquarters. Two corporate structures are considered: complete integration and the M-form. Under complete integration, all of the merging partners completely cooperate to maximize the joint profits. From resource allocation to production, all the decisions are centralized at headquarters. In contrast, under the M-form, the merging partners become independently operating competing divisions. The merged firm’s production decisions are decentralized at the divisions and only the resource allocation problem is centralized at the headquarters.

We find that the M-form is optimal in many cases of mergers. When a merged firm operates under the M-form, the merger does not change the degree of competition in the market. Then, the only way that the merger becomes profitable is by using the resources more

¹ Throughout this paper, we take the merger decisions as exogenously given to focus on the effect of capital reallocation on the profitability of horizontal mergers. Although the model can be easily extended to the case of endogenous merger, the focus of the paper would then shift to the choice of merging partners and the size of profitable mergers. For this reason, we do not discuss endogenous merger in this paper.
efficiently. The merged firm can improve its overall efficiency, producing more at a lower cost, by reallocating capital symmetrically to its constituent firms. The merged firm chooses the M-form because the increase in profits from reallocating capital efficiently under the M-form is higher than the increase from combining the total capital of merging partners under complete integration. Such a merger is also pro-competitive, because profitability follows from improved efficiency: The merger decreases market price and increases consumer surplus.

This paper makes a unique contribution to the literature in the following aspects. First, it is the first to model an endogenous corporate structure of a merged firm. Second, it proves that internal capital reallocation can improve the profitability of horizontal merger.

The rest of the paper is organized as follows. Section II gives a brief review of related literature and discusses the relevance of the M-form in contemporary corporate structures. Section III describes the model and derives the optimal solution to the merged firm’s capital reallocation problem. The last section summarizes of the major findings in the paper.

II. Decentralized Production and Resource Allocation

Many studies have discussed how organization affects economic performance. The main argument in those papers concerns the managerial incentive schemes under different organizational forms. Using a framework of the separation between formal and real authorities in organizations, Aghion and Tirole (1995) analyze the impact of growth opportunities or other changes in the environment on the extent of integration. Maskin, Qian, and Xu (2000) considers how different organizational forms affect managerial incentives to take steps to reduce the adverse consequences of shocks that affect the plants beneath managers. Miller and Pazgal (2001) consider firms’ choice over managerial incentive schemes in a two-stage differentiated-products oligopoly model, and show that, if the owners have sufficient power to manipulate their managers' incentives, the equilibrium outcome is the same regardless of whether the managers are competing in price or in quantity.
Another main argument in the literature concerns firms’ strategic incentives for decentralized production. Baye, Crocker, and Ju (1996) model firms’ strategic incentives to divide production among autonomous competing units through divisionalization, franchising, or divestiture, and derive equilibrium number of competing units. Tan and Yuan (2003) propose that product-line complementarities motivates divestiture of competing conglomerates. They show that, if the firms are able to coordinate their divestiture strategies, monopoly prices and profits can be achieved via a non-cooperative pricing game.

Several papers have addressed the role of organizational structure in the context of merger analysis. Most of them focus on how managerial compensation schemes under the delegation structure affect the profitability of mergers. Ziss (2001) and Gonzalez-Maestre and Lopez-Cunat (2001) examine incentive contracts between agents and owners in the presence of agency problem. They show that, under the consideration of delegation, the minimum market share that the merging parties require in order to merge profitably without efficiency gains is substantially smaller than without delegation. Creane and Davidson (2004) consider a case that merged firms operate under a multidivisional structure in which some divisions play Stackelberg leaders and the others become followers.

In many contemporary mergers, firms choose to keep some degree of competition alive between partners after the merger. After Volvo and Ford merged, Ford’s luxury brand, Jaguar, still competed with Volvo. Similar structures were observed when Daimler and Chrysler merged. When Kimberly Clark and Scott Paper merged, Kleenex, the leading brand of Kimberly Clark in facial tissue market, stayed in competition with Scottie, the leading brand of Scott Paper. Had the mergers resulted in complete integration of the merging partners, as it is assumed in most merger theories, the competition between merging partners should have disappeared after the merger.

Jacquemin et al. (1989) report that a large number of mergers and takeovers in 1980s was rarely a case of a “fusion,” in which the two companies genuinely become one. Many studies
(See Lang and Stulz (1994), and Fauli-Oller and Giralt (1995), for example) address the efficiency of a decentralized organizational structure.

Interestingly though, most merger theories have simply assumed that mergers always induce complete collusion. In this paper, firms choose whether or not to integrate completely. Under complete integration, all of the merging partners completely cooperate to maximize the joint profits. From resource allocation to production, all the decisions are made by the headquarters. As an alternative to complete integration, we consider the M-form, introduced by Williamson (1975). It is characterized by decentralized operating decisions, while the headquarters establishes strong central control over resource allocation. The divisions act independently of one another and are charged with maximizing “division” profits. Fligstein (1985) examines the spread of the M-form among the 100 largest non-financial corporations from 1919 to 1979, and reports that the proportion of the M-form rose to 84.2% by 1979, from 1.5% in 1929. In his study of organizational structure in fifty of the largest companies in the United States, Chandler (1962) concludes that companies driven by market growth and technological change to diversify their products and markets could manage their new strategies efficiently only if they adopted the M-form. The reason this structural form proved so powerful was because it defined a new set of management roles and relationships that emphasized decentralization, controlled by strong corporate management, that also made the company’s entrepreneurial decisions about resource allocation.

Kamien and Zang (1990) propose that an acquiring firm may want to keep the acquired rivals as competing divisions in order to deter rent shifting to other firms. This paper shows that firms may want to keep the merging partners as competing divisions because, under that structure, there exists efficiency improving capital reallocations. In the next section, we show

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2 The M-form in this paper represents a non-conventional corporate structure, in which merging partners retain some degree of independent decision-making. Since we focus on horizontal mergers, the M-form became a natural candidate as an alternative to the conventional structure of complete integration. Essentially, the question is whether the corporate structure allowing some independence for merging partners affects post-merger performance.
that internal capital reallocation can improve the overall efficiency of horizontal mergers and that the mergers choose the M-form in order to optimize the internal capital distribution.

III. The Model

Consider an industry comprised of \( N \) initially active firms competing à la Cournot. For simplicity, we assume a linear market demand given by:

\[ P = a - bQ \quad (1) \]

All firms have access to the same cost technology, \( C(\cdot) \). With the total cost of firm \( i \) equal to \( C(q_i, K_i) = \frac{q_i}{2K_i} \), the marginal cost \( \frac{q_i}{K_i} \) is a decreasing function of each firm’s capital stock \( K_i \). This cost function is the dual of the Cobb-Douglas production function \( q = A\sqrt{LK} \), and is homogeneous of degree one in capital and output.

In the Cournot competition prior to merger, each firm \( i \) is producing at the level of output that maximize profits, \( \pi_i = (a - bQ)q_i - \frac{q_i}{2K_i} \). Firm \( i \)'s first-order condition, \( \frac{\partial \pi_i}{\partial q_i} = 0 \), is

\[ q_i = \frac{\beta_i}{b}(a - bQ), \quad i = 1, 2, \ldots, N, \quad (2) \]

where \( \beta_i = \frac{bK_i}{bK_i + 1} \) for a given \( K_i \). \( \beta_i \) represents firm \( i \)'s efficiency level, \( i = 1, 2, \ldots, N \). Firms can differ in efficiency. We assume that the demand curve intersects firms’ marginal cost curve from above, i.e.; that

\[ \frac{\partial^2 C(q_i, K_i)}{\partial q_i^2} > |P'(Q)| \quad \Leftrightarrow \quad 1 > bK_i \quad \Rightarrow \quad \beta_i = \frac{bK_i}{bK_i + 1} < \frac{1}{2}. \quad (3) \]

The industry output is

\[ Q^* = \frac{a}{b \left( \beta_1 + \beta_2 + \cdots + \beta_N \right)} = \frac{a}{b \left( \frac{B}{B + 1} \right)}, \quad \text{where} \quad B = \sum_{i=1}^{N} \beta_i. \quad (4) \]

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3 It is the cost function used by McAfee and Williams (1992) and Perry and Porter (1985). This specific framework of a linear demand and a quadratic cost function is not essential in determining our main result that merged firms can improve their profits by reallocating their internal resources and optimizing their organizational structure.

