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ABSTRACT

Consolidations and the Sequence of Acquisitions to Monopoly

by Petri Lehto and Mihkel M. Tombak*

We examine horizontal merger activity between firms which have differing costs. Upon merging owners can transfer technology to an acquired firm and can decide whether to operate their firms as separate entities in the product market or consolidate their acquisitions. Thus, in our analysis, mergers can exhibit both an efficiency effect and a market power effect. The purchase prices of target firms are determined via a bargaining game. We find that the largest firm is likely to be acquisitive and that the optimal sequence of mergers entails targeting the next largest rival firm. We find that not consolidating an acquired firm can reveal the intention to acquire additional firms. The optimal sequence of mergers with technology transfers and no consolidations is found initially to be welfare improving. Ultimately, however, the acquisitions lead to consolidation and a decrease in total welfare.

ZUSAMMENFASSUNG

Konsolidierungen und die Folge von Akquisitionen zum Monopol

In dem Beitrag werden horizontale Unternehmenszusammenschlüsse zwischen Unternehmen mit unterschiedlichen Kosten analysiert. Für das erwerbende Unternehmen stellt sich die Frage, ob es Technologie zu einer erworbenen Firma transferieren sollte und, ob es das erworbene Unternehmen als getrennte Einheit im Produktmarkt betreiben oder mit dem fusionierten Unternehmen zusammen am Markt operieren will. In der Analyse wird der Effizienzeffekt und der Marktmachteffekt berücksichtigt. Der Kaufpreis des zu erwerbenden Unternehmens wird in einem "bargaining game" ermittelt. Im Ergebnis zeigt sich, daß das größte Unternehmen wahrscheinlich das erwerbende sein wird und daß die optimale Reihenfolge von Fusionen sich auf das nächst größte Konkurrenzunternehmen bezieht. Außerdem zeigt sich, daß die Nichtkonsolidierung mit erworbenen Unternehmen daraufhin deutet, daß eine Intention zum Erwerb weiterer Firmen vorliegt. Die optimale Folge von Fusionen mit Technologietransfer und ohne Konsolidierungen erhöht anfangs die Wohlfahrt. Letztlich aber führen die Erwerbungen zur Konsolidierung und zu einem Absinken der Gesamtwohlfahrt.

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1. Introduction

The takeover wave of the 1980s peaking in 1986 with 3,300 takeover transactions valued at about $180 billion in the U.S. has stimulated considerable interest among economists. Some claim that this merger activity has had a positive impact on the economy. For example, Jensen (1988) estimates that shareholder value in the U.S. increased by $396 billion during 1977-1986 as a result of the merger activity. It could be argued, however, that this value added has come from consumers and that mergers have had a negative net impact on the economy. Which view one holds ultimately depends on whether mergers are seen as being motivated by increased market power or as being triggered by improved efficiency. There is, however, no reason to believe that these motivations would be mutually exclusive. In this study we examine horizontal firm acquisitions behavior where both motives operate and where firms with market power choose when to exercise this power.

A number of empirical studies (see the surveys by Jensen and Ruback, 1983, and Jensen, 1988) seem to indicate that mergers have been beneficial for shareholders and society. These investigations are based on event studies using share prices of various firms involved before and after a merger or the antitrust challenge to a merger. Most of these studies do not distinguish between increased market power or efficiencies as the source of abnormal returns. In a few studies the movement of share prices has been interpreted as not consistent with the market power hypothesis (Eckbo, 1982, 1992, Stillman, 1983). Nevertheless, the market power hypothesis has support in a number of detailed case studies (e.g., in the tobacco industry, Burns, 1986; in the railroad industry, Prager, 1992; in the airline industry, Kim and Singal, 1993, and Peteraf and Reed, 1994; and in the steel industry, Mullin, Mullin, and Mullin, 1995).

The market power motive has mixed support from many normative studies. These studies use game theoretic models to examine the incentive to merge of firms engaged in either Cournot or Bertrand competition in various types of product markets with diverse production technologies. Salant, Switzer, and Reynolds (1983) found that with symmetric firms engaged in Cournot competition mergers motivated by market power would be unlikely as they need to encompass 80% of the market. This result is driven by the contraction in output by the consolidated firm with the ensuing „business stealing“ by its rivals. Perry and Porter (1985) examined a general model encompassing that of Cournot where firms had differing convex costs and found that firms had somewhat stronger incentives for mergers since the incentive to engage in business stealing is diminished. Kamien and Zang (1990) introduce the important idea that owners may not consolidate an acquired firm thus eliminating the business stealing effect. They compare a model where firms consolidate after an acquisition to one where firms always operate decentrally. With or without the exclusion of this business stealing externality, in their model of

firms simultaneously bidding for one another, Kamien and Zang found limits to monopolization. Our analysis differs from the above in that we use an asymmetric Cournot model with efficiency gains from acquisitions, consolidation is endogenous, and firm acquisitions take place sequentially.

Farrell and Shapiro (1990) analyze the welfare implications of a merger using a Cournot model with general demand functions and show that cost efficiencies must be significant in order for consumers to benefit. Deneckere and Davidson (1985), investigated a Bertrand model with differentiated products and found that producers benefited from mergers but consumers did not. The above literature is based on static models. Ravenscraft and Scherer (1987), among others, have noted that mergers occur in waves. This then has initiated investigations of the dynamics of mergers (Kamien and Zang, 1991, 1993, and Gowrisankaran, 1995a, 1995b) where the interdependence between mergers is explored. However, even in this setting monopolization is uncommon. Our study also exhibits a sequential acquisition process but unlike the previous analyses the acquisition prices are determined via a bargaining game and the consolidation decision has an essential impact on future negotiations. Furthermore, we examine the welfare results of the merger process.

