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ABSTRACT

Why Mergers Reduce Profits and Raise Share Prices — A Theory of Preemptive Mergers*

by Sven-Olof Fridolfsson and Johan Stennek

We explain the empirical puzzle why mergers reduce profits and raise share prices. If being an "insider" is better than being an "outsider," firms may merge to preempt their partner merging with a rival. The stock-value of the insiders is increased, since the risk of becoming an outsider is eliminated. We also explain why shareholders of targets gain while acquirers typically break even. These results are derived in an endogenous-merger model, predicting the conditions under which mergers occur, when they occur, and how the surplus is shared.

Keywords: Mergers, Acquisitions, Defensive Mergers, Coalition Formation

JEL Classification: L13, L41, G34, C78

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ZUSAMMENFASSUNG

Warum Fusionen Profite reduzieren und Aktienpreise steigen lassen

Es wird ein „Mechanismus der Gewinnung eines Vorsprungs durch Fusion“ aufgezeigt, der eventuell das empirische Rätsel, warum Fusionen Profite reduzieren und Aktienpreise steigen lassen, erklären kann. Eine Fusion kann starke negative externe Effekte bei den Unternehmen auslösen, die nicht an der Fusion beteiligt sind. Wenn es besser ist ein „Insider“ zu sein als ein „Outsider“, kann es sein, daß Firmen Fusionieren um dem zuvorzukommen, daß ihre Partner mit jemand anderem fusionieren. Desweiteren ist der Wert eines fusionierenden Unternehmens vor der Fusion niedrig, da er das Risiko ein Outsider zu werden reflektiert. Diese Ergebnisse werden aus einem Modell endogener Fusionen abgeleitet, welches die Bedingungen unter denen eine Fusion stattfindet, wann sie stattfindet und wie der Überschuß verteilt werden wird, vorhersagt.

1 Introduction

The empirical literature has measured the performance of mergers and acquisitions (M&As) employing two approaches which yield conflicting results. The so-called event studies investigate how the stock market values the merger when it is announced by comparing the share prices a few weeks before and after the event. Even though there are numerous event studies, their results are consistent. The shareholders of the target firms benefit, and those of the bidding firms generally break even. The combined gains are mainly positive.[1] The second strand of the literature compares accounting profits a few years before and after the transaction. A robust result is that mergers lead to a significant reduction in the merging firms' profitability compared to a control sample of firms from various industries. Surveys typically conclude that, on average, mergers are unprofitable.[2]

If all empirical evidence is correct, we are left with three puzzles: Why do unprofitable M&As occur? How can the value of firms increase when profits are reduced? Why do some firms volunteer as buyers when the targets capture the whole stock market surplus? This paper attempts to resolve these puzzles by proposing a single explanation for all the stylized facts.

An unprofitable merger may occur if mergers confer strong negative externalities on the firms outside the merger. If becoming an "insider" is better than becoming an "outsider," firms may rationally merge to preempt their partner merging with a rival. Expressed differently, even if a merger reduces the profit

[1] The early literature was surveyed by Jensen and Ruback (1983), and Jarrell, Brickley and Netter (1988). It contained some debate concerning the effect of merger on the aggregate value of the merging firms. Later contributions indicate more clearly that this effect is positive, see for example Bradley, Desai and Kim (1988), Stulz, Walking and Song (1990), Berkovitch and Narayanan (1993), Huston and Ryngaert (1994), Schwert (1996), and Banerjee and Eckard (1998).

[2] See for example Bild (1998), Caves (1989) and Scherer and Ross (1990). There is also complementary evidence of difficulties associated with mergers, emphasizing that the strategic potentials of mergers are not automatically realized. Organization research points at the role of cultural clashes. The human resource management literature indicates that acquired company employees may react unfavorably to M&As. For a survey and synthesis of these literatures, see Larsson and Finkelstein (1999).

flow compared to the initial situation, it may increase this flow compared to the relevant alternative – in this case, another merger.

Even though a preemptive merger reduces profits, the aggregate value of the firms (the discounted sum of *expected* future profits) is increased. The reason is that the firms' pre-merger value takes the risk that they may become outsiders into account. Under the hypothesis that the stock market is efficient (in the sense that share prices reflect the values of firms) our results demonstrate that the two strands of the empirical literature may be consistent. In particular, the event studies can be interpreted as showing the existence of an industry-wide anticipation of a merger; the new information in the merger announcement is which firms become insiders and outsiders, respectively.

Even though the aggregate value of the merging firms is increased, on average buyers only break even. Nevertheless, firms do not just wait to become targets, since they are afraid of becoming outsiders. Instead, they compete to buy other firms and, as a result, buyers give up the whole surplus to targets, much like in Bertrand competition. In fact, the buyer's share price is even reduced with positive probability.

The empirical result that mergers reduce profits is obtained in studies using control firms from various industries. When compared to control firms from the same industry, the results are mainly insignificant but favor the merging sample. The preemptive merger hypothesis also provides a possible explanation for why control groups matter. If the control firms compete with the insiders, they are exposed to externalities from the merger. Then, the change in relative profitability is a biased measure of the change in the insiders' profitability. If the merger induces a positive (negative) externality, the change in relative profitability underestimates (over-estimates) the change in profitability. In particular, preemptive mergers increase the merging firms' profitability relative to competitors, which is consistent with the empirical evidence. Increased relative profitability should thus not be taken as proof that mergers create value.

To derive these results and to describe the acquisition process, we construct an extensive form model of coalitional bargaining.[3] In particular, we construct a so-called game of timing.[4] Any firm can submit a merger proposal to any other firm at any point in time and the recipient of a proposal can either accept or reject it. In the latter case, firms can make new proposals in the future. As a consequence, firms endogenously decide whether and when to merge, and how to split the surplus while keeping alternative mergers in mind.

The model is presented in the next section. Section 3 demonstrates why mergers may reduce profits and raise share prices, Section 4 shows why control groups matter in profit studies and Section 5 explains why targets take it all. Implications for merger policy and future empirical work are spelled out in Section 6 and the Concluding Remarks, respectively. The related literature is discussed in appropriate places throughout the paper.

2 The Model

We consider an industry which initially consists of three identical firms. If they wish, any two firms may merge and turn the market into a duopoly. Mergers to monopoly are illegal, however.

In the spirit of Rubinstein-Ståhl bargaining, the acquisition process is modelled as a multi-stage (three-person) bargaining game with an infinite horizon. In every period, all firms simultaneously have the possibility to submit one bid each for some other firm. If more than one firm bids, only one bid is transmitted, all

[3] The idea to use the theory of coalition formation for studying mergers originates in Stigler (1950). The first formal models were studied by Salant, Switzer, and Reynolds (1983, section IV), and Deneckere and Davidson (1985b). More recent contributions include Kamien and Zang (1990, 1991, and 1993), Horn and Persson (2001a, 2001b) and Gowrisankaran (1999).

[4] Games of timing have previously been used for studying preemption, including patent races (Fudenberg, Gilbert, Stiglitz, and Tirole, 1983), the adoption of new technology (Fudenberg and Tirole, 1985), compatibility standards (Farrell and Saloner, 1988) and entry (Bolton and Farrell, 1990).

with equal probability.[5, 6] A firm receiving a bid can either accept or reject it. In all periods before an agreement, all three firms earn the triopoly profit, $\pi(3)$. Once a merger from triopoly to duopoly occurs, the bargaining ends. In every subsequent period, the merged and the outsider firms earn $\pi(2^+)$ and $\pi(2^-)$ respectively.