4 Sequential entry and imperfect capital markets might explain why firms evolve asymmetrically.
Thus, prior to merger, each firm $i$ produces $q^*_i = \frac{a_i}{b_i (B_i+1)}$ and earns

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\pi_i^* = \frac{a^2}{2b^2} \left( \frac{B_i + \beta_i^2}{(\beta_i + \beta_{i+1})^2} \right), \quad \text{where} \quad \beta_i = \sum_{j=1}^{i} \beta_j, \quad i = 1, 2, \ldots, N.
$$

(5)

Now consider a merger between two firms, firm 1 and firm 2, whom we call “insiders.” The merger brings the capital of firm 1, $K_1$, and that of firm 2, $K_2$, under the control of the headquarters of the merged firm. Assume that $K_1 \leq K_2$. The capital is fixed in the sense that it cannot be easily destroyed or increased in a short period. However, we assume that the capital is mobile in that it can be easily reallocated from one operating unit to another.\(^5\)

The merged firm’s optimization problem consists of two stages. In the first stage, the headquarters optimally reallocates the corporate resources $K_M$ to the insiders. At the end of this stage, how the resources have been reallocated determines whether the firm will operate under the M-form, which completes the restructuring process after the merger. In the second stage, the merged and non-merging firms resume competition and simultaneously determine their output levels. If the corporate structure of the merged firm is the M-form, each division $j$ competitively chooses its output level for a given level of capital, $K_{Mj}$, $j = 1, 2$. That is, while resource reallocation is conducted at the firm level, output decisions are made at the division level. If the insiders completely integrate, however, the headquarters also centrally controls output decisions.

Suppose that the merged firm is operating under the M-form. Let $K_{Mj}$ be the level of capital that each division $j$ has received from the headquarters in the first stage. Since the two divisions compete with one another, each division’s best response function is the same as before the merger, as shown in equation (2), except that the new level of capital $K_{Mj}$ that it receives

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\(^5\) Human capital, know-how, brands, shelf space, etc. would fit into the definition of this type of capital. In reality, this type of medium-run, fixed but mobile, capital accounts for substantial portion, but not all, of total capital for firms. For simplicity, in this model, we assume that the entire capital of the insiders is mobile. Limiting the fraction of mobile capital does not alter the main result that merged firms’ profits can improve as a result of internal capital reallocation, except that it reduces the range of profitable capital reallocation.
from the headquarters may differ from its pre-merger level of capital $K_j, j=1,2$. In the second stage, for a given $K_{Mj}$, division $j$’s best response is

$$q_{Mj} = \frac{\beta_{Mj}}{b}(a - bQ), \quad j = 1,2,$$

(6)

where $\beta_{Mj} = \frac{bK_{Mj}}{bK_{Mj} + 1}, \quad j = 1,2$. The subscript $M$ denotes the characteristics of the merged firm. The best response of rival firm $l$ is given by

$$q_l = \frac{\beta_l}{b}(a - bQ), \quad l = 3,4,\ldots,N,$$

(7)

where $\beta_l = \frac{bK_l}{bK_l + 1}, \quad l = 3,4,\ldots,N$. Then, $\beta_M = \beta_{M1} + \beta_{M2}$ and $\beta_{-M} = \sum_{l=3}^{N} \beta_l$ are the merged firm’s overall efficiency level after capital reallocation and the non-merging firms’ overall efficiency level, respectively. The industry output depends on $\beta_M$ and $\beta_{-M}$.

$$Q_M = \frac{a(\beta_{M1} + \beta_{M2} + \beta_3 + \cdots + \beta_N)}{b(\beta_{M1} + \beta_{M2} + \beta_3 + \cdots + \beta_N + 1)} = \frac{a}{b}\left(\frac{B_M}{B_M + 1}\right)$$

(8)

where $B_M = \beta_M + \beta_{-M}$.

The merged firm’s profits are the joint profits of the insiders,

$$\pi_M = \pi_{M1} + \pi_{M2} = (a - bQ)q_{M1} - \frac{q_{M1}^2}{2K_{M1}} + (a - bQ)q_{M2} - \frac{q_{M2}^2}{2K_{M2}}.$$

(9)

Plugging (6),(7), and (8) into the merged firm’s profit function (9), we get

$$\pi_M = \frac{a^2}{2b}\left(\frac{\beta_{M1} + \beta_{M2} + \beta_3 + \beta_4 + \cdots + \beta_N}{(B_M + 1)^2}\right).$$

(10)

In the first stage, the headquarters’ problem is to optimally determine the distribution between $\beta_{M1}$ and $\beta_{M2}$ under the constraint that $K_{M1} + K_{M2} = K_M = K_1 + K_2$, where $K_j, j=1,2$ is the initial level of capital that merging partner $j$ brings to the merger, and $K_{Mj}, j=1,2$ is the level of capital for division $j$ after the capital reallocation under the M-form. Consider the following distribution rule $\varepsilon$: 
\[(K_{M1} = K_1 + \varepsilon, K_{M2} = K_2 - \varepsilon), \quad -K_1 < \varepsilon \leq \frac{K_1 - K_2}{2}.\]  

Let \( \varepsilon = \frac{K_1 - K_2}{2} \) denote the capital reallocation that makes the two divisions symmetric. The range includes a capital transfer from the first division to the second division, \( \varepsilon \leq 0 \), which increases the concentration in this industry.

A small capital transfer from division 2 to division 1 improves \( \beta_{M1} \) and \( \pi_{M1} \), and reduces \( \beta_{M2} \) and \( \pi_{M2} \). Nonetheless, both divisions continue to compete and produce non-zero outputs under the M-form. However, if one division gets all of the capital, \( \varepsilon = -K_1 \), the other division can no longer produce. Such a capital reallocation eliminates the internal competition between the two divisions. Thus, at \( \varepsilon = -K_1 \), the capital reallocation completely integrates production. Conversely, if the optimal reallocation occurs in the range \( -K_1 < \varepsilon \leq \frac{K_1 - K_2}{2} \), the resulting corporate structure is the M-form. That is, if both divisions receive a non-zero level of capital at the optimal capital reallocation, the optimal internal structure of the merged firm is the M-form, and, if the optimal capital reallocation under the M-form does not have an interior solution, the optimal internal structure is complete integration. This way, the optimal capital reallocation and corporate structure of the merged firm are jointly determined by the process of capital reallocation.

Under complete integration, capital reallocation is irrelevant. That is, whether the entire capital is monopolized by a single plant or divided among many plants does not make a difference in terms of the firm’s strategic output decision, if the merger operates under complete integration. In Lemma 1 in the Appendix, we prove that producing everything in one division is equivalent, in terms of the firm’s strategic behavior, to all other types of completely integrated production in which the headquarters of a multi-plant firm centrally organizes each plant’s

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6 In the range \( \frac{K_1 - K_2}{2} < \varepsilon < K_1 \), the capital transfer makes the second division smaller than the first division. Since the dual outcome of such a capital transfer can be found in the range \( -K_1 < \varepsilon \leq \frac{K_1 - K_2}{2} \), the relevant range for a capital transfer is \( -K_1 < \varepsilon \leq \frac{K_1 - K_2}{2} \).
output level. It is because, under complete integration, there is essentially only one production decision unit regardless of the number of operating units.