In what follows we first examine a few cases of firms making a sequence of horizontal acquisitions and identify regularities in those processes. We then analyze a three-stage model which explains those phenomena that occur. In the first stage, we consider the acquisitions as a sequence of interrelated bargaining games. In the second stage, owners of acquiring firms can choose between consolidating with the newly acquired firm or operating it as a separate firm. Consequently, the exercise of market power is endogenous in our inquiry. In the final stage, we employ an asymmetric Cournot model where firms have differing marginal costs. Acquiring firms can transfer technology, that is, can reduce the marginal costs of the target firms. We thus introduce an efficiency effect in our analysis. We then examine which acquisitions take place, in what sequence, and whether the optimal sequence will lead to monopoly. While we find new results concerning the monopolization issue our analysis allows us to reinterpret some of the empirical literature. Given that we have both market power and efficiency effects of mergers we finally examine the welfare implications of the sequence of acquisitions.

We find that the largest (most efficient) firm is likely to be the acquirer. This firm, if it faces no restraints, will purchase firms in the order of descending efficiency operating its acquisitions in a decentralized fashion until it achieves monopoly. If this sequence were to be halted (for example, due to antitrust action) the firm would then under certain circumstances consolidate. Failure to consolidate under those conditions reveals an intention to continue acquiring rival firms. When acquisitions are not consolidated the acquisitions increase both consumer and producer surpluses due to the gains in efficiency. Ultimately, however, consolidation at monopoly would involve a transfer of

welfare from consumers to producer and a loss of total welfare despite the gains in efficiency.

In the next section we describe a number of case studies where firms have engaged in a sequence of mergers. We then develop our three-stage model. As we seek subgame perfect equilibria the remainder of the study is organized as follows. We first derive the Cournot equilibrium quantities, price, and profit levels for the different firms. We then address the question of how an owner would organize his firms after an acquisition. Subsequently, valuations of firms are determined. From these valuations the optimal pattern of acquisitions is derived. We then examine the welfare ramifications of this series of acquisitions. Finally, we summarize and discuss the results.

2. Some Case Studies

In this section we review a few case studies of firms which have attempted multiple horizontal mergers and acquisitions. As in the theoretical section to follow, we focus on the sequence of acquisitions in terms of size of the targets. We note when a rationale is given for a particular choice of target. Also we note how operations changed *ex post* of the acquisition. That is, we observe whether the target firms' products were merged with that of the acquirer or if the marketing operations of the target were kept distinct. Three case studies are summarized - American Tobacco Co., Swedish Match, and Service Corporation International.

American Tobacco Co.

Burns (1986) examined the purchasing prices of 43 competitors acquired by American Tobacco Company and two affiliated companies in order to establish dominant positions in the tobacco industry. Ultimately, American Tobacco bought approximately 250 firms in the industry and achieved average market shares during the period 1900-1910 of 77.2%, 68.8%, 90.7%, and 73.9% in the plug, smoking, snuff and fine cut markets, respectively.

While Burns (1986) focuses on the predatory pricing effect on purchase prices, there are two important observations of the behavior of the Company for the purposes of this study. The first observation is that rivals were acquired sequentially. This may be due to the sheer number of firms to be acquired for effective market control.

The second observation concerns the sequence of acquisitions. In particular, it was observed that

> „Evidently, the American Tobacco Company attempted to buy its largest and most expensive rivals first and preyed on them if necessary, while usually acquiring smaller firms only after it was well established in each branch of the industry“
>
> Burns (1986, pg. 279)

Furthermore, often when companies were acquired their brands continued to be sold which indicates the retention of some degree of competition between brands in the product market.

Swedish Match

The Kreuger Group (Aktiebolaget Kreuger & Toll) and its successor firm Swedish Match (Svenska Tändsticks Aktiebolaget) had grown throughout the 1920's via a series of acquisitions by its owner Ivar Krueger. By the mid-1930's it had grown to a group of 70 manufacturing companies in 31 countries. By the end of the 1930's it accounted for approximately 60% of the world's exports of matches (Olsson, 1993) and 20% of world sales (Lindgren, 1979, Table 16). This, however, gives a conservative perception of its market control as much of the remaining market was controlled indirectly through cartel agreements and through minority shareholdings in other match producing companies. Swedish Match had a policy of obtaining control of prices and quantities through a combination of the purchase of competing factories, match machine manufacturers and sales agents and cartel agreements (Lindgren, 1979, pg. 111).

Swedish Match obtained market power in Belgium by a concentrated campaign of acquisitions in the summer of 1920 of all but one of the Belgian manufacturers. Those acquisitions were assembled under the name Fabrique Belges d'Allumettes. Control was achieved with a market sharing agreement on August 1, 1920 with the largest Belgian competitor Union Allumettière (Lindgren, pg. 177)[1]. In 1925 Union Allumettière came under direct control as Swedish Match acquired a majority shareholding. Subsequent to all Belgian manufacturing coming under the control of Swedish Match there was a formal merger between Union Allumettière and Fabrique Belges d'Allumettes in 1929 under the name of Union Allumettière SA (Lindgren, Chap. 2, Footnote 12). In Portugal Swedish Match purchased control the largest match producer Sociedade Nacionale de Phosphoros in the beginning of 1931. Then in October 1932 this company in turn gained control over one of the two remaining independent manufacturers Companhia Lusitana de Phosphoros. By the end of 1932 a cartel agreement on Portugese market shares was

[1] Swedish Match made its first takeover attempt against the largest firm Union Allumettiere but failed.

reached with the remaining competitor Fosforeira Portuguesa (Lindgren, Table 20, Footnote 3). Again, generally the larger firms were acquired first. Furthermore, separate brands of matches were kept on the market and output restrictions occurred only once market control was achieved.

