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PROFITABLE HORIZONTAL MERGERS
WITHOUT COST ADVANTAGES:
THE ROLE OF INTERNAL ORGANIZATION,
INFORMATION, AND MARKET STRUCTURE

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Keywords: Merger, internal organizational structure, information, timing, market structure

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Profitable horizontal mergers without cost advantages: The role of internal organization, information, and market structure*

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Abstract

Merged firms are typically rather complex organisations. Accordingly, merger has a more profound effect on the structure of a market than simply reducing the number of competitors. We show that this may render horizontal mergers profitable and welfare-improving even if costs are linear. The driving force behind these results, which help to reconcile theory with various empirical findings, is the assumption that information about output decisions flows more freely within a merged firm.

1 Introduction

Although merger of two firms is frequently dubbed “fusion”, this term is quite misleading. In contrast to the fusion of atoms, the new entity that results from a merger of two firms is usually a much more intricate structure than either of the two firms. Through merger firms do not just become “bigger” they also become more complex organizations. This is empirically well documented. Prechel, Boies, and Woods (1999), for example, report that newly merged firms mostly move from the classical multidivisional form¹ to the so-called multisubsidiary organizational form, where the old firms are kept as still fully functional affiliates.²

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¹Chandler (1962) is usually credited for having been the first to conceptualize the “M-form”. A further classical reference is Cyert and March (1963).

²Zey and Swenson (1999) report similar findings.

The economics literature generally ignores such organizational issues and models a merger either as a fusion or as perfect collusion. In this paper we depart from both and draw on the above findings by modeling a merged firm as a firm with separately managed subsidiaries. We analyze how this affects market structure, profitability of firms and welfare. The main assumptions we make about mergers are very minimalistic. Instead of assuming “synergies” or cost reductions that render mergers profitable, we simply assume that within a merged firm information is exchanged more easily than between other firms.³ More specifically, we follow the observations by Prechel, Boies, and Woods (1999) according to which merging firms become affiliates in a holding company, with each affiliate having the discretion to make independent decisions, and we assume that, due to the many formal and informal links between these affiliates, one affiliate’s production plans can be observed by the other affiliate before this information is observable for firms that do not belong to the same holding company. Moreover, we allow for some time structure in production decisions. As a consequence, an affiliate among the merged firms might be able to observe the output decision of its “sibling” before deciding about its own output.

As innocent as this assumption may seem, it has dramatic consequences— for the two merging firms as well as for the market as a whole. In particular, we find that merger is profitable for the involved firms, reduces profits of outsiders and enhances welfare. All three results are in sharp contrast with the literature on mergers in markets with quantity competition that originated with Salant, Switzer, and Reynolds (1983) and help at the same time to reconcile theory with three stylized facts:

- There is no clear evidence for welfare reductions as a consequence of mergers, welfare changes go in both directions (see, for example, Pesendorfer 2000 who reports huge welfare gains for mergers in the paper industry and, for a general appraisal, Federal Trade Commission 1999).
- Competitors often suffer when other firms merge (see, for example, Banerjee and Eckard 1998).
- (Bilateral) mergers are observed in all industries, even in those where costs are unlikely to be convex (see Office of Fair Trading 1999).

³In a recent article, Nault and Tyagi (2000) argue that improved communication technologies make horizontal alliances and other horizontal organization structures more attractive and more prevalent than traditional centralised structures. Nault and Tyagi take this as a starting point for modelling coordination mechanisms in alliances of geographically dispersed firms.