The model aims at capturing frictionless communication in the sense that firms can make offers quickly. For this reason, it is convenient to assume that time is continuous but divided into short periods of length Δ and study the model as $\Delta \to 0$. The profit parameters must then be interpreted as continuous-time profit flows. Furthermore, we assume that merger proposals and replies are given at the very beginning of every period, without taking any time. For the remainder of the period (thus taking time Δ) the firms earn profit flows corresponding to the prevailing market structure. For example, if the triopoly survives the negotiations in the first period, all firms will earn $\int_0^\Delta e^{-rt}\pi(3)\,dt = \left(1-e^{-r\Delta}\right)\pi(3)/r$ before the second-period bidding starts, where r is the interest rate.[7]

Our analysis shows how merger incentives depend on the profits in the different market structures. To simplify our presentation, we construct a taxonomy of mergers based on the effects of mergers on profits. According to the exogenous merger literature,[8] a merger may be profitable, in the sense that $\pi(2^+) > 2\pi(3)$,

[5] This is a simple and transparent way of circumventing a well-known problem. Preemption games give rise to technical difficulties if all players decide to move immediately. In our model, the firms may agree on mutually inconsistent contracts. Other solutions to this problem are discussed by Fudenberg and Tirole (1991, pp. 126-8). Our assumption can be considered in terms of a continuous time model with bounded bidding densities. In that case, the probability that two firms bid at the same time is zero. Moreover, if all firms bid with the same density, they are all equally likely to be first.

[6] In Section 5, we explore the alternative assumption that the highest bid is transmitted.

[7] The alternative is to assume that time is discrete, and to study the model as the discount factor δ tends to one. The disadvantage of this approach is that firms' stock market values would tend to infinity as δ tends to one (holding per-period profits constant). To avoid normalizing firms' stock market values to per-period units, as is often done in repeated games, one may instead let $\delta = e^{-\mathsf{r}\,\Delta}$ and define the per-period profits as $\widetilde{\pi} = \left(1-e^{-\mathsf{r}\,\Delta}\right)\pi/r$. In fact, this solution is equivalent to our formulation.

[8] This literature studies whether an exogenously selected group of firms (insiders) would increase their profit by merging compared to the situation in an unchanged market structure. Depending on the details of the situation, the insiders (and outsiders) would or would not profit

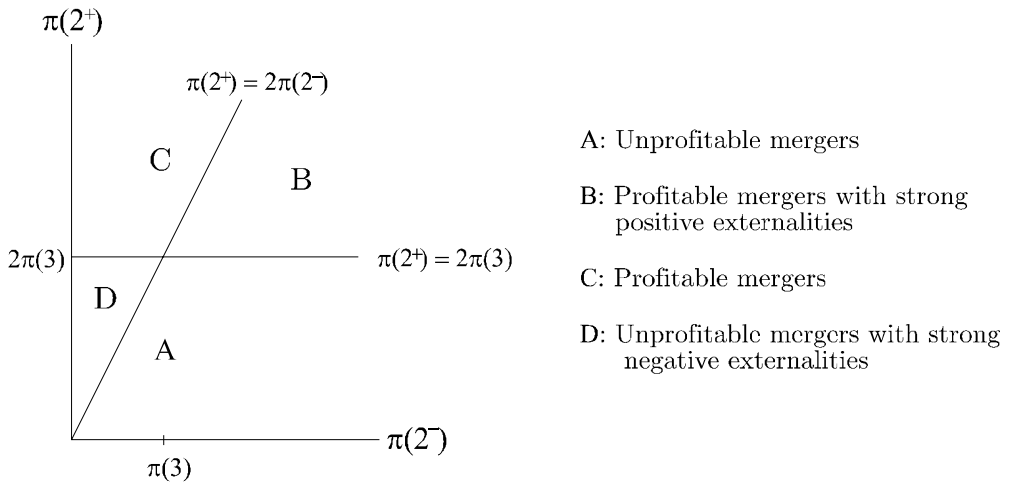

Figure 1: A taxonomy of different mergers.

for example due to increased market power or efficiency gains. In Figure 1, this possibility is illustrated as the area above the line $\pi(2^+) = 2\pi(3)$. However, a merger may also be unprofitable if, for example, the outsider expands its production substantially in response to the merger, if the new organization is more complex to manage or if there are substantial costs of restructuring. In Figure 1, this possibility is illustrated as the area below the line $\pi(2^+) = 2\pi(3)$. Normally, a merger also confers an externality on the outsider. Since a merger reduces the number of competitors, there is a positive market power effect so that $\pi(2^-) > \pi(3)$. In Figure 1, this possibility is illustrated as the area on the right-hand side of $\pi(3)$ on the x-axis. However, if the merging parties can reduce their marginal costs substantially, they become a more difficult competitor, which may harm outsiders, so that $\pi(2^-) < \pi(3)$. In Figure 1, this possibility is illustrated as the area on the left-hand side of $\pi(3)$ on the x-axis. Furthermore, the externality may be strong in the sense that the effect on the outsider's profit is larger than the effect on the insiders' profits, that is $|\pi(2^-) - \pi(3)| > \left|\frac{1}{2}\pi(2^+) - \pi(3)\right|$.

from a merger, see Szidarovszky and Yakowitz (1982), Salant, Switzer and Reynolds (1983), Deneckere and Davidson (1985), Perry and Porter (1985), Levy and Reitzes (1992), Reitzes and Levy (1995) and Boyer (1992).

Area D represents markets where a merger is unprofitable, and even more unprofitable to the outsider. Area B represents markets where a merger is profitable, but even more profitable to the outsider. In the following analysis, we show that the incentives to merge differ a great deal between the different areas A, B, C and D.[9]

A strategy describes a firm's behavior in the multi-stage bargaining game. For all periods and for all possible histories, the strategy specifies whether and how much to bid, and a reservation price at which to accept offers. We restrict the attention to Markov strategies, which means that firms do not condition their behavior on the outcome of previous periods. This assumption implies that a firm behaves in the same way in all periods. We also restrict the attention to symmetric equilibria. These assumptions allow us to illustrate the preemptive merger mechanism in the simplest possible framework. A symmetric Markov perfect equilibrium is characterized by the triple (p, b, a), where $p \in [0, 1/2]$ denotes the probability of a firm bidding for a specific firm in a given period (given that the triopoly remains in that period), b denotes the size of this bid, and a denotes the lowest bid a target accepts.[10] For convenience, only bids that would

[9]Rather than specifying an explicit oligopoly model, we take all profit levels in all market structures, that is $(\pi(3), \pi(2^+), \pi(2^-))$, as exogenous. All possible profit configurations in Figure 1 can be generated by means of a simple oligopoly model, however. Consider a linear homogenous good Cournot triopoly. Inverse demand is given by $p = 1 - q_1 - q_2 - q_3$. The common constant marginal cost is c. Equilibrium quantities are $q = (1-c)/4$ and equilibrium profits are $\pi(3) = (1-c)^2/16$. Assume now that one firm buys another and that, as a result, the marginal cost of the merged firm is reduced to zero and a fixed cost f has to be taken. The fixed cost may be thought of as including annuity payments of one-time costs of restructuring. The equilibrium profits are given by $\pi(2^+) = (1+c)^2/9 - f$ and $\pi(2^-) = (1-2c)^2/9$. The merger is privately profitable if, and only if, $f < -\frac{1}{72} + \frac{17}{36}c - \frac{1}{72}c^2$ and has a positive externality if, and only if, $c < \frac{1}{5}$. It is better to be an insider than to be an outsider if, and only if, $f < -\frac{1}{9} + \frac{10}{9}c - \frac{7}{9}c^2$. Assume first that $c = 0.15$, so that there is a fixed positive externality. When f is very high, the merger is unprofitable (region A). When f is moderately high, the merger is profitable, but it is better to be an outsider (region B). When f is small, it is better to be an insider than an outsider (region C). Second, assume that $c = 0.3$, so that there is a fixed negative externality. When f is very high, being an insider even worse (region A). When f is moderately high, the merger is unprofitable, but it is better to be an insider than an outsider (region D). When f is low, the merger is profitable (region C).