The merged firm adopts the M-form if it is more profitable than complete integration. In the following Proposition, first we show that, if the merger operates under the M-form, the merged firm maximizes profit by reallocating the capital symmetrically to the insiders, i.e., at $\varepsilon_S = \frac{K_2 - K_1}{2}$. Comparing the profit under the M-form (when the capital is reallocated at $\varepsilon_S = \frac{K_2 - K_1}{2}$) and the profit under complete integration, we derive the condition under which the M-form is optimal for the merged firm.

**PROPOSITION 1: (Optimality of Symmetric Capital Reallocation Under the M-form)**

Consider a merger between two asymmetric firms, firm 1 and firm 2, when $K_1 < K_2$ and $K_1 + K_2 = K_M$. If the merged firm operates under the M-form, the unique solution to the optimal capital reallocation is to move $\varepsilon_S = \frac{K_2 - K_1}{2}$ from division 2 to division 1.

**PROOF:** See the Appendix.

If the insiders are in competition under the M-form, the merged firm earns higher profits when the insiders are symmetric than otherwise. Under the M-form, symmetry reduces the merged firm’s average production cost to its lowest levels. For any cost technology $C(q, K)$ with diminishing marginal returns to capital, $\frac{\partial C(q, K)}{\partial K} < 0$, and $\frac{\partial^2 C(q, K)}{\partial K^2} > 0$ for any given output $q$.

Let $AC_M(q_1, q_2, K_1, K_2) = \frac{C(q_1, K_1) + C(q_2, K_2)}{q_1 + q_2}$ be the merged firm’s average cost before capital reallocation. Then, for $K_1 < K_2$, an infinitesimal amount of capital transfer, $\varepsilon > 0$, from division 2 to division 1 lowers the average cost:

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7 Consider a general Cobb-Douglas production function $q = L^\alpha K^\beta$, where $L$ is a variable input, and $K$ is the level of capital. The dual of the production function is $C(q, K) = wq^\alpha K^\beta$, where $w$ is the unit price of the variable input. For a given $q$, $\frac{\partial C(q, K)}{\partial K} = \frac{\beta}{\alpha} wq^\alpha K^{\beta - 1} < 0$, and $\frac{\partial^2 C(q, K)}{\partial K^2} = \frac{\beta(\alpha + \beta)}{\alpha^2} wq^\alpha K^{\beta - 2} > 0$ for any $\alpha > 0$ and $\beta > 0$. 

\[
\frac{\partial AC_M}{\partial \varepsilon} = \frac{1}{q_1 + q_2} \left( \frac{\partial C_1(q_1, K_1, \varepsilon)}{\partial \varepsilon} + \frac{\partial C_2(q_2, K_2, \varepsilon)}{\partial \varepsilon} \right) = \frac{1}{q_1 + q_2} \left( \frac{\partial C_1(q_1, K_1)}{\partial K_1} - \frac{\partial C_2(q_2, K_2)}{\partial K_2} \right) < 0. \tag{12}
\]

It is due to diminishing marginal returns to capital. This implies that, for any cost technology, as long as capital exhibits diminishing marginal returns, the total average cost of the two divisions is minimized when the capital is allocated symmetrically within the two divisions. Such an efficiency-improving capital reallocation always exists for any asymmetric insiders.

On the other hand, capital reallocation also increases the merged firm’s cost indirectly, because the improved efficiency increases the merged firm’s output. The effect of a small capital transfer on the merged firm’s profit is divided into the following three components:

\[
\frac{\partial \pi_M}{\partial \varepsilon} = \frac{\partial \left\{ (P(Q, q_{M1}) + q_{M2}) \right\}}{\partial \varepsilon} \left\{ \frac{\partial C(q_{M1}, K_{M1})}{\partial q_{M1}} \left( \frac{\partial q_{M1}}{\partial \varepsilon} \right) + \frac{\partial C(q_{M2}, K_{M2})}{\partial q_{M2}} \left( \frac{\partial q_{M2}}{\partial \varepsilon} \right) \right\} \left\{ \frac{\partial C(q_{M1}, K_{M1})}{\partial \varepsilon} + \frac{\partial C(q_{M2}, K_{M2})}{\partial \varepsilon} \right\}. \tag{13}
\]

The first component is the impact of capital reallocation on the merged firm’s revenue. The sign of this term is ambiguous (See the Appendix for the proofs). As the merged firm produces more, the firm’s revenue increases for a given market price. However, the increased output also lowers market price. The second component shows that the merged firm’s cost indirectly increases as the improved efficiency increases the output. The third component, the impact of capital reallocation on the merged firm’s profits through the change in the overall cost efficiency, is non-negative from (12). Overall, if the effect on the market price (A) and the increase in cost (B) is small enough, the efficiency-improving symmetric capital reallocation improves the merged firm’s profits. Obviously, it depends on the shapes of market demand and cost functions. In the appendix, we show that, in the current framework of linear demand and quadratic cost function, the condition for profitable symmetric capital reallocation is \( \beta_{-M} + \frac{1}{3} (2 \beta_s) > \frac{1}{3} \), where \( \beta_s \) is each insider’s efficiency level at the symmetric capital reallocation \( \varepsilon_s = \frac{K_s - K_i}{2} \). At \( \varepsilon_s = \frac{K_s - K_i}{2} \), \( \beta_{-M} = \beta_s + \beta_s = 2 \beta_s \). From (8), a large \( \beta_{-M} \) implies that the size of non-merging firms in the market is large enough to produce a large output \( Q \) regardless of the merger outcome. In this case, from (6), the efficiency-improving capital reallocation would not increase the merged firm’s output.
firm’s output much, and thus, it is likely that symmetric capital reallocation improves the merged firm’s profits. Similarly, a large $\beta_s$ implies large efficiency gains and large market share for the merged firm; it is likely to result in profitable capital reallocation.

As all of the firms in the industry are identical except for their initial levels of capital, there can be only two types of mergers: a merger between firms with initially asymmetric levels of capital, which we call a “merger between asymmetric firms,” and a merger between firms with initially symmetric levels of capital, which we call a “merger between symmetric firms.” The merged firm adopts the M-form if it is more profitable than complete integration. The M-form is optimal for mergers between asymmetric firms, and complete integration is optimal for symmetric firms. In the following propositions, we provide the conditions under which the merged firm optimally selects the M-form.

**PROPOSITION 2:** (Optimality of the M-form for a Merger Between Asymmetric Firms) Consider a horizontal merger between firm 1 and firm 2 when $K_1 < K_2$ and $K_1 + K_2 = K_M$. If $\frac{\beta_{CI}}{\beta_M} > \beta_{CI}$, the merged firm’s profits are higher under the M-form than under the complete integration and, thus, the merged firm optimally chooses the M-form for its internal structure, where $\beta_{CI} = \frac{b_{K_M}}{b_{K_F} + 1}$, $\beta_M = \sum_{l=3}^{N} \beta_l$, and $\beta_l = \frac{b_{K_l}}{b_{K_l} + 1}$, $l = 3, 4, \ldots, N$.