Service Corporation International

On September 24, 1996 Service Corporation International (SCI) the largest funeral home and cemetery company in North America made a takeover offer for second largest firm in that industry, The Loewen Group, for US$ 4.1 billion. A successful takeover would „remove what has become SCI's impediment to eternal growth: Loewen's emergence as a rival bidder for small prey" (Economist, 1996). The industry generates annual revenue of $16 billion in North America and is highly fragmented (89% of the 23,500 funeral homes in the U.S. and Canada are owned by independent operators, Martin, 1996). High barriers to entry exist due to location, zoning and other regulations, the high fixed costs of building new funeral homes, and due to the pre-need sales backlog of existing competitors. The industry has been going through a period of rapid consolidation with the three largest capitalization companies (The Loewen Group, Service Corporation International (SCI), and Stewart Enterprises) making acquisition expenditures totaling approximately $1.2 billion and $1.8 billion in 1994 and 1995, respectively. Loewen has focused on the acquisition of rural homes while SCI and Stewart concentrate on urban properties.

The acquisitions strategy of these large consolidators has been to purchase smaller regional acquisition-oriented companies and small family-owned businesses.

> „The consolidators place a great deal of importance on the geographic proximity of the property in relation to other properties that they already own, and the ability to acquire a group of properties in a region, because it enables the implementation of clustering strategies. Clustering provides opportunities to capitalize on economies of scale, for example, by enabling a company's various facilities to share vehicles, and employees, to reduce administrative expenses, ..."
>
> Martin, 1996, page 16.

Thus there can be efficiencies due to acquisitions in this industry. Clustering, however, can also generate market power as indicated by the four consent orders issued by the Federal Trade Commission restricting SCI from making acquisitions in ten areas of the U.S. over certain time periods.

Many of Loewen's acquisitions of family-owned businesses are initiated through its regional partnership program. This program allows former owners with the mandate,

resources, and incentive to grow their regional companies through acquisitions. These regional partners retain up to 10% interest in the future appreciation with the eventual purchase by Loewen of the retained interest based on a prearranged formula. Thus Loewen has ownership but the operations of the businesses are to some degree decentralized. The Loewen Group had made the largest acquisition in the previous two years in North America with aid in financing from a partner (Blackstone Capital, a merchant banking firm) by securing the right to purchasing Prime Succession for $295 million. Prime Succession is a venture capital backed consolidator which started in 1992 with the objective of being a funeral home/cemetery acquisition vehicle and rapidly became the fourth largest operator in North America. Thus, „Loewen eliminate[d] a strong acquisition competitor“ (Martin, 1996, page 14). These cases illustrate that a motivation for making acquisitions of large competitors could be to eliminate counter-offers for future acquisitions.

The first two case studies are well documented (usually as a result of anti-trust litigation) due to their (often flagrant) attempt at obtaining market power. Frequently other means for obtaining market power were used in conjunction with the takeover offer such as predatory pricing or offers to join in a cartel arrangement. What is striking, however, is that in such disparate cases across industries and across countries, there was a sequential process of mergers and acquisitions and that this sequence usually consisted of acquiring the larger firms first. As shown in the third case, one rationale for buying the larger competitors first could be to eliminate acquisitions competitors. Also notable, in many cases, the brands of the acquired firms were retained in the product market. It is these regularities in the sequence of acquisition and the decentralized operation of acquired firms for which we seek theoretical rationales. We now turn to formally modeling a sequential process of acquisition.

3. The Model and Analysis

We model industry consolidation as a sequential process involving the iteration of three stages. First, there is a stage in which an acquiring firm chooses a target firm and engages in a bargaining game with the target. Secondly, there is a consolidation stage where an owner can choose between operating his firms in either a decentralized or a centralized manner. Finally, there is a product market competition stage in which the remaining firms in the industry compete with homogeneous products. Each iteration represents a round where one acquisition takes place. This iterative process continues until there are no more gains to be had from any firm acquisition. The bargaining is conducted between a pair of firms and is of the Nash bargaining type. As we assume complete information of the relative efficiencies and the resulting payoffs, the reservation price of the target firm would be the price that another firm will be willing to pay or its

present profits. The acquiring firm, once it has successfully purchased a rival firm has the option to operate his original firm and any acquired firms as separate firms competing against each other in the product market. This then determines the number of firms competing in the product market stage. We also assume that the acquiring firm is more efficient and can transfer technology such that the acquired firm then becomes equally efficient. Thus we include in our analysis the prospect of welfare improving mergers via increased industry efficiency. This improvement in welfare, however, can be mitigated through the exercise of market power. We begin with the analysis of the final, product market competition stage.

Product Market Competition between Asymmetric Firms

We assume that there are n firms producing a homogeneous good where the firms can be rank ordered according to their marginal costs with firm 1 having the lowest marginal cost. Let c_i represent the marginal cost of firm i where $c_1 < c_2 < c_3 < ... < c_n$. These marginal costs can then be represented by differences from that of the most efficient firm, i.e., $c_j = c_1 + \varepsilon_j$ where ε_j is the difference in marginal costs between the jth firm and firm 1. We also assume a linear inverse demand function $P = \alpha - \beta Q$ where Q is the industry output and P is the price. Under perfect information the Cournot equilibrium outputs, price and profits are given by:

$$q_i^* = \frac{\left(a - c_1 - ne_i + \sum_{j\neq i}^{n} e_j\right)}{b(n+1)}, \qquad P^* = \frac{\left(a + nc_1 + \sum_{j=2}^{n} e_j\right)}{n+1},$$

and,

$$p_i^* = \frac{\left(a - c_1 - ne_i + \sum_{j\neq i}^{n} e_j\right)^2}{b(n+1)^2}, \text{ respectively.} \qquad (1)$$

The derivation of the above expressions are given in Appendix A.

From the above we can see that firms equilibrium profits decrease with the number of rivals in the product market or as those rivals become more efficient. An acquisition may result in both a reduction in the number of firms in the product market as well as an increase in efficiency of rival firms for firms not party to the transaction. Hence for those firms outside a merger the transaction can have ambiguous effects on equilibrium profits.

The Operation of Multidivisional Firms

We now examine how a multidivisional firm would operate, that is, what happens when there is one owner of several firms in an industry. This will be useful in determining the industrial structure *ex post* a merger. There are two considerations; one is how production is organized, the other is how the marketing of products is organized.