There is a vast body of theoretical literature on mergers and some strands of it can accommodate some of these findings. For example, Deneckere and Davidson (1985) show that bilateral merger in Bertrand markets is profitable. This can explain why we observe bilateral mergers. However, they also show that merger in these markets reduces consumer welfare and that competitors benefit if other firms merge.⁴

The literature on mergers in markets with quantity competition (Cournot markets)⁵ is, however, at odds with all three observations. In Cournot markets mergers have only two consequences: First, they reduce the number of firms (or strategic players) acting in the market as mergers are indeed modelled as a fusion after which one firm has disappeared. Second, if costs are non-linear, they may change the cost function of the newly merged firm. This has a number of important implications:

- Mergers are only welfare-improving if firms are asymmetric and output is shifted from less to more efficient firms (Farrell and Shapiro 1990).
- Competitors benefit if other firms merge (Salant, Switzer, and Reynolds 1983).
- Bilateral mergers are only profitable if costs are sufficiently convex (Perry and Porter 1985).

A corollary to this is that bilateral mergers in *linear* markets are never profitable and always welfare-reducing.⁶ Consequently, one should observe mergers only if the cost savings are sufficiently large which seems to be in conflict with the third observation above—that there is merger activity in all industries regardless of specific production technologies. Cost effects are very hard to observe and measure. Accordingly, it is difficult or impossible to test this theory. In order to eliminate possible production cost effects from our consideration we will consider the case with linear cost.⁷ We propose a different reasoning that resolves the

⁴Cabral (1999) shows that merger in markets with differentiated products may increase consumer welfare if there is the possibility of free entry.

⁵At first sight quantity competition might be seen as of lesser importance than price competition. However, as Kreps and Scheinkman (1983) show standard Cournot analysis might be interpreted as a shortcut to analysing markets where firms have to build up capacities and then engage in price competition.

⁶This was first pointed out by Salant, Switzer, and Reynolds (1983).

⁷This assumption is mainly for purity. We will show that merger will be profitable and welfare enhancing, even with a linear technology. This result implies that, if there are additional “synergies” (e.g., cost savings due to the convexity of cost functions) the merger will be even more profitable. In other words, by focussing on linear technologies we do not restrict the generality of our analysis but rather focus on the hardest case, and a generalization to cases with “synergies” is straightforward.

puzzle but is based on assumptions can be tested more easily. As we shall show, the puzzle can be resolved by taking into consideration that merger is not a process that transforms two firms into one firm of the same type, basically eliminating one of the firms, but rather leads to a different organization: merged firms are kept as intact decision units within a more complex entity.

Our analysis comes in two parts. In the first part we assume that the merged firm has a joint headquarter that can govern its affiliates. In particular, we assume that the HQ can enforce the *sequence* in which its two affiliates decide about their output. For example, the HQ can force one affiliate to decide before the other (which then, because information flows freely between the two affiliates, will be informed about the quantity of its sibling when making its own decision). This has an important consequence for the market as a whole because the market will no longer be a simple Cournot market. Rather, the market will have the flavor of a Stackelberg market as the affiliate that decides first becomes some sort of Stackelberg leader. Of course, this leadership is partial as the outsiders will not be able to observe what the second-moving affiliate can observe. Accounting for this pattern we will introduce the following terminology. We shall call the first-moving affiliate of the merged firm a “partial Stackelberg leader” and the second moving affiliate a “partial Stackelberg follower” (or the “informed firm”). To all the other firms we shall refer as “Cournot firms” (or the “uninformed firms”). Analyzing this market we arrive at the above mentioned main conclusions: mergers can be profitable and welfare-improving even if all firms have the same linear cost functions. At the same time competitors’ profits are reduced.

In the second part of our analysis we will relax the assumption about the all-powerful joint headquarter. In fact, we shall completely abandon it (which might even more closely resemble a *multisubsidiary* form) and we will show that even in the absence of a headquarter, the same timing of decisions that the headquarter would enforce, will *endogenously* evolve. Consequently, the same Stackelberg commitment power will result endogenously and, hence, the same market outcome. Thus, even if the merged firm does not benefit from “commitment by governance” it will increase its joint profit.