**PROOF:** See the Appendix.

In the case of a merger between asymmetric firms, at $\epsilon^* = \frac{K_s}{2} + \frac{K_1}{2}$, $\beta_{M_l} = \beta_s$ by definition. Therefore, under the M-form, the merged firm’s profits are

$$\pi^*_M = \frac{a^2}{2b} \left( \beta_{M_1} + \beta_{M_2} + \beta_{M_3} + \beta_{M_4} \right)^2 = \frac{a^2}{2b} \left( \frac{2\beta_s + 2\beta_s^2}{(2\beta_s + \beta_s + 1)^2} \right).$$

Under complete integration, the merged firm earns
\[ \pi_{M:N-1} = \frac{a^2}{2b} \left( \frac{\beta_{CI} + \beta_{CI}^2}{(\beta_{CI} + \beta_{CI} + 1)^2} \right), \]  

(15)

where \( \beta_{CI} = \frac{bK_M}{bK_M + 1} \) represents the merged firm’s efficiency level when it combines the total capital, and \( \pi_{M:N-1} \) denotes the merged firm’s profit when the merger reduces the number of competitors in the market to \( N - 1 \).

Using \( \beta_{CI} = \frac{K_i}{K_i + 1} \), we can rewrite that \( \varepsilon_S = \frac{K_i - K_i}{2b(1 - \beta_i)(1 - \beta_i)} \). At \( \varepsilon_S = \frac{\beta_i - \beta_i}{2b(1 - \beta_i)(1 - \beta_i)} \),

\[ \beta_{M1} = \beta_{M2} = \frac{(\beta_i + \beta_i - 2\beta_i) + \beta_i}{(2\beta_i - \beta_i)} = \beta_S \], and therefore, \( \beta_M = \beta_{M1} + \beta_{M2} = 2\beta_S = \frac{2(\beta_i + \beta_i - 2\beta_i)}{(2\beta_i - \beta_i)} > \beta_i + \beta_i \). In contrast, when the firm operates under complete integration, due to the diminishing marginal returns to capital, combining the total capital lowers the overall efficiency of the merged firm:

\[ \beta_M = \left\{ \begin{array}{ll} 2\beta_S > \beta_i + \beta_i & \text{under the M-form} \\ \beta_{CI} < \beta_i + \beta_i & \text{under complete integration.} \end{array} \right. \]

In summary, \( \beta_M = \left\{ \begin{array}{ll} 2\beta_S > \beta_i + \beta_i & \text{under the M-form} \\ \beta_{CI} < \beta_i + \beta_i & \text{under complete integration.} \end{array} \right. \)

The M-form is optimal if and only if \( \pi_M^* > \pi_{M:N-1} \) and \( \pi_M^* > \pi_1 + \pi_2 \). Since we are considering mergers with a fixed level of total capital \( K_M \), we get \( \beta_S = \frac{b(K_M/K_i + 1)}{b(K_M/K_i + 1)} = \frac{\beta_i}{2\beta_i} \). Then, from (14) and (15),

\[ \pi_M^* = \frac{a^2}{2b} \left( \frac{2\beta_S + 2\beta_S^2}{(2\beta_S + \beta_S + 1)^2} \right) > \frac{a^2}{2b} \left( \frac{\beta_{CI} + \beta_{CI}^2}{(\beta_{CI} + \beta_{CI} + 1)^2} \right) = \pi_{M:N-1}. \]  

(16)

That is, the M-form is optimal if \( \beta_{CI} \) is large, \( \beta_{CI} \) is small, or both. Since \( \frac{(\beta_M + 1)(3\beta_M - 1)}{(\beta_M - 1)^2} > 0 \) only if \( \beta_{CI} > \frac{1}{3} \), for mergers to be profitable under the M-form, there must exists a profit-enhancing symmetric capital reallocation, \( \beta_{CI} + \frac{1}{3} \cdot (2\beta_S) > \frac{1}{3} \). Also, \( \frac{(\beta_M + 1)(3\beta_M - 1)}{(\beta_M - 1)^2} > 1 \)

---

8 The result can be easily extended to the case of a positive merger cost \( \delta > 0 \). Mergers are profitable under the M-form if \( \pi_M^* - \pi_{M:N-1} > \delta \) and \( \pi_M^* - (\pi_1 + \pi_2) > \delta \), which simply implies that the range of parameters where mergers are profitable is reduced when we consider \( \delta > 0 \). But the qualitative results of this paper would not be affected.
for $\beta_{-M} > \sqrt{2} - 1$, and thus, $\frac{\mu_{-M} + \mu_{-U} \beta_{-M}}{(\beta_{-M} - 1)^2} > \beta_{CI}$ is always satisfied. Hence, if $\beta_{-M}$ is large enough, the merged firm always chooses the M-form regardless of $\beta_{CI} (\beta_S)$.

Under the M-form, the merged firm increases its profits by producing a large amount of output and increasing its market share owing to symmetric capital reallocation that lowers the average cost for the merged firm. From (6) and (8),

$$q_M = q_{M1} + q_{M2} = \frac{a(2\beta_1)}{b} \left( \frac{1}{2\beta_1 + \beta_{-M} + 1} \right) > \frac{a(\beta_1 + \beta_2)}{b} \left( \frac{1}{\beta_1 + \beta_2 + \beta_{-M} + 1} \right) = q_1 + q_2,$$

since $2\beta_2 > \beta_1 + \beta_2$. Under complete integration, on the contrary, producing a small amount of output increases the merged firm’s profits. As the merger decreases the level of competition in the market, the merged firm produces a smaller quantity ($q_{CI} < q_1 + q_2$) at a higher price than it did before the merger. Then, the merged firm profits only if the merger substantially reduces market competition. Perry and Porter (1985, p. 222) write, “the profits of the merged firm can exceed those of its constituent firms only if the merger results in a price rise sufficient to offset the lower output level.”

If profits under the M-form are higher than they are under complete integration, gains from large decentralized production must outweigh gains from small centralized production under reduced market competition, and vice versa. Since $\frac{\partial Q}{\partial \beta_{-M}} < 0$ from (7), for any given $\beta_{-M}$, the effect of the merger on market output (and price) gets smaller as $\beta_{-M}$ increases. This means that when $\beta_{-M}$ is large, if the merged firm completely integrates the insiders’ production, the price rise is not sufficient to offset the lower output level for the merged firm. Thus, the merged firm cannot gain much from reducing competition. Instead, the firm can improve its profits by increasing its market share and lowering its average cost under the M-form. Similarly, if $\beta_{CI} (\beta_S)$ is small, the size of total capital that the merged firm can combine is too small to induce a large price rise from reducing market competition. The merged firm is better off increasing its output

---

9 See Perry and Porter (1985) for the proof.
and market share under the M-form than reducing its output and market competition under complete integration. This explains the condition in Proposition 2.

For any merger between asymmetric firms, if the merged firm operates under the M-form, there always exists a profit-enhancing capital reallocation (Proposition 1), and, if \( \frac{(\beta_{u+1}^2 \beta_{u-1}^2)}{(\beta_u^2 \gamma_u^2)} > \beta_{CI} \), the merged firm operates under the M-form since the increase in profits under the M-form is greater than the increase in profits under complete integration (Proposition 2). Therefore, we have the following result:

**COROLLARY 1:** If \( \frac{(\beta_{u+1}^2 \beta_{u-1}^2)}{(\beta_u^2 \gamma_u^2)} > \beta_{CI} \), a merger between asymmetric firms is always profitable through divisionalization and capital reallocation.

For a merger between symmetric firms, however, the M-form is never optimal. Under the M-form, the merged firm would make at most the same profits as before by doing nothing; any capital reallocation makes the two divisions asymmetric and more inefficient. The merged firm profits only from a price rise and reduced competition. Moreover, under complete integration, the headquarters rationalizes each plant’s output, so the merged firm’s profits do not vary with capital redistribution (Lemma 1 in the appendix). With complete integration of the insiders’ production and output rationalization, the merged firm would earn \( \pi_{M,N-1} \). Such a merger is profitable if \( \beta_{CI} > \frac{(\beta_u^2 \gamma_u^2 \beta_{u-1}^2)}{(\beta_u^2 \gamma_u^2 \beta_{u+1}^2)} \).