[10]Firm 1's strategy can be described by the vector $\left(\left[p_2^1(h), p_3^1(h)\right], \left[b_2^1(h), b_3^1(h)\right], \left[a_2^1(h), a_3^1(h)\right]\right)$ where, for example, p_2^1 denotes the probabil-

be accepted if submitted are considered.

We assume that the stock market is efficient in the sense that the stock market value of a firm equals the expected discounted sum of future profits. It is also assumed that firms distribute the surplus in every period as dividends. The next step is to compute these values at different points in time, namely after a merger has occurred, at the date of a merger and before a merger. After a merger to duopoly, the stock market values of the merged firm (+) and the outsider firm (-) are given by

$$W\left(2^i\right) = \pi\left(2^i\right)/r \quad \text{for } i \in \{+,-\}, \tag{1}$$

where $\pi\left(2^i\right)/r$ is the discounted value of all future profits. At the time when a merger is announced, the values of the buying, selling, and outsider firms are given by

$$V^{buy} = W\left(2^+\right) - b, \tag{2a}$$

$$V^{sell} = b, \tag{2b}$$

$$V^{out} = W\left(2^-\right), \tag{2c}$$

respectively. It is assumed that the merger occurs instantaneously at the time of the announcement. In the triopoly, the stock market value of any firm is given by

$$W(3) = \frac{1}{r}\pi(3)\left(1 - e^{-r\Delta}\right) + e^{-r\Delta}\left[2qV^{buy} + 2qV^{sell} + 2qV^{out} + (1-6q)W(3)\right]. \tag{3}$$

The first term is the value generated by the triopoly in the current period, the second term is the discounted expected value of all future profits. In particular, the value of being a buyer (seller, outsider, triopolist) in the next period is multiplied by the probability of becoming a buyer (seller, outsider, triopolist) in

ity with which firm 1 bids for firm 2, and h denotes history. The Markov assumption implies that the firm does not condition its behavior on h. Symmetry means that firm 1 treats both competitors in the same way implying, for example, that $p_2^1 = p_3^1 \equiv p^1$. Symmetry also means that all firms behave in the same way, implying that $p^1 = p^2 = p^3 \equiv p$.

that period. By definition, q is the probability of a specific firm buying another specific firm. It is given by:[11]

$$q = \frac{1-(1-2p)^3}{6}. \tag{4}$$

The stock market value of firms are changed as a result of the merger. Initially the buying firm is worth $W(3)$ and at the announcement date it is worth V^{buy}. Likewise, the aggregate value of the merging firms is $2W(3)$ at every date before the merger and $W(2^+) = V^{buy} + V^{sell}$ forever after.

Firms maximize their expected discounted sums of future profits, which is equivalent to maximizing the current stock market value of the firm. To formulate the equilibrium conditions, using the one stage deviation principle, we define the expected value of bidding and not bidding in the following way. Let $EVNB$ be the expected value for a firm if it does not bid in the current period, but behaves according to (p, b, a) in all future periods, assuming that the other firms behave according to (p, b, a) in the current and all future periods. Likewise, let EVB be the expected value for a firm if it bids b with certainty in the current period, but behaves according to (p, b, a) in all future periods, assuming that the other firms behave according to (p, b, a) in the current and all future periods. The exact expressions for $EVNB$ and EVB, to be found in Appendix A, are weighted sums of the values of the firm associated with the different outcomes of the bidding game.

Three equilibrium conditions complete the model. Without loss of generality, we restrict the attention to one-stage deviations.[12] First, by subgame perfection, an offer is accepted if, and only if, the bid is at least as high as the value of the

[11] To write q as a function of p, note that $q = (1-q_0)/6$, where q_0 is the probability of remaining in status quo, and that $q_0 = (1-2p)^3$, which is the probability that no firm makes a bid. The status quo only remains if no firms submit a bid, since all bids are designed to be accepted.

[12] The game is continuous at infinity so that the one-stage deviation principle holds (Fudenberg and Tirole, 1991).

firm,[13] that is

$$a = W(3). \tag{5}$$

Second, for the bidder to maximize its value, the bid should be as low as possible, that is

$$b = W(3). \tag{6}$$

The third equilibrium condition is that firms submit bids if, and only if, this is profitable:

$$\begin{cases} \text{Immediate-merger:} & p = \frac{1}{2} & \text{and} & EVB \geq EVNB & \text{or} \\ \text{No-merger:} & p = 0 & \text{and} & EVB \leq EVNB & \text{or} \\ \text{Delayed-merger:} & p \in (0, 1/2) & \text{and} & EVB = EVNB. & \end{cases} \tag{7}$$

The two key ingredients of the model are the condition for stock market efficiency, that is equation (3), and the condition for bidding equilibrium, that is expression (7). The two conditions together determine the equilibrium values of the two key variables $W(3)$ and p.

We are mainly interested in situations where all firms bid with certainty in all periods, that is, in immediate-merger equilibria. To understand the logic behind such equilibria, the first step is to focus on the firms' choice of bidding probabilities. Consider a firm whose competitors stick to their equilibrium strategies, i.e. bidding with certainty ($p = 1/2$). Then, the firm's expected value of bidding (that is, sticking to the equilibrium) is given by $EVB = \frac{1}{3}\left(V^{buy} + V^{sell} + V^{out}\right)$, since a merger will then occur with certainty and since an individual firm will become a buyer, a seller or an outsider with equal probability. Moreover, when the competitors bid with certainty, the firm's expected value of not bidding (that

[13] The shareholders of a target are treated as a single individual. This is a reduced form both for statutory mergers (where shareholders vote), and for tender offers (where shareholders make independent decisions). For a statutory merger to be approved, at least some fraction α must vote for accepting the proposal. In the voting game, it is a weakly dominating strategy for a shareholder to vote for acceptance if $b > W(3)$, and to vote for rejection otherwise. In a tender offer, the buyer must acquire at least a fraction β of the target firm's shares in order to control this firm. Bagnoli and Lipman (1988) show that if $b > W(3)$, there exist equilibria where exactly this fraction β is tendered.

is a one-stage deviation) is given by $EVNB = \frac{1}{2}\left(V^{sell} + V^{out}\right)$, since a merger still occurs with certainty and since the deviating firm will become a seller or an outsider with equal probability. Thus, bidding with certainty is a best reply to competitors bidding with certainty if, and only if, $V^{buy} \geq \frac{1}{2}\left(V^{sell} + V^{out}\right)$. This condition can also be written as $W(3) \leq (2W(2^+) - W(2^-))/3$, since $V^{buy} = W(2^+) - b$, $V^{sell} = b$, $V^{out} = W(2^-)$ and $b = W(3)$. The second step is to use the fact that the stock market is efficient. When all firms bid with certainty (so that $p = 1/2$ and $q = 1/6$), the stock market value of a triopoly firm is $W(3) = (W(2^+) + W(2^-))/3$. Thus, in an immediate-merger equilibrium $W(2^+) + W(2^-) \leq 2W(2^+) - W(2^-)$, which simplifies to $\pi(2^+)/2 \geq \pi(2^-)$ since $W(2^i) = \pi(2^i)/r$. In sum, there is an equilibrium where all firms bid with certainty ($p = 1/2$) and have the stock market value $W(3) = (\pi(2^+) + \pi(2^-))/3r$ if, and only if, $\pi(2^+)/2 \geq \pi(2^-)$.