On the production side we assume that a technology transfer takes place after a merger such that the less efficient firm becomes as efficient as the more efficient firm by which it is acquired. In other words, it is assumed that technology transfers only go from more efficient to less efficient firms. This could be achieved, for example, by consolidating production within the plant of the more efficient firm. This, however, does not necessarily imply consolidation on the marketing side. General Motors is an example where there is consolidated production and decentralized marketing. GM often produces cars for different sales divisions (Buick, Oldsmobile, Chevrolet) on the same production line.

With respect to the organization of the marketing function of newly merged firms the owner(s) could choose between operating a decentralized organization or they could consolidate the marketing organizations of the two firms.[2] Here we use the terminology of Kamien and Zang (1990) who refer to a decentralized firm as being one which continues to operate *ex post* a merger as two separate firms in the product market. Consolidation implies that the merged firm would act as one entity in the product market. With decentralization the owner can make use of strategic delegation (Fershtman and Judd, 1986) to credibly commit to a higher combined output. Thus, after acquisitions of a set of firms A by firm *i* the combined profits of the firms would be

$$p_{iA} = MAX\left[\frac{m+1}{b(n+1)^2}\left(a - c_1 - (n-m)e_i + \sum_{\substack{k\neq i \\ k\notin A}}^{n} e_k\right)^2, \frac{1}{b(n-m+1)^2}\left(a - c_1 - (n-m)e_i + \sum_{\substack{k\neq i \\ k\notin A}}^{n} e_k\right)^2\right] \quad (2)$$

where n is the number of firms *a priori* the merger ($n \geq 2$) and m is the number of firms that have been acquired by firm *i*. In other words, the owner of the firms could choose between operating the firms as separate entities (the first profit expression in the square brackets) or consolidating the m+1 firms (the second profit expression). Considering a firm, which does not regard possible subsequent mergers, leads to the following lemma.

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[2] Schwartz and Thompson (1986) study the strategic use of divisionalization to discourage entry and provide other rationales for multiple competing divisions.

Lemma 1: *A firm not considering future acquisitions will consolidate in the product market if and only if*

$$m \geq m^* = n + \tfrac{1}{2} - \sqrt{\tfrac{5}{4} + n}\ .$$

Proof:

From (2) the maximum is obtained by decentralization of the firms when

$$\frac{m+1}{(n+1)^2} > \frac{1}{(n-m+1)^2}$$

which implies the condition in the lemma where m^* is the root ($m^* \leq n-1$) at which the above holds as an equality.

Q.E.D.

The above Lemma examines the decentralization/consolidation decision of an acquiring firm in isolation from its other mergers. The Lemma provides a condition under which consolidation is more profitable than decentralized operations. If the owner of the merged firms were to consider subsequent mergers its consolidation behavior is generally different as it would wish to keep the potential target firms small.

Decentralized marketing organizations arise since in the event of a merger an owner may want to prevent any positive spillover to his rivals. If the owner of two firms consolidates their operations then the consolidated firm's output would decrease and the rivals would engage in business stealing since quantities are strategic substitutes. Consequently, an owner of an acquiring firm would not want to reduce the overall number of firms competing in the product market in the presence of other owners. Conversely, rival firms would prefer the consolidation of merging firms. Once an owner has gained control over the entire industry then there will be an incentive to centralize operations and reduce output to the monopoly level. The condition in the proof of the Lemma is that found by Salant, Switzer, and Reynolds (1983) in their analysis of Cournot's example (their expression (3′), page 191). Thus their result of potential merger losses is robust to efficiency differentials in an industry if industry structure is treated as exogenous.

Lemma 2: A monopolizing firm consolidates only when it has control of the market.

Proof:

If m = n-1 there is no possibility of future acquisitions, the condition in Lemma 1 holds and the firm consolidates. For any m < n-1, the firm compares the surpluses from

mergers when operating in a decentralized manner after the acquisition to consolidating after the merger. As consolidation affects the purchase prices of subsequent rounds of acquisitions we must examine the surpluses from three rounds of mergers in order to assess the effect of consolidating in the m^{th} round as opposed to consolidating on the $m+1^{th}$ round. Firm *i* would operate in a decentralized manner until round m if:

$$\left[p_{iA}^{D}(m)-p_{iA'}^{D}(m-1)-p_{j}^{D}(m-1)\right]+\left[p_{iA''}^{C}(m+1)-p_{iA}^{D}(m)-p_{j}^{D}(m)\right] \geq \left[p_{iA}^{C}(m)-p_{iA'}^{D}(m-1)-p_{j}^{D}(m-1)\right]+\left[p_{iA''}^{C}(m+1)-p_{iA}^{C}(m)-p_{j}^{C}(m)\right]$$

where the superscripts D and C refer to decentralized and consolidated operations, respectively and the parameter in the parenthesis signifies the round of acquisition. For example, $p_{iA}^{D}(m)$ is the expression on the R.H.S. of the MAX function in (2) and $p_{iA}^{C}(m)$ is the L.H.S. of that function. The L.H.S. of the above expression is the sum of surpluses if the firm consolidates in the $m+1^{th}$ round of acquisitions the R.H.S. is the sum of surpluses from consolidating on the m^{th} round. After canceling terms this condition becomes

$$p_{j}^{D}(m) \leq p_{j}^{C}(m)$$

$$\Rightarrow \quad \frac{1}{b(n+1)^2}\left(a-c_1-ne_j+me_i+\sum_{\substack{k\neq j\\ k\notin A}}^{n}e_k\right)^2 \leq \frac{1}{b(n-m+1)^2}\left(a-c_1-(n-m)e_j+\sum_{\substack{k\neq j\\ k\notin A}}^{n}e_k\right)^2$$

which holds for $e_j \geq e_i$.

Q.E.D.