**PROPOSITION 3:** (Optimal Internal Structure for a Merger Between Symmetric Firms) Consider a horizontal merger between two symmetric firms, firm 1 and firm 2. The optimal internal structure for the merged firm is complete integration.

**PROOF:** See the Appendix.
Table 1 summarizes the ranges of parameters under which profitable mergers arise, and the optimal corporate structure of the merged firm in each case. The parameter range under which the M-form is superior to complete integration, \( \frac{(\beta_M+1)(3\beta_M-1)}{(\beta_M-1)^2} > \beta_{CI} \), and the range under which complete integration is superior to the M-form, \( \beta_{CI} > \frac{(\beta_M+1)(3\beta_M-1)}{(\beta_M-1)^2} \), are mutually exclusive and exhaustive.

Table 1. Profitability of Mergers and the Optimal Corporate Structure of the merged firm

<table>
<thead>
<tr>
<th>( \beta_{CI} &gt; \frac{(\beta_M+1)(3\beta_M-1)}{(\beta_M-1)^2} )</th>
<th>Merger between symmetric firms</th>
<th>Merger between asymmetric firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profitable</td>
<td>Complete integration</td>
<td>Profitable</td>
</tr>
<tr>
<td>(Perry and Porter (1985))</td>
<td>Complete integration</td>
<td>(Perry and Porter (1985))</td>
</tr>
<tr>
<td>( \frac{(\beta_M+1)(3\beta_M-1)}{(\beta_M-1)^2} &gt; \beta_{CI} )</td>
<td>Not profitable</td>
<td>Profitable</td>
</tr>
<tr>
<td>(Salant et al. (1983))</td>
<td>The M-form</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 shows that if firms optimize over organizational forms, horizontal mergers between asymmetric firms are always profitable either through capital reallocation under the M-form or through output rationalization under complete integration.

**COROLLARY 2:** Any horizontal merger between asymmetric firms is profitable.

Horizontal mergers may not be anti-competitive. When a merged firm organizes its production under the M-form, the merger enhances competition.\(^{10}\)

\(^{10}\) Farrell and Shapiro (1990 b) discuss a condition under which exogenous capital sales between oligopoly firms improve welfare. They show that a small capital sale from a larger firm to a smaller firm improves welfare. When the welfare effect alone is considered, it appears as though capital sales between firms achieve the same welfare-enhancing effect as does a merger operating under the M-form. However, mergers under the M-form are intrinsically different from capital sales in one important aspect: incentives. As the capital level determines a firm’s competitiveness in the market, capital sales between competing firms necessarily imply that the seller loses profits and the buyer gains profits as a result. Obviously, no profit-maximizing firm would be willing to be engaged in such
**PROPOSITION 4:** (Pro-competitive Horizontal Mergers) *Horizontal mergers lower market price, increase market output, and increase consumer surplus if the merged firms operate under the M-form.*

**PROOF:** See the Appendix.

**IV. Conclusion**

This paper examines whether internal capital reallocation can improve the profitability of horizontal mergers. We find that the merged firm may not always prefer to completely integrate the merging partners, but may choose the M-form, in which merging partners do not completely cooperate. The merged firm can improve its overall efficiency by symmetrically reallocating its resources to the insiders under the M-form. Such a merger is not only privately profitable, but also socially efficient, as the merger lowers market price.

**APPENDIX**

**A1. PROOF OF PROPOSITION 1**

Consider a merger between firm 1 and firm 2 with a fixed level of total capital $K_M = K_1 + K_2$. Assume that $K_1 \leq K_2$. Suppose that the merger is operating under the M-form. The merged firm reallocates $K_M$ to the insiders according to the following distribution rule $\varepsilon$:

$$ (K_{M1} = K_1 + \varepsilon, K_{M2} = K_2 - \varepsilon), \quad -K_1 < \varepsilon \leq \frac{K_1 - K_2}{2}. \quad \text{(A-1)} $$

capital sales unless the firm faces some financial constraint that forces capital sales. Hence, typically, welfare-improving capital sales are difficult to enforce in the first place. On the contrary, in the case of merger, the merged firm can enforce the optimal capital reallocation because it improves its *overall* profits. Although one division must incur losses in order for the optimal capital redistribution to work, the headquarters has the authority to reallocate the resources as long as it improves the total profits. That is, merger is an enforcement mechanism for the welfare-improving capital redistribution (or capital sales). Moreover, even if the capital sales occur, firms are never interested in achieving the level of capital sales that induces the most efficient capital distribution among them. Thus, the capital sales can never be as efficient as the capital redistribution after mergers.
At $\varepsilon_S = \frac{K_1 - K_i}{2}$, which we call “symmetric distribution,” the insiders become symmetric in their capital levels. In all other cases, which we call “asymmetric distribution,” the insiders remain asymmetric in their capital levels. Under the redistribution rule, each division’s capital level can be rewritten as

\[ K_{M1} = \frac{\beta_{M1}}{b(1-\beta_{M1})} = \frac{\beta_1}{b(1-\beta_1)} + \varepsilon \Rightarrow \beta_{M1} = \beta_1 + \varepsilon b(1-\beta_1) = \frac{\beta_1 + x_1}{1 + \varepsilon b(1-\beta_1)} \]

\[ K_{M2} = \frac{\beta_{M2}}{b(1-\beta_{M2})} = \frac{\beta_2}{b(1-\beta_2)} - \varepsilon \Rightarrow \beta_{M2} = \frac{\beta_2 - \varepsilon b(1-\beta_2)}{1 - \varepsilon b(1-\beta_2)} = \frac{\beta_2 - x_2}{1 - x_2} \]

where $x_1 = \varepsilon b(1-\beta_1), x_2 = \varepsilon b(1-\beta_2)$. A capital transfer in the range $-K_1 < \varepsilon < \frac{K_1 - K_i}{2}$ always results in $\beta_{M2} \geq \beta_{M1}$ with equality in the symmetric distribution. Using $K_i = \frac{\beta_i}{(1-\beta_i)}$, we can rewrite that

\[ \varepsilon_S = \frac{K_1 - K_i}{2} = \frac{\beta_1 - \beta_2}{2b(1-\beta_1)(1-\beta_2)} \cdot \text{At } \varepsilon_S = \frac{\beta_1 - \beta_2}{2b(1-\beta_1)(1-\beta_2)} , \beta_{M1} = \beta_{M2} = \frac{(\beta_1 + \beta_2 - 2\beta_1\beta_2)}{2(1-\beta_1)(1-\beta_2)} \equiv \beta_S . \]

Plugging (6), (7), (A-1) and (A-2) into the merged firm’s profit function (9), we get

\[ \pi_n = \frac{a^2}{2b} \left( \frac{\beta_{M1} + \beta_{M2} + \beta_{M1} + \beta_{M2}}{b(M + 1)} \right) . \]  

(A-3)

A small amount of capital transfer $\varepsilon$ changes the profits of the merged firm as follows:

\[ \frac{\partial \pi_n}{\partial \varepsilon} = \frac{\partial[(a-bQ)(q_{M1} + q_{M2})]}{\partial \varepsilon} - \left( \frac{\partial(q_{M1})}{\partial \varepsilon} \left( \frac{1}{2K_{M1}} \right) + \frac{\partial(q_{M2})}{\partial \varepsilon} \left( \frac{1}{2K_{M2}} \right) \right) \left( q_{M1} \frac{\partial(1/2K_{M1})}{\partial \varepsilon} + q_{M2} \frac{\partial(1/2K_{M2})}{\partial \varepsilon} \right) \]  

(A-4)

The first term is the effect of capital reallocation on the merged firm’s revenue:

\[ A: \frac{\partial[(a-bQ)(q_{M1} + q_{M2})]}{\partial \varepsilon} = \frac{a^2}{2b} \left( \frac{1 + \beta_{M1} - \beta_{M2}}{b(M + 1)} \right) \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} . \]

Since $\frac{1}{2} > \beta_M = \frac{bK_M}{bK_M + 1}$ from (3), $1 + \beta_{M1} - \beta_{M2} > 0$. Then, $A$ is positive if and only if $\frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} > 0$.