The complete equilibrium structure is presented and formally proved in Lemma 1 of Appendix B. Figure 1 above summarizes the Lemma by illustrating the parameter configurations under which the different types of equilibria exist. As already argued, there exists an immediate-merger equilibrium if, and only if, it is better to be an insider than an outsider $[\pi(2^+)/2 \geq \pi(2^-)]$, illustrated as areas C and D. There exists a no-merger equilibrium if, and only if, the merger is unprofitable $[\pi(2^+) \leq 2\pi(3)]$, illustrated as areas A and D. There exists a delayed-merger equilibrium if, and only if, mergers are profitable but being an outsider is even more profitable $[\pi(2^-) > \pi(2^+)/2 > \pi(3)]$, illustrated as area B, or mergers are unprofitable but being an outsider is even more unprofitable $[\pi(2^-) < \pi(2^+)/2 < \pi(3)]$, illustrated as area D. Hence, there exists an equilibrium for all points in the parameter space.

In area D, all three types of equilibria exist. We will focus on the immediate-merger equilibrium, since this equilibrium yields predictions replicating the stylized facts from the empirical literature.[14]

[14]Standard selection arguments do not offer clear-cut results. The no-merger equilibrium

Finally, we should mention an extension of the model. Assume that firms are asymmetric and that one merger is profitable while the other two are unprofitable. Then, the immediate-merger equilibrium is unique (Fridolfsson, 2001). Since one merger is profitable, a no-merger equilibrium does not exist. Moreover, in the immediate-merger equilibrium, unprofitable mergers occur with strictly positive (sometimes high) probability. Intuitively, if the negative externality from the profitable merger is large, some firms have an incentive to preempt this merger.

3 The Preemptive Merger Hypothesis

The condition for a merger to immediately occur is not that it is profitable; rather, it is that it is better to be an insider than an outsider. Expressed differently, if one firm has an incentive to merge, then (in our symmetric setting) so do the other firms. Thus, the relevant alternative to a merger is not status quo, but another merger. As a direct consequence of Lemma 1:

Proposition 1 *Unprofitable mergers may occur in equilibrium, if being an outsider is even more disadvantageous.*

To make the preemptive (or defensive) merger hypothesis more concrete, we supply an example why a merger may be unprofitable for the merging firms, and even more unprofitable for the outsider.[15] Consider a horizontal merger. If the merger generates important marginal cost synergies, the outsiders will lose; if it is costly

Pareto-dominates the immediate-merger equilibrium. Hence, if the firms can make an agreement not to merge, and be fully confident that this agreement is followed, the reasonable prediction is that unprofitable mergers do not occur. On the other hand, risk-dominance (Harsanyi and Selten, 1988) points at the immediate-merger equilibrium (see Fridolfsson and Stennek, 1999).

[15] A preemptive merger mechanism has also been demonstrated by Horn and Persson (2001b), using a cooperative game theory model. They study an international oligopoly and the so-called tariff-jumping argument according to which international mergers are more likely than domestic mergers, since the former saves on trade costs. Horn and Persson show, however, that domestic firms may agree to (a profitable) merger to preempt international mergers that would stiffen the competition in the home market. Nilssen and Sorgard (1998) discuss the preemption motive in an exogenous merger model.

to arrange, the insiders may lose.[16] Both conditions deserve to be commented upon. First, in a homogenous good oligopoly, marginal cost savings must be substantial for a merger to reduce the price and thus harm competitors (Farrell and Shapiro, 1990). For instance, a pure reallocation of production between plants is not sufficient; some synergy is required, for example, due to complementary patents. On a market with spatially differentiated products, on the other hand, synergies are not required for a merger to hurt competitors (Boyer, 1992). Second, the one-time costs of restructuring can indeed be substantial, for example due to problems of fusing different company cultures. As an example, the cost of the merger between Pharmacia and Upjohn was estimated to 1.6 billion dollars for the period 1995-97, as a contrast to the equity value of 5.5 billion dollars (Affärsvärlden, 1998).[17]

There are several cases illustrating that preemption is sometimes the primary motive behind one firm's acquisition of the control rights of another. Northwest Airline acquired 51 percent of the voting rights in Continental Airline, but agreed not to use its voting stake to interfere in the management of Continental for six years; it has only reserved the right to block mergers (The Economist, 1998). A more recent example is Volvo's attempted acquisition of Scania. Håkan Frisinger, the chairman of the board of Volvo, confirmed that the primary motive behind the attempted transaction was to preempt other firms with an interest in Scania (Dagens Nyheter, 1999).[18] We should emphasize that we do not claim these two mergers to be unprofitable; that we do not know. These cases only illustrate that strategic motives, and preemption in particular, are important for merger

[16] This example is formalized in footnote 7, assuming that the fixed cost f includes annuity payments of the one-time cost of restructuring.

[17] Finally, note that this example of a preemptive merger is not inconsistent with the empirical evidence showing that horizontal mergers increase consumer prices. First, if the merger induces the outsider to exit, the price may increase even though the insiders' marginal costs have decreased. Second, Boyer (1992) shows that mergers in spatially differentiated markets may hurt competitors at the same time as the average price is increased.

[18] Shortly after the merger was blocked by the European Commission, Volkswagen bought a large minority stake in Scania.

incentives in the real world. Our results show that, in principle, strategic motives may be so strong so as to induce firms to agree to unprofitable mergers.[19]

A preemptive merger also affects the merging firms' share prices. In fact, all unprofitable mergers that occur in equilibrium increase the combined value of the merging firms [$W(2^+) > 2W(3)$]. Assuming that share prices reflect the sum of the discounted expected future profits:

Proposition 2 *Unprofitable mergers occurring in equilibrium increase the combined stock market value of the merging firms.*

The proof is straightforward. Consider the case of an immediate and unprofitable merger. Such an equilibrium exists if $\pi(2^+) > 2\pi(2^-)$. Furthermore, the pre- and post-merger stock market values are given by $W(2^+) = \pi(2^+)/r$ and $W(3) = [\pi(2^+) + \pi(2^-)]/3r$ in an immediate-merger equilibrium. Hence, $W(2^+) > 2W(3)$ is equivalent to $\pi(2^+) > 2\pi(2^-)$, which is true.

Intuitively, the pre-merger value of a merging firm is low since it reflects the risk of the firm becoming an outsider. This result demonstrates that the empirical studies based on share prices and profit flows may be consistent. In particular, we may interpret the event studies as showing the existence of an industry-wide anticipation of a merger; the new information in the merger announcement is what firms are insiders and outsiders, respectively.[20]

[19]The Northwest-Continental "virtual merger" points at an objection to the preemptive merger hypothesis. Northwest continues to operate the firms under separate management. In this way, the firm protects itself against becoming an outsider, thereby avoiding the costly process of merging employees and different types of airplanes. A virtual merger (buying a competitor without integrating the firms) is not always an option, however. Once the competitor has been bought, the buyer may, in fact, have an incentive to integrate the firms. To see this, first note that an owner's decision to delegate management need not be credible. The owner certainly wants to internalize price and output decisions among his firms. This is also understood by the competitors. Hence, joint ownership may entail joint pricing and output determination. Second, once the price and quantity decisions are coordinated, the owner may also want to integrate the production processes. For example, attaining variable cost synergies, at the expense of increased fixed costs (or costs associated with the integration), may be a strategically profitable "top dog" strategy (Fridolfsson and Stennek,1999; Example 1).