The Lemma states that owners do not make use of their market power until the ultimate acquisition if they plan to monopolize the industry. The reason for this is that a premature consolidation would raise the Cournot profits of unacquired firms due to the „business stealing“ effect and thereby decrease the surplus of any subsequent merger. Summarizing the implications of the above two lemmas yields

Proposition 1: The decision not to consolidate an acquired firm when $m \geq m^*$ reveals the intention to acquire additional firms.

Proof: It follows from Lemmas 1 and 2.

If there is a consolidation after an acquisition of a firm then the conditions in Lemma 1 hold and either the firm considers the purchase a one-shot deal, has attained control of the market, or is prevented in some way from achieving monopoly (through, for example, antitrust regulations). For example, if n = 6 then m^* = 3.8 and if an owner has

acquired 4 firms and does not consolidate this would be an indication that the owner plans on purchasing the remaining independent firm in the industry. Thus industry analysts and antitrust regulators may be able to infer the acquisition strategy of a firm from its behavior in managing previous mergers.

The Valuation of Mergers

In this section we examine the first stage where firms evaluate a merger considering all other firms and determine at which prices they would be willing to purchase rival firms and at which they would be willing to sell their firm to a rival. These valuations depend on the profits *ex post* the merger as well as on the purchase price. We assume that there is an incentive for more efficient firms to merge with their less efficient rivals, i.e., that technology transfers occur from acquirers to target firms. The value of an acquisition to the acquiring firm will depend on the *ex ante* and *ex post* profits of the acquiring firm and on the purchase price. That is,

$$V_{ij} = p_{ij} - p_i - PP_{ij},$$

where, V_{ij} is the value of the merger to firm *i* when it acquires firm *j*, p_{ij} is the combined Cournot equilibrium payoff of firms *i* and *j* as defined in (2), and PP_{ij} is the purchase price firm *i* pays for firm *j*. This purchase price, in turn, is the result of a bargaining game between firm *i* and *j*. If we were to assume that both firms have identical bargaining power during the negotiations then the solution to the bargaining game is that of the Nash Bargaining Solution,[3] i.e.,

$$PP_{ij} = \frac{1}{2} \cdot \left(p_{ij} - p_i + RV_j \right).$$

While there is reason to believe that the acquiring firm may be under more time pressure (due to financing of the merger, or other factors) which would result in the target firm shareholders appropriating a greater proportion of the surplus, we ignore such considerations for the moment. Probably of greater concern is the fear of a „white knight“ or counteroffer. This is taken into consideration in our evaluation of the reservation value.

As in many bargaining situations the purchase price above depends considerably on the reservation value of the target firm. This, in turn, relies on the information set of the target firm. If we assume that there is complete information of the relative efficiencies and payoffs then the target firm would know the valuations of all other firms in that round.

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[3] A bargaining game of alternating offers will yield the same subgame perfect equilibrium solution under certain conditions (Osborne and Rubinstein, 1990).

Thus,

$$RV_j = MAX\left[\underset{k\neq i}{MAX}\left(p_{kj} - p_k\right), p_j\right]. \qquad (3)$$

The reservation value of a firm would be the maximum valuation of firms not involved in the transaction or the profit of the target. That is, the reservation value would take into consideration the maximum counteroffer for the target firm. This maximum valuation, as we shall see, will always be that of the largest (most efficient) firm not including firm *i*. There are two justifications for this assumption. First, as we shall see there are firms other than *i* which have an incentive to acquire firm *j* (*j* >2). Secondly, this is a conservative assumption for acquisitions to take place. A mechanism by which the target firm would obtain such a reservation value would be an English auction between all potential buyers. Furthermore we assume that the reservation value will always be positive for every firm. Consequently, we assume Cournot profits and quantities will be positive for even the smallest firm i.e., a firm through its acquisitions and technology transfers cannot force another firm to exit. Thus, in our analysis, a firm must purchase every other firm to obtain a monopoly. Collecting the above expressions yield,

$$V_{ij} = \tfrac{1}{2}\cdot\left(p_{ij} - p_i - RV_j\right) \qquad (4)$$

The optimal merger in any period and the optimal order of mergers is addressed in the following propositions.

Proposition 2: In the first round of acquisitions the incentive to merge is greatest between the largest firm and the second largest firm.

Proof:

We seek that merger which yields the highest valuation (4). Such a merger would be the combination of i and j which would maximize $p_{ij} - p_i$ - RV_j . We need to examine only the case where n ≥ 3, the reservation value for any firm *j* is,

$$RV_j = \begin{cases} p_2 & if \;\; j = 2 \\ p_{2j} - p_2 & if \;\; j > 2 \end{cases}$$

and we know that $p_{2j} - p_2 < p_2$ from (1). Firm 1 would prefer to acquire firm 2 over any other target if

$$p_{12} - p_1 - p_2 > p_{1j} - p_1 - \left(p_{2j} - p_2\right) \quad \forall\; j > 2 \quad \Rightarrow \quad p_{12} - 2p_2 - p_{1j} + p_{2j} > 0 \quad \forall\; j > 2$$

a condition which simplifies to

$$2ne_2\left(e_j - e_2\right) > 0$$

which holds for $j > 2$. The incentive for the merger between firms 1 and 2 is greater than the incentive for any other acquisition as

$$p_{12} - p_1 - p_2 > p_{kj} - p_{kl} - \left(p_{1j} - p_1\right) \Rightarrow p_{12} - 2p_1 - p_2 + p_{kl} - p_{klj} + p_{1j} > 0 \quad \forall k > 1, j > 2$$

.

This condition implies

$$2\left[a - c_1 + \sum_{k\neq 2,l,j}^{n} e_k\right](n-1)\left(e_l + e_2\right) - 2(n+1)e_l e_j + 4(n-1)e_l e_2 + 2(n-1)e_j e_2$$
$$-\left(n^2 - 4n + 1\right)e_l^2 - \left(n^2 + 1\right)e_2^2 \;>\; 0 \quad \forall\, l > 1,\; j > 2$$

which always holds since $a - c_1 + \sum_{k\neq 2,l,j}^{n} e_k \;>\; ne_n$ for positive Cournot quantities of the smallest firm.