By construction,

\[ \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} = \frac{b}{(1 + x_1)^2(1 - x_2)^2} (2 - \beta_1 - \beta_2)(\beta_1 - \beta_2) - 2\varepsilon b(1-\beta_1)(1-\beta_2) . \]

(A-5)

At $\varepsilon_S = \frac{\beta_1 - \beta_2}{2b(1-\beta_1)(1-\beta_2)} , \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} = 0$ and, for $-K_1 < \varepsilon < \varepsilon_S , \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} > 0$. Thus, $A \geq 0$.

The second term in (A-4) is the indirect effect of capital reallocation on production cost.
\[
B : \left\{ \frac{\partial (q_i^*)}{\partial \varepsilon_1} \left( \frac{1}{2K_1} \right) + \frac{\partial (q_i^*)}{\partial \varepsilon_2} \left( \frac{1}{2K_2} \right) \right\} = \frac{a^2}{b(B_u + 1)^3} \left[ \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} \right] \left[ (\beta_{-M} + 1)(1 - \beta_{M1}) + \beta_{M2}(\beta_{M2} - \beta_{M1}) \right].
\]

At \( \varepsilon_S \), this effect is zero. For \(-K_1 < \varepsilon < \varepsilon_S\), \( B \) is positive since
\[
\frac{\partial \beta_{M1}}{\partial \varepsilon} > \frac{\partial \beta_{M2}}{\partial \varepsilon} \Leftrightarrow (2 - \beta_1 - \beta_2)(\beta_1 - 2e(1 - \beta_2)(1 - \beta_1)) > 0
\]
and \((\beta_{-M} + 1)(1 - \beta_{M1}) + \beta_{M2}(\beta_{M2} - \beta_{M1}) > (\beta_{-M} + 1)(1 - \beta_{M1}) - \beta_{M1}(\beta_{M2} - \beta_{M1})\). That is, increasing the symmetry of the insiders’ capital levels increases the merged firm’s production cost indirectly.

The third term is the direct effect of capital allocation on the production cost:
\[
C : \left\{ q_i \left( \frac{\partial (y_{i,N})}{\partial \varepsilon} \right) + q_i^2 \left( \frac{\partial (y_{i,N})}{\partial \varepsilon} \right) \right\} = \frac{a^2}{2b(B_u + 1)^3} \left[ \frac{\partial \beta_{M1}}{\partial \varepsilon} - \frac{\partial \beta_{M2}}{\partial \varepsilon} \right]
\]
This term is zero at \( \varepsilon_S \) and negative for \(-K_1 < \varepsilon < \varepsilon_S\). That is, increasing the symmetry of the insiders’ capital levels decreases the production cost directly.

The symmetric solution \( \varepsilon_S \) is a candidate for solving the optimal capital reallocation problem. In the following, we prove that, under the M-form, an interior solution to the capital reallocation problem exists if \( \beta_{-M} > \frac{1}{3} - \frac{2}{3} \beta_S \), and that \( \varepsilon_S \) is the unique interior solution in that case. The first-order condition (A-4) reduces to
\[
\frac{\partial \sigma_{\pi}}{\partial \varepsilon} = \frac{a^2}{2b(B_u + 1)^3} \left[ \frac{\partial \beta_{M1}}{\partial \varepsilon} \left[ y - \beta_{M1} + 2\beta_{M2} y - 2\beta_{M1}(\beta_{M2} - \beta_{M1}) \right] \right] = 0,
\]
where \( y = \beta_{-M} + 1 \). For any level of \( \beta_1, \beta_2, \beta_{-M}, \varepsilon \) and \( b \), there are three roots satisfying this equation. One of them is \( \varepsilon^* = \varepsilon_S = \frac{\beta_1 - \beta_2}{2b(1 - \beta_1)(1 - \beta_2)} \geq 0 \) and the other two are \( \varepsilon_S \pm \delta \), where
\[
\delta = \sqrt{R} = \frac{\sqrt{6(1 - \beta_1)(1 - \beta_2)(6 + 2\beta_{-M})(1 - \beta_2)(1 + 3\beta_{-M})(2 - \beta_1)}}{2b(1 - \beta_1)(1 - \beta_2)(1 + 3\beta_{-M})(2 - \beta_1)}.
\]
and \( \beta_S = \frac{(\beta_1 + \beta_2 - 2\beta_{-M})}{(2 - \beta_1 - \beta_2)} \). If \( R > 0 \), \( \delta \) is a real number. \( R > 0 \) if and only if
\[
\beta_{-M} > \frac{1}{3} - \frac{2}{3} \beta_S,
\]
(A-7)
and \( R \leq 0 \) when \( 0 < \beta_{-M} \leq \frac{1}{3} - \frac{2}{3} \beta_S \).

Evaluating the second-order condition, \( \frac{\partial^2 \pi_M}{\partial \varepsilon^2} \), at \( \varepsilon = \varepsilon_S \), we get

\[
\frac{\partial^2 \pi_M}{\partial \varepsilon^2} \bigg|_{\varepsilon = \varepsilon_S} = \frac{16a^2b}{(B_M + 1)^2} \left\{ (1 - \beta_Y) (1 - \beta_Y) \right\} \left\{ (1 - 3 \beta_{-M})(2 - \beta_1 - \beta_2) - 2(\beta_1 + \beta_2 - 2 \beta_{-M}) \right\},
\]

\[
\Leftrightarrow \frac{\partial^2 \pi_M}{\partial \varepsilon^2} \bigg|_{\varepsilon = \varepsilon_S} < 0 \quad \text{iff} \quad \frac{1 - 3 \beta_{-M}}{2} < \beta_s,
\]

\[
\Leftrightarrow \beta_{-M} > \frac{1}{3} - \frac{2}{3} \beta_S \quad \Leftrightarrow \quad \frac{2(1 - 3 \beta_{-M})}{3} < \beta_{c1},
\]

since \( \beta_S = \frac{(\beta + \beta_2 - 2 \beta_1)}{(2 - \beta_1 - \beta_2)} = \frac{\beta_S}{2 - \beta_S} \). According to (A-7) and (A-8), the parameter range that generates real roots for the solutions to optimal capital reallocation coincides with the parameter range that gives \( \frac{\partial \pi_M}{\partial \varepsilon} \bigg|_{\varepsilon = \varepsilon_S} < 0 \).

Figure 1: The existence of an interior solution to the optimal capital reallocation problem under the M-form

We have two cases to consider. If \( \beta_{-M} > \frac{1}{3} - \frac{2}{3} \beta_S \), the two roots \( \varepsilon_1 = \varepsilon_S + \delta, \varepsilon_2 = \varepsilon_S - \delta \) are real, and we are in case 1, in which \( \frac{\partial \pi_M}{\partial \varepsilon} \bigg|_{\varepsilon = \varepsilon_S} < 0 \), as shown in figure 1. In this case, the global maximum occurs at \( \varepsilon_S \); that is, the symmetric distribution is the unique interior solution to the
optimal capital reallocation problem. On the other hand, if \( 0 < \beta_{-M} \leq \frac{1}{2} - \frac{1}{2} \beta_S \), the two roots are imaginary, and we are in case 2, in which \( \frac{\partial \pi_M}{\partial e} \bigg|_{e=e_1} > 0 \), and \( e_S \) gives the global minimum profits.