[20]The effect of mergers on share prices may be quite large according to the model. The increase in the aggregate value of the insiders ranges from zero to 50 percent, and the reduction

Proposition 2 thus shows that rising share prices should not be taken as proof that a merger creates value, since share prices and profits may go in opposite directions. This result, however, depends crucially on the stock market being efficient. Assume that the stock market does not understand the equilibrium of the merger formation game, and does not foresee an upcoming merger. Assume, in particular, that the stock market expects the triopoly to continue forever. The pre-merger value of the firms is then given by $\widetilde{W}(3) = \pi(3)/r$. Consequently, the evolution of the stock market value of the merging firms, from $2\widetilde{W}(3)$ to $W(2^+) = \pi(2^+)/r$ does reflect the profitability of the merger. Hence, in order to correctly interpret event study evidence, it is important to empirically discriminate between the efficient market (anticipation) hypothesis and the surprise hypothesis.

The preemptive merger hypothesis also has a residual implication, namely that the outsider's value decreases, that is, $W(2^-) < W(3)$. Unfortunately, the available evidence on this point is not conclusive. Stillman (1983) finds no statistically significant effect on the outsiders' share prices while Eckbo (1983) finds a statistically significant increase. However, the latter study is also inconclusive; in those cases where the competition authorities announce an investigation of the merger, there is no significant effect on the outsiders' share prices. Schumann (1993) confirms this pattern. The most favorable evidence for the preemption hypothesis has been produced by Banerjee and Eckard (1998). They show that during the Great Merger Wave of 1897 - 1903 the competitors suffered significant value losses.[21]

The previous literature contains several other explanations why unprofitable mergers occur. Roll (1986) argues that those managers that overestimate their

in the value of the outsider ranges from zero to 100 percent, depending on the exact location of the market in Figure 1.

[21] Banerjee and Eckard also report small drifts in the share prices for two months before the merger event. The insiders' values are increased (although economically insignificantly). The outsiders' values are reduced (although statistically insignificantly). These movements are consistent with the preemptive merger cum anticipation hypothesis if the stock market already expects an unprofitable merger, and if it is membership information that is leaking in the last two months.

ability (or profit opportunities in general) most, are also most likely to buy a target firm. Shleifer and Vishny (1988) argue that managers have other motives than value maximization, such as the size of their organization, while Fauli-Oller and Motta (1996) argue that unprofitable mergers are a side effect of strategic delegation. Rau and Vermaelen (1998) show that, provided that the buyer has a high book-to-market value before the merger, a large number of merged firms underperform on the stock market in the first three years after the merger. To explain their findings, they suggest that the market (not only the management) systematically over-extrapolates the past performance of successful managers. All these hypotheses (hubris, empire-building, strategic delegation, over-extrapolation and preemption) may contribute to a full understanding of why unprofitable mergers occur. The two latter may also explain why share prices are increased.

4 On the Construction of Control Groups in Profit Studies

The empirical evidence suggests that most M&A activity is due to identifiable shocks, examples of which are deregulation, factor price changes, foreign competition and technological innovations (Mitchell and Mulherin, 1996). Although we have not emphasized this point earlier, our model should also be interpreted as mergers being associated with shocks. Immediate (or delayed) mergers must occur immediately (or some time) after the current market conditions were settled. Before that, the initial market structure (triopoly) was stable, i.e. in a no-merger equilibrium.

This association of mergers with changes in external conditions creates an identification problem; the effect of the merger on profits and share prices must be separated from the effect of the shocks. The identification problem is probably not severe in event studies; since they compare share prices a few weeks before

and after the announcement, they are not likely to capture the direct effect of the shock. Therefore, the model builds on the assumption that the shock has already occurred before the beginning of the merger game. Expressed differently, the pre-merger value of firms, that is $W(3)$, should be interpreted as a firm's value after the effects of the shock have been incorporated into the share prices, but before a possible (and anticipated) merger occurs. Note, however, that this requires "immediate" mergers to be interpreted as mergers undertaken "as fast as possible," allowing for inevitable administrative delay.[22]

The identification problem is likely to be severe in the accounting profit studies, however. Since these studies must be extended for several years around the transaction, they are likely to include the event triggering the merger. To control for exogenous shocks, all modern studies relate the change in the insiders' profits to the change in the profits of a control sample. The literature can be divided into two parts, depending on how the control sample is constructed. In some studies, the control sample consists of firms from various industries (e.g. Meeks, 1977; Ravenscraft and Scherer, 1987). In other studies, the control sample consists of firms from the same industry as the merging firms (e.g. Healy, Palepu and Ruback, 1992). As it turns out, the construction of the control group is important for the results. Merging firms perform significantly worse than the control group in the studies including firms from various industries. In contrast, when compared to control firms from the same industry, the effect of mergers is mainly insignificant, and in the cases where it is significant, the results favor the merging sample.[23]

The latter methodology is likely to more efficiently control for external shocks

[22] An interesting area for future research is to also explore the other possibility, i.e. that the administrative delay is short, and that event-studies thus do capture the direct effects of the shocks. Such a model could be used for comparing the equilibrium when the shock is anticipated by the stock market and when the shock comes as a surprise. Potentially, one might also investigate which of all hypotheses (long versus short administrative delay; surprise versus anticipation) is favored by the empirical evidence.

[23] The crucial importance of the control group was first noted by Bild (1998).

since some shocks are industry specific. There is, however, also a problem with this methodology; since the firms in the control group may compete with the insiders, they are exposed to externalities from the merger. If so, the change in relative profitability is a biased measure of the change in the insiders' profitability. In particular, if there is a positive (negative) externality, the change in relative profitability under-estimates (over-estimates) the change in profitability, a bias of crucial importance for interpreting the empirical literature. In fact:

Proposition 3 *Unprofitable mergers occurring in equilibrium increase the insiders' profits in relation to the profit of the outsider.*

The proof is straightforward. Consider region D where unprofitable mergers may occur. Before the merger, the insiders' relative profitability is $\pi(3)/\pi(3) = 1$ and after the merger, it is $\frac{1}{2}\pi(2^+)/\pi(2^-) > 1$.

Proposition 3 provides a potential explanation why the results in accounting profit studies are sensitive to the choice of control group. Proposition 3 also shows that an increase in the profits relative to other firms in the same industry should not be taken as proof that a merger creates value.[24]

Bear in mind, however, that we illustrate the bias problem in an extreme way. We assume that the control sample consists of the outsider(s) only, and we have not formally included external shocks in the model. In reality, the attractiveness of including firms from the same industry in the control sample depends on the relative strength of externalities and external shocks, and the extent to which external shocks are industry specific. The important conclusion is that one must be careful when constructing the control group. If possible, one

[24]Quite a few other studies find a negative (but insignificant) effect of mergers, as compared to firms in the same industry (e.g. some country studies in Mueller, 1980). In our model, the only mergers that occur in equilibrium and reduce relative profits are those in area B of Figure 1. Hence, in equilibrium, if a merger reduces the insiders' profits in relation to that of the outsider, it is a profitable merger. Thus, according to this model, if a merger reduces profits in relation to competitors, the merger should be concluded to be profitable and not unprofitable, as is usually the case. This result indicates that the negative impact of mergers on profits may have been overstated.

should avoid controlling for external shocks by using firms likely to be exposed to an externality from the merger, for example firms active in both the same product market and the same geographical market.