The model we employ in the second part of our analysis is closely related to the literature on endogenous timing in Stackelberg markets. It closely follows Hamilton and Slutsky (1990) who show that two perfectly symmetric firms may endogenously play according to the Stackelberg solution. This happens in a two-period model in which both firms can commit themselves to a quantity in the first period. Alternatively, they can decide to wait and produce in the second period (then knowing

the other firm's decision). The only subgameperfect equilibria in this market game that are in undominated strategies are characterized by Stackelberg behavior.⁸

The remainder of the paper is organized as follows: In Section 2 we present the basic model and the benchmark case without merger. In Section 3 we describe the equilibrium outcome if firms merge and are governed by a headquarter that can impose rules for them. In Section 4 we abandon this assumption and study the model in which the timing of moves is endogenous. Finally, Section 5 summarizes and discusses our results.

2 The benchmark case without merger

We consider a market for a homogenous product with linear demand and cost. Let there be n symmetric firms. We can normalize price and unit such that inverse demand can be written as $p(X) = \max\{1 - X, 0\}$ with $X = \sum_{i=1}^n x_i$ denoting total supply and x_i firm i 's individual quantity.

Each firm chooses its supply quantity according to the following game structure. There are two production periods. A firm can choose to produce either in period 1 or in period 2. Production costs do not depend on whether a firm decides to produce early (in 'period 1') or late (in 'period 2'). Only after period 2, that is, when all firms have chosen their outputs, can each firm observe each other firm's output decision and the market opens. This reflects that production and sale do not take place instantaneously (what is assumed in most of the economics literature). Rather production takes some time and precedes selling.

However, although actual output decisions may not necessarily occur simultaneously, due to simultaneous information revelation, the output choice in the benchmark case is a standard Cournot–Nash game. Accordingly, the unique Cournot equilibrium is given by $x_i^* = \frac{1}{n+1}$. Total supply is given by $X = \frac{n}{n+1}$ and the equilibrium price by $p = \frac{1}{n+1}$. Firms' profits are $\frac{1}{(n+1)^2}$.

Note that the choice of timing of production is inconsequential in this benchmark case: Given the information assumptions, the benchmark case is structurally equivalent with the standard Cournot model with n symmetric firms. However, the additional choice of timing allows for more structure within more complex organizational forms. This is what we consider next.

⁸The main reason for this result is that playing Cournot quantities in the first period is a dominated action. (By waiting a firm can always react optimally to what its competitor has done previously.)

3 Model A: A headquarter governs merged firms

Suppose two of the n firms merge. A “holding” is formed with a joint headquarter and decision making units in each of the two affiliates, labelled L and I . As discussed briefly in the introduction, the governance structure in the merged firms is characterized by two properties. First, information flows more easily and quickly between the merged affiliates than between other firms. More precisely, we assume that the two merged firms can observe each other’s output decision immediately when it occurs. Second, the headquarter controls the sequencing of output decisions of the two affiliates and can force affiliate L to choose x_L prior to affiliate I ’s decision. Hence, when I chooses x_I , it knows the choice x_L made by affiliate L . Of course, all other firms observe x_L and x_I only at the end of period 2, at the same time when L and I also observe these other firms’ output choices. This structure is common knowledge. We refer to a merger that results in a holding with two affiliates and this information and decision structure as *a merger with enforced information sharing*.

The game which results after the merger has taken place is a sequential game without proper subgames. It can be interpreted as a market with “partial Stackelberg leadership” and we refer to the firm in the merger which moves first (L) as the “leader”. To the second firm in the merger (I) we refer to as the “informed firm”. To all other firms we refer to as the “uninformed firms”, indexed $u \in U$.

While a strategy of the leader is simply a number, its quantity x_L , the informed firm’s strategy is a *function* prescribing for each possible quantity of the leader a quantity of its own. We denote this function by $f(x_L)$. A strategy of one of the uninformed firms prescribes, strictly speaking, the period in which to produce and the quantity that is produced in this period. However, as an uninformed firm’s quantity decision is not revealed until the end of period 2, its choice of period is irrelevant. Hence, we can simplify an uninformed firm’s strategy to a number, its quantity x_u .