In this case, we do not have an interior solution to the capital reallocation problem in the M-form. Therefore, the only optimal capital reallocation exists at the corner solution that induces complete integration structure: \( e^* = -K_1 \).

If the merged firm operates under the M-form, it must be that \( \beta_{-M} > \frac{1}{2} - \frac{1}{2} \beta_S \). In this case, the optimal distribution is \( e^* = \frac{K_1 - K_i}{2} \). At \( e_s = \frac{K_1 - K_i}{2} \), \( \beta_M = 2 \beta_S = \frac{2(\beta_1 + \beta_2 - 2 \beta_S)}{(2 \beta_S - \beta_1)} > \beta_1 + \beta_2 \). That is, the overall efficiency of the merged firm \( \beta_M \) improves because of the capital reallocation. At \( e_s = \frac{K_1 - K_i}{2} \), the merged firm’s output level is higher than the combined level of outputs of the insiders prior to merger:

\[
q_M = q_{M_1} + q_{M_2} > q_1 + q_2 \iff \frac{\alpha(2 \beta_S)}{b} \left( \frac{1}{2 \beta_S + \beta_{-M} + 1} \right) > \frac{\alpha(\beta_1 + \beta_2)}{b} \left( \frac{1}{\beta_1 + \beta_2 + \beta_{-M} + 1} \right),
\]

since \( 2 \beta_S > \beta_1 + \beta_2 \). ■

A2. PROOF OF PROPOSITION 2

For a merger between asymmetric firms, the merged firm can choose either the M-form or complete integration. From Proposition 1, the merged firm should reallocate internal capital symmetrically if it operates under the M-form. Thus, the highest profit under the M-form, \( \pi_M^* \), is \( \frac{\alpha}{2b} \left( \frac{2 \beta_S + 2 \beta_S^2}{(2 \beta_S + \beta_{-M} + 1)^2} \right) \) from (A-3). Under complete integration, the best responses of the merged firm, and that of a rival firm \( l \), are \( q_{CI} = \frac{\beta_S}{b} (a - bQ) \) and \( q_l = \frac{\beta_S}{b} (a - bQ) \) respectively. The market output is \( Q_{CI} = \frac{a}{b} \left( \frac{\beta_S + \beta_{-M}}{\beta_S + \beta_{-M} + 1} \right) \), and the merged firm earns \( \pi_{M:N-1} = \frac{\alpha}{2b} \left( \frac{\beta_S + \beta_{-M}}{(\beta_S + \beta_{-M} + 1)^2} \right) \). The headquarters
chooses the M-form over complete integration only if \( \pi_M^* > \pi_{M,N-1} \Leftrightarrow \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{3(\beta_{-M} - 1)^2} > \beta_{CI} \). Combining this with the result from (A-8), we get three parameter ranges to consider:

(i) \[ \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{3(\beta_{-M} - 1)^2} > \beta_{CI} > 0 > \frac{2(1 - 3\beta_{-M})}{3} \] .

In this range, \( \frac{\partial \pi_M^*}{\partial \epsilon} \bigg|_{\epsilon=\epsilon_i} < 0 \) and, thus, the symmetric distribution is the unique interior solution for capital reallocation under the M-form. Under the M-form, the merged firm earns

\[ \pi_M^* = \frac{a^2}{2b} \left( \frac{2\beta_{-M} + 2\beta_{-M}^2}{(2\beta_{-M} + 1)^2} \right) \] and \( \pi_M^* > \pi_1 + \pi_2 \) since \( \beta_{CI} > \frac{2(1 - 3\beta_{-M})}{3} \). While the firm could have earned

\[ \pi_{M,N-1} = \frac{a^2}{2b} \left( \frac{\beta_{CI} + \beta_{CI}^2}{(\beta_{CI} + \beta_{-M})^2} \right) \] under complete integration, the M-form generates higher profits because

\[ \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{3(\beta_{-M} - 1)^2} > \beta_{CI} \]. If \( \beta_{-M} > \sqrt{2} - 1, \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{(\sqrt{2} - 1)^2} > 1, 0 > \frac{2(1 - 3\beta_{-M})}{3} \) and, thus, \( \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{3(\beta_{-M} - 1)^2} > \beta_{CI} \) is always satisfied. Hence, if \( \beta_{-M} \) is large enough, horizontal mergers between asymmetric firms are profitable and the M-form is the optimal internal structure for the merged firm for any \( \beta_{CI} \).

(ii) \( \beta_{CI} > \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{3(\beta_{-M} - 1)^2} > 0 > \frac{2(1 - 3\beta_{-M})}{3} \) or \( \beta_{CI} > \frac{2(1 - 3\beta_{-M})}{3} > 0 > \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{(\beta_{-M} - 1)^2} \).

In these parameter ranges, although the symmetric distribution is optimal under the M-form, \( \beta_{CI} > \frac{2(1 - 3\beta_{-M})}{3} \), the profits under complete integration are higher than they are under M-form production. Therefore, the merged firm’s optimal corporate structure is complete integration. In this case, \( \pi_{M,N-1} > \pi_M^* > \pi_1 + \pi_2 \). The second inequality holds because, under the M-form, the symmetric redistribution improves the profits of the merged firm.

(iii) \[ \frac{2(1 - 3\beta_{-M})}{3} > \beta_{CI} > 0 > \frac{(\beta_{-M} + 1)(3\beta_{-M} - 1)}{(\beta_{-M} - 1)^2} \].

In this range, there is no optimal interior solution to the capital reallocation problem under the M-form because \( \frac{2(1 - 3\beta_{-M})}{3} > \beta_{CI} \). If the merger is profitable, it must be the case that \( \pi_{M,N-1} > \pi_1 + \pi_2 \).

That is, in this case, the only optimal internal structure for the merger is complete integration.
The range \( \frac{2(1-3\beta_{-\mu})}{3} > \frac{(\beta_{-\mu}+1)(3\beta_{-\mu}-1)}{(\beta_{-\mu}-1)^2} > \beta_{CI} \) is infeasible because \( \frac{(\beta_{-\mu}+1)(3\beta_{-\mu}-1)}{(\beta_{-\mu}-1)^2} \) always take the opposite sign of \( \frac{2(1-3\beta_{-\mu})}{3} \) around \( \beta_{-\mu} = \frac{1}{3} \). Overall, from (i), (ii), and (iii), the M-form is optimal for a merger between asymmetric firms when \( \frac{(\beta_{-\mu}+1)(3\beta_{-\mu}-1)}{(\beta_{-\mu}-1)^2} > \beta_{CI} \). Otherwise, for a profitable merger, complete integration is optimal. ■

A3. PROOF OF PROPOSITION 3

First, we prove that capital reallocation is irrelevant under complete integration.

**Capital Reallocation under Complete Integration**

**LEMMA 1:** When a merger completely integrates the production of the insiders, the merged firm’s profits are invariant to any capital reallocation.

**PROOF:** Let \( \pi_{M:N-1} \) be the merged firm’s profits under complete integration. The headquarters’ problem is to choose \( q_i \) and \( K_i \) of each plant \( i \) that maximize

\[
\pi_{M:N-1} = (a-bQ)q_1 - \frac{q_1^2}{2K_1} + (a-bQ)q_2 - \frac{q_2^2}{2K_2},
\]

\[
= (a-bQ)q_1 + (a-bQ)q_2 - \left( \frac{K_1K_2}{2} \right) \left( \frac{q_1}{K_1} \right)^2 - \left( \frac{K_1K_2}{2} \right) \left( \frac{q_2}{K_2} \right)^2,
\]

where \( q_i \) and \( K_i \) are the quantity and the level of each plant \( i, i=1,2 \).