5 Why Targets Take it All

The event study literature shows that targets capture the whole stock market surplus from mergers. Our next goal is to show how the preemptive merger mechanism can explain such an unequal split of the surplus.

The essential element of the preemptive merger mechanism is that firms compete to buy other firms. Still, we have not captured the full intensity of the bidding competition occurring in reality. When two firms bid for the same firm, the target will choose the most favorable offer and, as a result, a Bertrand-like competition may arise. In contrast, we have assumed that targets only receive one of the offers tendered by the other firms. Moreover, the offers are randomly selected with equal probability, independent of the magnitude of the bid. As a result, the model predicts that targets only receive their reservation values and, thus, that the buyer takes the whole surplus, which is at odds with the empirical evidence.[25]

In this section, we discuss a variation of the model, allowing for the full intensity of bidding competition. This is not a trivial extension, however, since a very high target premium creates a strong disincentive for firms to bid and, as a consequence, a strong disincentive for mergers. Therefore, it is not obvious that mergers giving the target the whole surplus can occur in equilibrium. In fact, our analysis shows that pure strategy equilibria fail to exist due to this disincentive

[25] This first mover advantage may seem surprising, since the respondent can reject the offer and make a counter offer almost immediately. However, if the respondent rejects the offer, there is a 1/3 risk that he becomes an outsider in the next period, which would yield an even lower value; a risk exploited by the first mover.

to merge.[26]

The revised model is different in one respect only. We now distinguish between non-competing bids (two bids for different targets) and competing bids (two bids for the same target). Essentially, we assume that among competing bids, only the highest bids are transmitted, an assumption capturing the fact that a target receiving two bids will choose the highest one.[27] It turns out that we now need to explicitly allow firms to randomize over different bids for an equilibrium to exist. A symmetric Markov perfect equilibrium is characterized by the triple $(a, p, F(b))$, where $F(b)$ denotes the cumulative distribution of bids, given that a firm submits a bid. Note that there are two opposing forces determining the optimal bid. A high bid increases the target premium, while a low bid increases the risk of becoming an outsider.

The equilibrium structure of this model is similar to the basic model. The only interesting difference is the size of the bids. When it is better to be an insider than an outsider, the bids are distributed over an interval, $\left[W(3), \overline{b}\right]$. The equilibrium bid distribution balances the already mentioned two opposing forces, making all bids in the interval equally profitable. Since the bid is always larger than $W(3)$, the target's stock market value is always increased. Moreover, the buyer's stock market value both increases and decreases with positive probability. In fact:

Proposition 4 *If being an insider is better than being an outsider, the combined stock market value of the merging firms increases, as does the stock market value of the target firm. In expectation, the stock market value of the buying firm is unaffected.*

The proof of Proposition 4 is to be found in Fridolfsson and Stennek (2001).

[26] We are greatful to two anonymous referees for suggesting this variation of the model.

[27] Formally, we can describe the transmission technology in the following way. The probability that a particular firm j is selected as target in a certain period is equal to the number of bids submitted to j, divided by the total number of bids submitted in that period. Among the bids submitted to j, the highest bids are selected with equal probability.

An immediate consequence of the Proposition is that the target receives the whole surplus in expectation, since the stock market value of the buying firm is unaffected in expectation. The intuition is the same as in Bertrand competition, although here, bidding competition eliminates the buyer's share of the surplus in expected terms. The significance of this result is that it generates the stylized facts found in the event-study literature.[28]

There exists a small literature on "preemptive takeover bidding" attempting to explain why bidders offer targets such a high premium. For example, Fishman (1988) argues that a first bidder may offer a high premium to signal a high private valuation of the target. Thus, a second bidder may be deterred from investing in costly information about the target and, hence, from submitting a competing bid. Although our results have much in common, there are also important differences; in our model the identity of the target is endogenous, for example.

6 Policy Implications

The diverging empirical evidence on M&A performance has created a controversy regarding the benefits of merger control. The results of the present paper, however, indicate that the empirical evidence does not support very strong policy conclusions.

Is antitrust costly for shareholders? Since event studies indicate that mergers increase the combined stock market value of the merging firms, Jensen and Ruback (1983) argue that "antitrust opposition to takeovers imposes substantial costs on the stockholders of merging firms". The preemptive merger hypothesis, however, shows that increasing share prices are consistent with the merger

[28] There is a potential problem, however. The prediction is conditional on it being better to be an insider than an outsider. If this condition is not satisfied, the stock market values of the target and the acquiring firms are not affected. Fortunately, the condition in Proposition 4 can be identified empirically. It is straightforward to show that if it is better to be an insider than an outsider, the stock market value of the outsider is reduced. If, on the other hand, it is better to be an outsider than an insider, this value is increased.

reducing the firms' profitability. If antitrust could consistently block mergers motivated by preemption, shareholders would be better off.

Is antitrust good for consumers? Since anti-competitive mergers raise outsiders' profits, it has been argued that they should also raise their stock market values. Surprisingly, however, event studies indicate that even mergers challenged by antitrust authorities do not increase competitors' share prices. Based on this evidence, Eckbo and Wier (1985) argue that "all but the 'most overwhelmingly large' mergers should be allowed to go forward". However, in Fridolfsson and Stennek (2000b) we show that event studies cannot detect anti-competitive mergers, since such mergers may reduce outsiders' stock market value. This result is an immediate corollary of Lemma 1 of the present paper. Hence, the opposition toward merger control expressed by Eckbo and Wier is not well-founded.

Should antitrust authorities block unprofitable mergers? Since accounting profit evidence indicates that a large proportion of all mergers are unprofitable, Mueller (1993) proposes a policy preventing efficiency-reducing mergers, and not only those harming competition. "Such a policy would look radically different from that delineated in the 1992 Guidelines, and would probably require antimerger legislation that goes beyond Section 7 [of the Clayton Act]." Actually, such a policy has already been used in the U.K. The Monopolies and Mergers Commission has condemned mergers due to their likely adverse effects upon the firms' efficiency (Whish, 1993). However, our work indicates that such an ambitious policy might not be required. According to the preemptive merger hypothesis, unprofitable mergers occur when a merger has negative externalities on competing firms. A horizontal merger that is bad for competitors, is likely to be good for consumers, however. For example, if a merger reduces marginal costs (but increases fixed costs), it may reduce the price and hence, benefit consumers. Preemptive mergers may even increase social welfare.[29]

[29] Consider the Cournot model in footnote 7. If, for example, $c = 0.5$ and $f = 0.22$, there is a preemptive merger equilibrium. Moreover, it is easy to verify that social welfare, defined as

Should antitrust authorities neglect the effect of mergers on the merging firms' profits? Farrell and Shapiro (1990) argue that the authorities may not need to check that mergers are privately profitable; since the merger is proposed, it must be profitable. The competition authorities can concentrate on evaluating the effects of mergers on consumers and competitors. If the externalities are also positive, the merger is socially desirable. However, the empirical findings that profit flows are often reduced cast doubts on the foundations of this recommendation. In order to address this concern, however, we need to understand why unprofitable mergers take place. Some explanations of unprofitable mergers rely on the assumption that the owners of the firms lack the instruments to discipline their managers, and that managers consistently overestimate their abilities (Roll, 1986), or that managers are motivated by a desire to build a corporate empire (Shleifer and Vishny, 1988). If the hubris or the empire-building explanations are correct, the externality approach may be appropriate. Rather, improvements in the owners' ability to control their management are warranted. The preemptive merger hypothesis, on the other hand, depicts profit flow reductions as a result of the competitive forces in the product market, which opens up for a discussion of whether competition policy should be used for preventing privately unprofitable mergers. In our view there are important objections to such a policy, however. Unprofitable mergers may systematically be good for consumers and, potentially, also for social welfare. Moreover, antitrust authorities may not have the expertise required to perform such a task.