This game has an infinite number of Nash equilibria, similar to a standard Stackelberg game. In contrast to a standard Stackelberg game the number of equilibria cannot be reduced by simple backward induction, i.e., by requiring subgame perfection. However, by requiring that the informed firm reacts optimally to its information, i.e., by requiring sequential rationality we can achieve a unique solution.

As the derivation of the sequentially rational equilibrium is slightly tedious we refer the full analysis of the game into the Appendix. The results are this: The leader supplies $x_L^* = \frac{2}{n+2}$. Uninformed firms choose

$x_u^* = \frac{1}{n+2}$. And the informed firm chooses the function $f^*(x_L) = \frac{2}{n+2} - \frac{1}{2}x_L$ which yields in equilibrium $x_I^* = \frac{1}{n+2}$.

At first sight it may seem surprising that uninformed firms choose the same quantity as the informed firm. After all, one might have suspected that the informed firm “suffers” more from its knowledge about the leader’s quantity than the uninformed firms do. However, in equilibrium this cannot happen. The key to understanding this property is the following observation: In equilibrium all firms know the quantities of all other firms. (Of course, about the informed firm they only know the equilibrium function $f^*(x_L)$, but since they know x_L^* they also know x_u^* .) Thus, each uninformed firm has to maximize $x_u(1 - X_{-u}^*)$ with X_{-u}^* being the total quantity of all firms except u . At the same time the informed firm has to choose $f(x_L)$ such that $x_i(1 - X_{-i}^*)$ is maximized. But this implies that the first order conditions for uninformed firms and the informed firms are symmetric and $x_i = x_u$ *must* hold in equilibrium.

Having solved the market game after the merger we can now proceed by analyzing a) whether this merger is profitable, b) whether it decreases or increases welfare, and c) how it affects the profits of the merged firms’ competitors. All questions are not hard to answer.

In order to analyze the profitability of the merger we have to compare the joint profit of the two firms before and after they merge. Before, the joint profit is $\frac{2}{(n+1)^2}$. After, it is $\frac{3}{(n+2)^2}$. (Simply note that the price after the merger is $\frac{1}{n+2}$.) Thus, the change in profits is $\frac{3}{(n+2)^2} - \frac{2}{(n+1)^2} = \frac{n^2-2n-5}{(n+2)^2(n+1)^2}$ which is positive if $n^2 - 2n - 5 > 0$, i.e., if $n \geq 4$.

In order to analyze social welfare it is (due to linearity) sufficient to compare the induced change in total quantities which is $\frac{n+1}{n+2} - \frac{n}{n+1} = \frac{1}{(n+2)(n+1)}$ and unambiguously positive. Thus, the merger is welfare improving. Finally, we find that a competitor’s profit is unambiguously reduced (from $\frac{1}{(n+1)^2}$ to $\frac{1}{(n+2)^2}$).

We summarize our results in

Proposition 1 *In symmetric linear Cournot markets with at least four firms a merger with enforced information sharing is profitable and welfare-improving. Furthermore, it reduces competitors’ profits.*

4 Model B: Merger without headquarter

We take the same setup as above. Each of the two merged firms maximizes its own profit. The only aspect we alter is that the two merged firms must now autonomously decide in which period to produce. Thus, we shall speak of *a merger with endogenous information sharing*.⁹ Let

⁹This term does not preclude that merged firms won’t share information. However, as we will show below, they will.

the two merged firms be indexed by j . Then a merged firm's strategy is a 3-tuple $(x_i^1, f_i(x_j^1), x_i^2)$ where x_i^1 either specifies an output for period 1 or indicates that the firm waits, i.e. $x_i^1 \in \mathbf{R} \cup \{W\}$ with W indicating the decision to wait. The function $f_i(x_j^1)$ is a mapping $\mathbf{R} \rightarrow \mathbf{R}$ specifying the firm's reaction in case it has decided to wait while the other firm has chosen $x_j^1 \neq W$. Finally, x_i^2 specifies firm i 's quantity decision for the case that both firms have decided to wait.¹⁰ An uninformed firm's strategy can, as above, be simply described by a number, i.e., its quantity choice x_u that is taken in either of the two periods.¹¹

We focus on equilibria in pure strategies. Some observations about possible subgame perfect equilibria of this game can be made.