Q.E.D.

The above proposition provides a theoretical rationale for the behavior of the firms examined in the cases in Section 2. There are two intuitive explanations for this behavior. Firm 1 being the acquirer will lead to the largest gains in efficiency and hence it has the largest incentives to acquire other firms. Firm 1 acquiring firm 2 maintains the maximum asymmetry in the market of any merger and thus minimizes the negative impact of the merger on firm 1's profit flows. This logic can be extended to subsequent acquisitions as follows in the absence of discounting between rounds of purchases and where the target firms are not aware of the acquiring firm's acquisition strategy.

Proposition 3: The privately optimal sequence of mergers is for firm 1 to acquire its rivals in the order of size - largest to smallest.

Proof:

If the acquiring firm is not intending to monopolize then the above logic in the proof of Proposition 2 is repeated with

$$RV_j = \begin{cases} p_j & \text{if } j = MIN\left[\text{ firm subscript} \notin A\right] \\ p_{ij} - p_i & \text{otherwise} \end{cases}.$$

If the acquiring firm considers the value of the whole sequence of acquisitions (VS) in the absence of discounting between acquisition periods then he seeks to maximize

$$VS_A = \frac{1}{2} \cdot \left[p_{im} - p_i - \sum_{j \in A}^{m} RV_j \right]$$

where A is the set of firm subscripts ordered by sequence of acquisition. *VS* is constructed by adding the successive surpluses of each round of acquisitions. Let A be the sequence {2, 3, 4, ..., m-1, m} where m ≤ n. *2VS* is then

$$p_{1m} - p_1 - p_2 - p_3 - \cdots - p_j - p_{j+1} - \cdots - p_m . \qquad (5)$$

Switching the sequence of any two acquisitions j and j+1 to A′ = {2, 3, ... , j+1, j, ... , m} would yield a *2VS′* of

$$p_{1m} - p_1 - p_2 - p_3 - \cdots - \left(p_{j\,j+1} - p_j\right) - p'_j - p_{j+2} - \cdots - p_m . \qquad (6)$$

where p'_j is the Cournot equilibrium profit of firm *j* when $e_1, e_2, \ldots, e_{j-1}, e_{j+1} = 0$.
Comparing the values of the two sequences of acquisitions (*2VS'* s) (5) and (6) yields

$$2VS = 2VS' + p_{j\,j+1} - 2p_j - p_{j+1} + p'_j .$$

As $p_{j\,j+1} - 2p_j - p_{j+1} + p'_j$ is positive for all j this implies that *VS* > *VS*¢. Switching the sequence of any k-1 acquisitions j, j+1, j+2, ..., j+k-1 to A^{k-1} = {2, 3, ..., j+1, j+2, ... , j+k-1, j, ..., m} yields a $2VS^{k-1}$ of

$$p_{1m} - p_1 - p_2 - \cdots - \left(p_{j\,j+1} - p_j\right) - \left(p_{j\,j+2} - p'_j\right) - \ldots - \left(p_{j\,j+k-1} - p_j^{k-2}\right) - p_j^{k-1} - p_{j+k} - \cdots - p_m \qquad (7)$$

where p_j^{k-1} is the Cournot equilibrium profit of firm *j* when $e_1, e_2, \ldots, e_{j-1}, e_{j+1}, \ldots, e_{j+k-1} = 0$.
Finally, if we reverse the ordering of k acquisitions we obtain a value for the sequence of

$$p_{1m} - p_1 - p_2 - \cdots - \left(p_{j\,j+1} - p_j\right) - \left(p_{j\,j+2} - p'_j\right) - \ldots - \left(p_{j\,j+k} - p_j^{k-1}\right) - p_j^{k} - p_{j+k+1} - \cdots - p_m \qquad (8)$$

Again, comparing the values of the sequences (7) and (8) we obtain

$$2VS^{k-1} = 2VS^{k} + p_{j\,j+k} - 2p_j^{k-1} - p_{j+k} + p_j^{k}$$

As $p_{j\,j+k} - 2p_j^{k-1} - p_{j+k} + p_j^{k}$ is positive for all j and k, this implies VS >VS′ > ... > VS^{k-1} > VS^{k} and consequently the value of the sequence defined in (5) is the largest for the acquirer.

Q.E.D.

In the first part of the above proof the optimal sequence is derived by the acquiring firm examining each acquisition as a one-shot deal. In this case firm 1 finds the acquisition of firm 2 optimal as per Proposition 2. In the next round the owner of firms 1 and 2 finds that the next acquisition that maximizes its value is the purchase of firm 3 and so on so that the optimal sequence of acquisitions is for firm 1 to acquire firms 2, 3, 4, ..., m. The justification of this optimal sequence becomes stronger as the acquirer examines the acquisition as one of many. That is, if in the development of an acquisitions strategy the acquirer were more forward thinking and take into consideration how a purchase of one firm would affect subsequent acquisitions. The incentive to purchase the largest rival first becomes greater since doing so would decrease the reservation values and hence the prices of ensuing purchases. Furthermore, it can be shown that any target firm has an incentive to be purchased in the sequence described in Proposition 3. The above leads to the following Proposition.

Proposition 4: The optimal sequence of mergers with technology transfers and decentralized operations will result in monopolization.