7 Concluding Remarks

We demonstrate a preemptive (or defensive) merger mechanism that may explain the empirical puzzle why mergers reduce profits and raise share prices. In Fridolfsson and Stennek (2000b), we also demonstrate why mergers may reduce

the sum of consumers' surpluses and producers' profits, is increased by such a merger.

competitors' share prices even though their profits increase (as, for example, in an anti-competitive merger). These results may be reformulated as a critique of the empirical literature on mergers.

We have demonstrated that mergers may affect the value of firms (the sum of expected discounted profits) and profits in opposite directions. If the stock market understands merger dynamics, the change in the firms' stock market values reflects the change in their true values. If, on the other hand, the merger comes as a surprise, the change in the firms' stock market values reflects the change in their profitability. Hence, to understand the informational contents of share prices, it is essential for future event studies to empirically discriminate between the efficient market (anticipation) hypothesis and the surprise hypothesis.

We have shown that the current practice to control for external shocks by measuring M&A performance relative to the performance of firms in the same industry, may produce biased estimates. The reason is that mergers confer externalities on, for example, competitors. Finding other methods of controlling for external shocks is an important challenge for future empirical work. A minimum requirement is that one must be careful not to control for external shocks by including firms likely to be exposed to an externality from the merger (e.g. competitors) in the control sample.

Some empirical studies of M&A performance use share price data, while others use accounting profits. In the past, the two types of data have been viewed as substitutes. However, our results indicate that these data are complements. Relying on share prices only, it may not be detected that unprofitable mergers occur; relying on accounting profits only, the reasons why they occur may not be detected.[30] Hence, in future empirical work, it is desirable to integrate the two types of data.

[30]For example, it might be suspected that mergers motivated by empire-building reduce the stock market value of the merging firms. Since preemptive mergers increase their value, share-price data should be useful for discriminating between the two hypotheses.

Similarly, we have demonstrated the importance of externalities for firms' incentives to merge. Hence, in future empirical work, it is desirable to integrate data on insiders and outsiders. One possibility is to classify mergers (with reference to Figure 1) as type B, C, or D (and perhaps even as type A). Such an approach would also be crucial for testing the preemptive merger hypothesis. In particular, there are some residual implications of the hypothesis that can be useful for further testing, namely that outsiders lose in terms of profits as well as share prices, both in absolute and in relative terms.

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A Definitions of EVB and $EVNB$

In this appendix, we derive formal expressions for EVB and $EVNB$. Let there be n (=3) firms in the initial market structure, and let $m \in \{0, \ldots, n-1\}$ denote the number of *other* firms ($j \neq i$) submitting a bid at a certain point in time. Note that m is a binomial random variable with parameters $(n-1)$ and $(n-1)\,p$.[31] Then,

$$EVB = V^{buy} E\left\{\tfrac{1}{m+1}\right\} + V^{sell} E\left\{\tfrac{m}{m+1}\right\} \tfrac{1}{n-1} + V^{out} E\left\{\tfrac{m}{m+1}\right\} \tfrac{n-2}{n-1}. \tag{8}$$

The value of buying is multiplied by $E\{1/(m+1)\}$, since $1/(m+1)$ is the probability of firm i's bid being transmitted when $m+1$ firms make a bid. The value of selling is multiplied by $E\{m/(m+1)\}/(n-1)$, since $m/(m+1)$ is the probability of i's bid not being transmitted, and $1/(n-1)$ is the probability of i receiving the transmitted bid. Moreover,

$$EVNB = W(3)\Pr\{m=0\} + V^{out}\left[1-\Pr\{m=0\}\right]\tfrac{n-2}{n-1} + V^{sell}\left[1-\Pr\{m=0\}\right]\tfrac{1}{n-1}. \tag{9}$$

[31] That is

$$\Pr\{m=\mu\} = \binom{n-1}{\mu}\left[(n-1)\,p\right]^{\mu}\left[1-(n-1)\,p\right]^{(n-1)-\mu},$$

since the probability that μ specific firms post a bid is $[(n-1)\,p]^{\mu}$, the probability that $(n-1)-\mu$ specific firms do not post a bid is $[1-(n-1)\,p]^{(n-1)-\mu}$, and there are $\binom{n-1}{\mu}$ ways of selecting μ bidders out of $(n-1)$ potential bidders.

The value of remaining in status quo is multiplied by the probability that no other firm bids ($m = 0$), which is the only case where the triopoly ($n = 3$) persists. The value of being an outsider is multiplied by $[1 - \Pr\{m = 0\}]\left(\frac{n-2}{n-1}\right)$, that is, the probability that at least one firm bids and that this bid is not for i.

B The Equilibrium Structure

Lemma 1 *Consider the symmetric Markov perfect equilibria as $\Delta \to 0$. A no-merger equilibrium exists if, and only if, $\pi(2^+)/2 \leq \pi(3)$. An immediate-merger equilibrium exists if, and only if, $\pi(2^+)/2 \geq \pi(2^-)$. A delayed-merger equilibrium exists if, and only if, $\pi(2^-) > \pi(2^+)/2 > \pi(3)$ or $\pi(2^-) < \pi(2^+)/2 < \pi(3)$. There exist no other symmetric Markov perfect equilibria as $\Delta \to 0$.*[32]

Proof: The proof of the Lemma makes use of some technical results reported as Lemmas 2, 4 and 3 in Appendix C.

We start the proof by rewriting the definitions of $W(3)$, EVB and $EVNB$. Let $\delta = e^{-r\Delta}$. Substitute (2a)-(2c) into (3) and solve for $W(3)$:

$$W(3) = \pi(3)/r + \tfrac{2\delta q}{1-\delta+6\delta q}\left[W\left(2^+\right) + W\left(2^-\right) - 3\pi(3)/r\right]. \tag{10}$$

Note that by Lemma 2, when $p > 0$ and $n = 3$,

$$E\left\{\tfrac{1}{m+1}\right\} = \tfrac{1-(1-2p)^3}{6p}. \tag{11}$$

Note also that $E\left\{\frac{m}{m+1}\right\} = 1 - E\left\{\frac{1}{m+1}\right\}$. By equations (8) and (9), we thus have:

$$EVB = V^{buy} E\left\{\tfrac{1}{m+1}\right\} + \left[1 - E\left\{\tfrac{1}{m+1}\right\}\right]\left[V^{sell} + V^{out}\right]\left(\tfrac{1}{2}\right), \tag{12}$$

$$EVNB = W(3)\Pr\{m = 0\} + [1 - \Pr\{m = 0\}]\left[V^{out} + V^{sell}\right]\left(\tfrac{1}{2}\right). \tag{13}$$

Now we analyze immediate-, no- and delayed-merger equilibria.

[32] Actually, a delayed merger equilibrium also exists in the non-generic case when $\pi(2^-) = \pi(2^+)/2 = \pi(3)$ (the intersection of the two lines in Figure 1). In this case, any $p \in (0, 1/2)$ is a (delayed) equilibrium. Unless $p \to 0$ as $\Delta \to 0$, the merger will occur (almost) immediately.