1. If one of the merged firms decides to wait, the other will produce in the first period. (The waiting firm will adjust its output to the first mover's quantity or, to put it differently, regardless of the behavior of the uninformed firms there is a Stackelberg-leader advantage.)
2. In any subgameperfect equilibrium in which the two merged firms produce in the first period *all* firms produce standard Cournot quantities $\frac{1}{n+1}$. (Otherwise some firm would obviously not play a best reply.)
3. All firms producing Cournot quantities in the first period is an equilibrium in dominated strategies. (For one of the merged firms, playing Cournot in the first period can never be better than waiting. On the other hand, waiting can clearly be better than playing Cournot.)
4. If one of the merged firms decides to wait, i.e., decides to produce in the second period, it will produce the same equilibrium quantity as each uninformed firm. (This follows from the same logic as above.)

Taken together, these observations dramatically narrow down the set of possible solutions. Most importantly, we find that *(i)*, *(ii)*, and *(iii)*

¹⁰Note that, as Hamilton and Slutsky (1990), we rule out that a firm which has chosen to produce in the first period can produce again in the second period. This assumption can be justified by assuming that firms have to make some arrangements for production actually to take place and that, consequently, producing in two periods instead of one causes fixed costs the firms wish to avoid. However, our results are nevertheless robust in the sense that allowing production in two periods would still yield the same outcomes (see Ellingsen, 1995, for details).

¹¹As before, the timing of a firm not involved in the merger is irrelevant, as information about output decisions before the end of period 2 is available only within the merged firm, i.e., an uninformed firm can neither observe the output of others at the end of period 1 nor can its output, if it produces in period 1, be observed by others before the end of period 2.

imply that one of the merged firms has to move first while the other has to wait. This implies that the same market structure results as in the case with a headquarter. Consequently, the firms will also produce the same quantities such that we get identical market outcomes as in the case with a headquarter.

Proposition 2 *In symmetric linear Cournot markets with at least four firms a merger with endogenous information sharing is profitable and welfare-improving. Furthermore, it reduces competitors' profits.*

5 Discussion

Empirical evidence on the effects of mergers is mixed even where standard theory makes unambiguous predictions. For example, Banerjee and Eckard (1998) find that during the first great merger wave from 1897 to 1903 competitors of merging firms suffered significant losses which is inconsistent with the traditional modelling of mergers. The observation is, however, consistent with our approach which predicts such losses.

Our approach also predicts the opposite of standard models with respect to the profitability of mergers in a market with linear costs and with respect to their welfare implications. As the new wave of mergers still is irresistible we observe mergers in virtually all kinds of markets, including those where the linear-cost assumption seems well-justified. In the traditional approach where one firm “disappears” after a merger this is puzzling. But empirical evidence clearly shows that firms acquiring other firms typically keep target management (Hubbard and Palia 1999) and that the multisubsidiary form (which is implicitly assumed in our model) is the standard organizational form of a merged firm (see, for example, Prechel, Boies, and Woods 1999 or Zey and Swenson 1999). As we have shown, such an organizational form may have a significant impact on the structure of the market which provides a new rationale for mergers.

In the first part of our analysis we show that if a joint headquarter can govern the (timing) decisions of its affiliates this may render a merger profitable even in the absence of cost advantages through the merger. One assumption drives this result— within a merged firm information flows more quickly and freely, and, due to this, clever governance can induce a commitment advantage for the merged firm even if no other firm can observe what its affiliates are doing. In the second part of our analysis we abandon the assumption of a headquarter and show that, if all firms are free to choose when to produce, the same market structure results as in the presence of a headquarter governing the merged firm. As in Hamilton and Slutsky's (1990) model of endogenous timing (which our

model generalizes by adding uninformed firms) we observe endogenous (partial) Stackelberg leadership. Thus, it turns out that two simple assumptions which both seem quite realistic make a merger profitable—the assumption that production does not take place at one and the same instant for all firms and that, as pointed out above, a merger may create information channels through which affiliated firms can observe what other affiliates do.