Proof:

Since in the optimal sequence the acquirer holds the target firm's reservation value at its own profit flows, we must show that $p_{ij} - p_i - p_j > 0$. This is shown to hold for the case where n=2 in the proof of Proposition 2. For the case n ≥ 3

$$p_{ij} - p_i - p_j = \frac{1}{b(n+1)^2}\left[2F^2 - (F+\Delta)^2 - (F - n\Delta)^2\right]$$

where $F = \left(a - c_1 - ne_i + e_i + \sum_{\substack{k\neq i \\ k\neq j}}^{n} e_k\right)$ and $\Delta = e_j - e_i$. Consequently,

$$p_{ij} - p_i - p_j > 0 \quad \Rightarrow \quad F > \frac{n+1}{2}\cdot\Delta .$$

Since we know by Proposition 2 that the acquirer (firm *i*) will be the most efficient firm this condition for acquisition becomes

$$a - c_1 + \sum_{k\neq j}^{n} e_k > \frac{n+1}{2}\cdot e_j .$$

This condition is most restrictive when the target firm is the least efficient ($j = n$) as the R.H.S. of the above condition is then maximized while the L.H.S. is minimized. The condition for positive quantities in Cournot equilibrium for the least efficient firm implies

$$a - c_1 + \sum_{k \neq j}^{n} e_k > n \cdot e_n .$$

As $n \cdot e_n > \frac{n+1}{2} \cdot e_n > \frac{n+1}{2} \cdot e_j$, the condition for the most efficient firm to have an incentive acquire rival firms in the optimal sequence always holds.

Q.E.D.

4. Welfare Analysis

Whether the industry structure obtained after the sequence of horizontal mergers described above is welfare improving depends on the classic tradeoff in anti-trust between the increased market power of the largest firm and the improvements in efficiency due to the technology transfer.

The effect on consumer welfare of acquisitions during the sequence of firm procurements before monopoly is unambiguous. Consumer welfare increases from the mergers in this interval. This occurs since the firms continue to compete independently in the product market (by Lemma 2) while the technology transfer makes the industry more efficient. Consequently, in this intermediate stage of acquisitions prices decrease and consumer surplus increases. This does not imply the privately optimal sequence of acquisitions is also socially optimal. Clearly, the optimal sequence of acquisitions for the consumers would be one where the most inefficient firms are acquired first as this would lead to a faster rate of price decreases. As Proposition 4 indicates this process will ultimately lead to monopoly. We focus on the welfare in the final outcome of the acquisition process.

Lemma 3: Despite the efficiency gains from the mergers, monopolization leads to lower consumer welfare[4].

Proof:

To examine the ultimate effects on the consumer surplus one need only consider the

[4] Note that we have not considered economies of scale in our model. Such economies may result in larger efficiency gains from mergers.

changes in price, that is, compare the equilibrium price given in (1) to the monopoly price,

$$P^{mon} = \frac{a + c_1}{2}$$

which is higher if

$$a - c_1 - \frac{2}{(n-1)} \sum_{k=2}^{n} e_k > 0 .$$

The above condition always holds by the condition for positive Cournot equilibrium quantities for firm n. That is, the price under monopoly will be higher despite the cost efficiencies due to mergers.

Q.E.D.

The effect on firm profits, however, is less clear. Since the condition for beneficial acquisitions holds for the most efficient firm (Proposition 3) clearly the surplus for the firms involved in the merger increases. The rival firms outside of the merger transaction, however, will be worse off as the number of competitors in the product market has not lessened while one of their rivals has become more efficient. The following Lemma shows that producers surplus increases.

Lemma 4: Producers surplus increases with monopolization.

Proof:

The producers surplus under monopoly is

$$PS^{mon} = \frac{(a - c_1)^2}{4b} .$$

This is greater than the producers surplus when one owner controls the industry and operates is a decentralized manner

$$PS^{D} = \frac{n(a - c_1)^2}{b(n+1)^2}$$

as n ≥ 2. The producers surplus under the original oligopoly is

$$PS^{oli} = \sum_{i=1}^{n} p_i = \sum_{i=1}^{n} \frac{1}{b(n+1)^2} \cdot \left(a - c_1 - ne_i + \sum_{k \neq i}^{n} e_k \right)^2$$

$$= PS^D + \sum_{i=1}^{n} \left[2(a - c_1) \left(-ne_i + \sum_{k \neq i}^{n} e_k \right) + \left(-ne_i + \sum_{k \neq i}^{n} e_k \right)^2 \right]$$

the term in the square brackets is negative as $(a - c_1) > \left(-ne_i + \sum_{k \neq i}^{n} e_k \right)$ for all i and

$\sum_{i=1}^{n} (a - c_1) \left(-ne_i + \sum_{k \neq i}^{n} e_k \right) = -(a - c_1) \sum_{i=1}^{n} e_i$ is negative. Consequently,

$$PS^{mon} > PS^D > PS^{oli}.$$

Q.E.D.

Together, the above two lemmas imply that ultimately,

Proposition 5: With the optimal sequence to monopoly there is a transfer of welfare from consumers to producers.

The above proposition alludes to the need for antitrust regulators to study the origin of claimed cost efficiencies, to monitor the evolution of industries and company backgrounds. Early detection of an acquisition strategy which leads to monopoly would be desirable. Proposition 1 suggests that even if monopoly is prevented, a high level of industry concentration may lead to consolidation and a potential welfare transfer.

A simple numerical example illustrates the optimal sequence and the welfare implications. Say α= 101, β=1, in the above linear inverse demand function and there are three firms with c_1=1, c_2=2, and c_3=3. The equilibrium profits are then $p_1^{oli} = 10609/16$, $p_2^{oli} = 9801/16$, $p_3^{oli} = 9025/16$. In this case, m^*= 1.438 and so the first acquisition would not lead to consolidation. The reservation value of firm 3 would be $p_{23}^{oli} - p_2^{oli} = 9407/16 > p_3^{oli}$. Firm 1 would prefer to buy firm 2 first as $\left(p_{12}^{oli} - p_1^{oli} - p_2^{oli}\right) + \left(p_1^{mon} - p_{12}^{oli} - p_3^{D}\right) = 10754/16 > \left(p_{13}^{oli} - p_1^{oli} - \left(p_{23}^{oli} - p_2^{oli}\right)\right) + \left(p_1^{mon} - p_{13}^{oli} - p_2^{D}\right) = 10577/16$. The consumer surpluses are $CS^{oli} \approx 2756$ and $CS^{mon} = 1275$ while the producers surpluses are $PS^{oli} \approx 1840$ and $PS^{mon} = 2500$ leading to a transfer of welfare from consumers to producers of approximately 660 and a net welfare loss of monopoly of approximately 821 or about

17.9% of the total welfare.