When the multi-plant firm operates both plants efficiently, the marginal cost of the firm \( mc \) must satisfy

\[
mc = \frac{q_1}{K_1} = \frac{q_2}{K_2} = \frac{q_1 + q_2}{K_1 + K_2}.
\]

Plugging (A-10) into the firm’s profit function (A-9), we obtain
\[
\pi_{M,i-1} = (a - bQ)(q_i + q_2) = \frac{K_1}{2} \left( \frac{q_i + q_2}{K_i + K_2} \right)^2 - \frac{K_2}{2} \left( \frac{q_i + q_2}{K_i + K_2} \right)^2 \\
= (a - bQ)(q_i + q_2) - \left( \frac{q_i + q_2}{K_i + K_2} \right)^2 (K_i + K_2) \\
= (a - bQ)q_{CI} - \frac{q_{CI}^2}{2K_M}
\]

where \( K_M = K_i + K_2 \) and \( q_{CI} = q_i + q_2 \). The multi-plant firm’s optimization problem is essentially to choose \( q_{CI} \) for a given \( K_M \). Therefore, for a fixed \( K_M = K_i + K_2 \), any capital reallocation results in the same profits \( \pi_{M,i-1} \). Q.E.D. ■

**Unprofitable Capital Reallocation under the M-form**

For a merger between symmetric firms, \( \beta_1 = \beta_2 = \beta_S \). Under the M-form, from (A-2), \( \beta_{M1} = \frac{\beta_R + \varepsilon}{1 + \varepsilon} \), and \( \beta_{M2} = \frac{\beta_R - \varepsilon}{1 - \varepsilon} \), where \( x \equiv \varepsilon b(1 - \beta_S) \) and \( -K_1 < \varepsilon < 0 \). Then, we get \( \beta_M = \frac{2x}{1 - \varepsilon} \leq 2\beta_S \) for any \( \varepsilon \).

That is, if the insiders are initially symmetric, any capital reallocation under the M-form only worsens the merged firm’s efficiency, as \( \beta_M \leq 2\beta_S = \beta_1 + \beta_2 \). The merged firm incurs losses from reallocating capital under the M-form. The first-order condition is

\[
\frac{\partial \pi_M}{\partial \varepsilon} = a^2 \left( \frac{1}{(B_\varepsilon + 1)^4} \right) \left( 1 + \beta_{M1} \right) \left( \frac{\partial \beta_{M1}}{\partial \varepsilon} + \frac{\partial \beta_{M2}}{\partial \varepsilon} \right) + 2\beta_{M1} \left( \frac{\partial \beta_{M1}}{\partial \varepsilon} + \beta_{M1} + \frac{\partial \beta_{M2}}{\partial \varepsilon} \beta_{M2} \right) \right).
\]

(A-12)

For any \( \varepsilon \) in the range \( -K_1 < \varepsilon < 0 \), \( (\beta_{M1} - \beta_{M2}) < 0 \). Since \( \frac{\partial \beta_{M1}}{\partial \varepsilon} - \frac{(1 - \beta_S)^2 b}{(1 + \varepsilon)^2} > 0 \) and \( \frac{\partial \beta_{M2}}{\partial \varepsilon} - \frac{(1 - \beta_S)^2 b}{(1 - \varepsilon)^2} < 0 \), evaluating (A-12), we get that \( \frac{\partial \pi_M}{\partial \varepsilon} \bigg|_{\varepsilon=0} < 0 \). Thus, for a merger between two symmetric firms, the M-form is never optimal. The merger can be profitable only under complete integration.
Profitability of a Horizontal Merger between Symmetric Firms

Let $\beta_{CI} \equiv \frac{bK_{M}}{aK_{M}+1}$ be the efficiency level of the merged firm under complete integration. By construction, $K_{M} = \frac{\beta_{CI}}{b(1-\beta_{CI})}$, and $K_{1} + K_{2} = \frac{2\beta_{S}}{b(1-\beta_{S})}$. Since $K_{M} = K_{1} + K_{2}$, we get $\frac{\beta_{CI}}{b(1-\beta_{CI})} = \frac{2\beta_{S}}{b(1-\beta_{S})}$.

Thus, $\beta_{S} < \beta_{CI} < 2\beta_{S}$. The merged firm earns $\pi_{M,N-1} = \frac{a^{2}}{2b} \left( \frac{\beta_{CI} + \beta_{CI}^{2}}{2b(\beta_{CI} + \beta_{CI} + 1)^{2}} \right)$. Without merger, the combined profits of the two merging partners are $2\pi_{i}^{*} = \frac{a^{2}}{2b} \left( \frac{2\beta_{S} + 2\beta_{S}^{2}}{(2\beta_{S} + \beta_{S} + 1)^{2}} \right)$. Therefore, the merger is profitable if

$$\pi_{M,N-1} > 2\pi_{i}^{*} \Leftrightarrow \frac{a^{2}}{2b} \left( \frac{\beta_{CI} + \beta_{CI}^{2}}{2b(\beta_{CI} + \beta_{CI} + 1)^{2}} \right) > \frac{a^{2}}{2b} \left( \frac{2\beta_{S} + 2\beta_{S}^{2}}{(2\beta_{S} + \beta_{S} + 1)^{2}} \right).$$

(A-13)

Since $\beta_{S} = \frac{\beta_{M}}{2-\beta_{M}}$, (A-13) reduces to $\beta_{CI} > \frac{(\beta_{M}+1)(\beta_{M}^2-1)}{(\beta_{M}^2-1)^{2}}$. If $0 < \beta_{-M} \leq \frac{1}{3}$, this condition is satisfied for any $\beta_{CI}$. If $\frac{1}{3} < \beta_{-M} < \sqrt{2} - 1$, $1 > \frac{(\beta_{M}+1)(\beta_{M}^2-1)}{(\beta_{M}^2-1)^{2}} > 0$. In this range, $\frac{(\beta_{M}+1)(\beta_{M}^2-1)}{(\beta_{M}^2-1)^{2}}$ decreases as $\beta_{-M}$ decreases. Therefore, horizontal mergers between symmetric firms are profitable if $\beta_{-M}$ is small, $\beta_{CI}$ is large, or both. If $\beta_{-M} > \sqrt{2} - 1$, $1 > \beta_{CI}$, and the merger is never profitable.

A4. PROOF OF PROPOSITION 4

When the merged firm operates two symmetric divisions under the M-form,

(i) $\beta_{M} = 2\beta_{S} = \frac{2\beta_{S} + 2\beta_{S} - 2\beta_{S} \beta_{M}}{(2\beta_{S} + \beta_{M})^{2}} > \beta_{1} + \beta_{2}$.

(ii) Thus, $Q_{M} = \frac{a}{b} \left( \frac{\beta_{M} \beta_{M}}{\beta_{M} + \beta_{M} + 1} \right) > \frac{a}{b} \left( \frac{\beta_{S} \beta_{M}}{\beta_{S} + \beta_{M} + 1} \right) = Q^{*}$ and $P_{M} = a \left( \frac{1}{(\beta_{M} + \beta_{M} + 1)} \right) < a \left( \frac{1}{(\beta_{S} + \beta_{S} + 1)} \right) = P^{*}$, where $Q_{M}$, $P_{M}$ are the market output and the market price after the merger, respectively.

(iii) Consumer welfare increases as a result.

$$\Delta CS = \int_{Q^{*}}^{Q_{M}} (a - bQ)dQ = \frac{a^{2}}{2b(B_{M} + 1)^{2}(B + 1)^{2}} \{(2 + B + B_{M})(B_{M} - B)\} > 0.$$

[26]
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