The policy implications of our analysis are twofold: Socially, mergers may be more welcome than traditional views suggest. This, however, may depend on the organizational form merged companies choose. Hence, in judging the (anti)competitive effect of mergers governing bodies may wish to be mindful of how the merged firm plans to operate.

On a more general level, the model suggests that one can only fully understand the consequences of merger when carefully considering its consequences for market structure. If one does, the standard view that mergers have to induce cost advantages to be profitable and/or welfare-improving is no longer warranted.

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APPENDIX

To solve the game of Section 3 let us proceed step by step.

First, consider an uninformed firm u and let X_U denote total output of all uninformed firms. Its best-reply correspondence assigns to each possible combination of x_L , $f(x_L)$ and $X_{U \setminus u} = \sum_{i \in U \setminus \{u\}} x_i$ a unique quantity x_u which maximizes $x_u(1 - x_L - f(x_L) - X_U)$. Thus firm u 's best reply is given by

$$x_u^* = \frac{1}{2}(1 - x_L - f(x_L) - X_{U \setminus u}). \quad (1)$$

The informed firm's best-reply correspondence assigns to each possible combination of x_L and X_U a function f such that $f(x_L)(1 - x_L - f(x_L) - X_U)$ is maximized. Therefore,

$$f^*(x_L) = \frac{1}{2}(1 - x_L - X_U) \quad (2)$$

has to hold. It is important to notice that there is for each combination of x_L and X_U an infinite number of functions f^* fulfilling this condition. The best-reply correspondence only demands that f^* assumes a certain value at one particular point and says nothing about the shape of the function elsewhere. Obviously, this is the reason for the multiplicity of equilibria.

However, requiring sequential rationality narrows down the set of functions for firm I . Sequential rationality demands that firm i reacts optimally in all its information sets. As the information sets of firm I are single-valued there are no problems of specifying I 's beliefs. Firm I can only react to what it knows about x_L . Taking into account that (2) has to hold, this implies that firm i must choose a function of the form

$$f^*(x_L) = Z - \frac{x_L}{2}. \quad (3)$$

In essence, this means that, demanding sequential rationality, we now can analyze a “truncated game” where Z is firm I 's only choice variable. This means that we can rewrite (1) and (2) as follows. For a firm u

$$x_u^* = \frac{1}{2}(1 - \frac{1}{2}x_L - Z - X_{U \setminus u}) \quad (4)$$

has to hold and for firm I

$$Z^* = \frac{1}{2}(1 - X_U). \quad (5)$$

Notice that (5) ensures uniqueness.

Next, we can focus on the leader L . In the truncated game its best-reply correspondence assigns to each combination of Z and X_U a unique quantity x_L maximizing $x_L(1 - \frac{1}{2}x_L - Z - X_U)$. Accordingly,

$$x_L^* = 1 - Z - X_U. \quad (6)$$

Using the symmetry of the uninformed firms, we can now solve the following simultaneous equations

$$\begin{aligned} x_u^* &= \frac{1}{2}(1 - \frac{1}{2}x_L^* - Z^* - (n-3)x_u^*) \\ Z^* &= \frac{1}{2}(1 - (n-2)x_u^*) \\ x_L^* &= 1 - Z^* - (n-2)x_u^* \end{aligned} \quad (7)$$

which gives $x_u^* = \frac{1}{n+2}$, $x_L^* = \frac{2}{n+2}$, and $Z^* = \frac{2}{n+2}$. This implies that the informed firm chooses $f^*(x_L) = \frac{2}{n+2} - \frac{1}{2}x_L$ which yields in equilibrium $x_I^* = \frac{1}{n+2}$.