5. Conclusions and Discussion

We have examined horizontal mergers between asymmetric firms as a three stage game. We assume firm acquisitions take place in a sequential process. In the first stage owners decide on which firm to acquire or which firm to sell off to. The purchase prices are determined via a bargaining game between pairs of potential buyers and sellers. The purchase price depends on the supposition that subsequent to any acquisition, technology is transferred from the more efficient firm to a less efficient firm which is under the same ownership. The owner of several firms then decides on whether to consolidate his firms in the second stage. In the final stage, with efficiencies and market structure determined in the first two stages, firms compete in an asymmetric Cournot game. These three stages are repeated until no further gains to acquisitions can be made.

The purchase price of any firm is constrained from below by its reservation value which can be either the present value of its current profit flows or it could be the highest counter offer of an alternative acquiring firm. This highest counter offer would be the net surplus the acquisition would bring to this alternative consolidator. We find that the largest (the most efficient) firm will be the acquirer. This firm provides the largest efficiencies in any subsequent technology transfer and therefore in this acquisition there is the greatest surplus over which to bargain. Therefore the most efficient firm would be willing to pay the largest purchase price.

The acquiring firm, if it faces no restraints, will purchase firms in the order of descending efficiency operating its acquisitions in a decentralized fashion until it achieves monopoly. There are two reasons for buying the most efficient rival first: (i) it minimally reduces the profits of the acquiring firm due to the resulting smallest possible reduction of asymmetry and, (ii) it reduces the subsequent purchase prices by reducing the reservation values of future targets to that of their present profit flows. Cases in which such sequences of acquisitions were found are reported. If this sequence were to be halted (for example, due to antitrust action) the firm would then under certain circumstances consolidate. Thus a failure to consolidate acquisitions could signify the intention of a firm to acquire additional firms. When acquisitions are not consolidated the acquisitions increase both consumer and producer surpluses. Ultimately, however, consolidation at monopoly will involve a transfer of welfare from consumers to producer and a loss of total welfare.

In terms of the debate between those who argue for the efficiency rationale for horizontal mergers and those who contend that market power is the motivation we find that both rationales may be operative. However, market power would tend to be used when con-

centration is significant and when there are barriers to entry. This does not imply that merger control should be eased. Rather we find that mergers that initially seem welfare improving may ultimately prove to decrease total welfare despite the efficiencies involved. Hence antitrust authorities need to pay attention to the historical evolution of industries when they investigate mergers. To prevent the harmful consequences of monopolization antitrust regulators need to prevent sequences of acquisitions at an early stage.

We have assumed in our analysis that target firms are not aware of the acquisitions strategy of the acquirer and do not take into consideration future acquisitions when bargaining over purchase prices. That is, with the exception of the last remaining rival, target firms do not anticipate monopolization of the industry. Incorporating a rational expectations argument one would start with the last target firm behaving as we have modeled above. The second last target firm would then use the monopoly surplus less the expected purchase price of the last firm as the starting point for its bargaining over purchase price and so on. This would yield higher purchase prices and thereby be a possible explanation for the capture of higher portions of the surplus by target firms (Bradley, Desai, Kim, 1988). Rational expectations may have to include, however, the prospect of antitrust authorities ending the sequence.

There may be many other reasons for acquisitions which we do not model here. For example, opportunities may arise for the purchase of otherwise closely held shares due to cash requirements of target firm shareholders or simply that those shareholders no longer wish to be involved in the business. There may also be constraints which we have not modeled such as liquidity constraints or antitrust restrictions which prevent a firm from following the optimal acquisitions sequence. We are simply saying that, given a choice, acquiring firms would be more likely to attempt to purchase their most efficient and largest rivals first and that this may lead to monopolization.

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Appendix A - The Derivation of the Asymmetric Cournot Equilibrium Quantities

Given $c_1 < c_2 < c_3 < ... < c_n$, $c_j = c_1 + \varepsilon_j$ and a linear inverse demand function $P = \alpha - \beta Q$, the payoff functions can be defined as

$$p_i = q_i\left(a - b\sum_{j=1}^{n} q_j - c_1 - e_i\right).$$

From which one can derive the first order conditions

$$\frac{\partial p_i}{\partial q_i} = a - 2bq_i - b\sum_{j\neq i}^{n} q_j - c_1 - e_i = 0.$$

This defines the $n \times n$ matrix

$$\begin{bmatrix} 2b & b & b & \cdots & b & a - c_1 \\ b & 2b & b & \cdots & b & a - c_1 - e_2 \\ b & b & 2b & \cdots & b & a - c_1 - e_3 \\ \vdots & \vdots & \ddots & & & \vdots \\ b & b & \cdots & b & 2b & a - c_1 - e_n \end{bmatrix}$$

which we divide through each row by β, then take each row and subtract the first row and then take the first row and subtract all other rows yields

$$\begin{bmatrix} n+1 & 0 & 0 & \cdots & 0 & \dfrac{\left(a - c_1 + \sum_{j=2}^{n} e_j\right)}{b} \\ -1 & 1 & 0 & \cdots & 0 & \dfrac{-e_2}{b} \\ -1 & 0 & 1 & \cdots & 0 & \dfrac{-e_3}{b} \\ \vdots & \vdots & & \ddots & & \vdots \\ -1 & 0 & \cdots & 0 & 1 & \dfrac{-e_n}{b} \end{bmatrix}.$$

Thus the Cournot equilibrium quantities are given by

$$q_1^* = \frac{\left(a - c_1 + \sum_{j=2}^{n} e_j\right)}{b(n+1)} \quad \text{and} \quad q_i^* = \frac{\left(a - c_1 - ne_i + \sum_{j \neq i}^{n} e_j\right)}{b(n+1)}.$$

When the above quantities are substituted into the inverse demand function and into the above payoff function we obtain the equilibrium price and payoffs defined in (1).