An **immediate-merger** equilibrium is characterized by $p = 1/2$. By equation (4), we have $q = 1/6$. By equation (10), we have $W(3) = [W(2^+) + W(2^-)]/3$ when $\Delta \to 0$ (that is, $\delta \to 1$). By equation (11), $E\left\{\frac{1}{m+1}\right\} = 1/3$. By equation (12), equations (2a)-(2c) and equilibrium condition (6), we have $EVB = [W(2^+) + W(2^-)]/3$. By equation (13), equations (2b)-(2c) and equilibrium condition (6), we have $EVNB = [W(2^-) + W(3)]/2$, since $\Pr\{m = 0\} = 0$. Hence, $EVB \geq EVNB$ if, and only if, $W(3) \leq [2W(2^+) - W(2^-)]/3$. Insert the equilibrium value for $W(3)$. By equation (1), the inequality simplifies to $\pi(2^+) \geq 2\pi(2^-)$.

A **no-merger** equilibrium is characterized by $p = 0$. By equation (4), we have $q = 0$. By equation (10), we have $W(3) = \pi(3)/r$. By Lemma 2, $E\left\{\frac{1}{m+1}\right\} = 1$. By equation (12), we have $EVB = W(2^+) - \pi(3)/r$. By equation (13), we have $EVNB = \pi(3)/r$, since $\Pr\{m = 0\} = 1$. Hence, by equation (1), $EVB \leq EVNB$ if, and only if, $\pi(2^+) \leq 2\pi(3)$.

A **delayed-merger** equilibrium is characterized by $p \in (0, 1/2)$. Use equation (1) to eliminate $W(2^i)$ in equation (10). Use equation (4) to eliminate q. Then:

$$W(3) = H(p, \delta) \equiv \pi(3)/r + \eta(p, \delta)\left[\pi\left(2^+\right) + \pi\left(2^-\right) - 3\pi(3)\right]/r, \qquad (14)$$

where η is defined in Lemma 3. Use equations (2a)-(2c) to eliminate V^{buy}, V^{sell} and V^{out} in the expressions for EVB and $EVNB$, given by equations (12) and (13) respectively. Use equilibrium condition (6) to eliminate b and equation (1) to eliminate $W(2^i)$. Equate EVB and $EVNB$ and solve for $W(3)$:

$$W(3) = K(p) \equiv \pi\left(2^+\right)/2r - 2\xi(p)\left[\pi\left(2^+\right)/2 - \pi\left(2^-\right)\right]/r, \qquad (15)$$

where ξ is defined in Lemma 4. Equations (14) and (15) define the equilibrium values of p and $W(3)$.

First, assume that $\pi(3) > \pi(2^+)/2 > \pi(2^-)$, corresponding to area D in Figure 1. In this case, equations (14) and (15) are displayed in Figure 2 and their intersection represents the equilibrium point. Note that $K(p)$ is monotonically

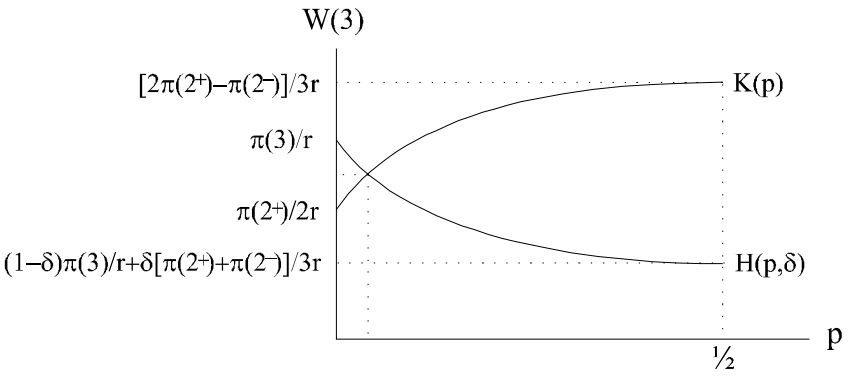

Figure 2: The delayed merger equilibrium in area D of Figure 1.

increasing, since $\xi' \leq 0$ (by Lemma 4) and $\pi(2^+)/2 > \pi(2^-)$. Note also that $H(p,\delta)$ is monotonically decreasing in p, since $\partial\eta/\partial p \geq 0$ (by Lemma 3) and $\pi(2^+) + \pi(2^-) < 3\pi(3)$ when $\pi(3) > \pi(2^+)/2 > \pi(2^-)$. Moreover, note by Lemmas 4 and 3 that $K(0) = \pi(2^+)/2r < H(0,\delta) = \pi(3)/r$ and $K(1/2) = [2\pi(2^+) - \pi(2^-)]/3r > H(1/2,\delta) = (1-\delta)\pi(3)/r + \delta[\pi(2^+) + \pi(2^-)]3/r$ if δ is sufficiently close to 1. Hence, $K(p)$ and $H(p,\delta)$ intersect once if δ is sufficiently close to 1. This solution defines p and $W(3)$ as functions of δ. Finally, we analyze this solution as $\delta \to 1$ (that is, $\Delta \to 0$). By Lemma 3, $\eta(p,\delta)$ is Γ-shaped as $\delta \to 1$. Consequently, $H(p,\delta)$ is L-shaped as $\delta \to 1$, since $\pi(2^+) + \pi(2^-) < 3\pi(3)$. Therefore, $p \to 0$ and $W(3) \to K(0) = \pi(2^+)/2r$ as $\delta \to 1$.

Second, assume that $\pi(3) < \pi(2^+)/2 < \pi(2^-)$, corresponding to area B in Figure 1. By analyzing the slopes and intercepts of $K(p)$ and $H(p,\delta)$, it is once more easy to show that equations (14) and (15) have a unique solution. As in the first case, it is easy to show that $p \to 0$ and $W(3) \to K(0) = \pi(2^+)/2r$ as $\delta \to 1$.

Third, we show that there do not exist any delayed merger equilibria in areas A and C of Figure 1. Assume that $\pi(2^+)/2 > \pi(2^-)$ and $\pi(2^+) + \pi(2^-) > 3\pi(3)$. By Lemma 4, $K(p)$ is monotonically increasing, since $\pi(2^+)/2 > \pi(2^-)$. By Lemma 3, $H(p,\delta)$ is monotonically increasing in p, since $\pi(2^+) + \pi(2^-) > 3\pi(3)$.

Finally, we show that $K(0) > H(1/2, \delta)$ which implies that the system of equations (14) and (15) does not have a solution. By Lemma 4, $K(0) = \pi(2^+)/2r$. By Lemma 3, $H(1/2, \delta) = (1-\delta)\pi(3)/r + \delta[\pi(2^+) + \pi(2^-)]/3r$. Note that $K(0) > H(1/2, 1)$, since $\pi(2^+)/2 > \pi(2^-)$. By continuity, it follows that $K(0) > H(1/2, \delta)$ if δ is sufficiently close to 1. Finally, partition the remaining profit configurations into the three following cases: $\pi(2^+)/2 > \pi(3)$ and $\pi(2^+) + \pi(2^-) \leq 3\pi(3)$; $\pi(2^+)/2 < \pi(2^-)$ and $\pi(2^+) + \pi(2^-) < 3\pi(3)$; $\pi(2^+)/2 < \pi(3)$ and $\pi(2^+) + \pi(2^-) \geq 3\pi(3)$.[33] By analyzing the slopes and intercepts of $K(p)$ and $H(p, \delta)$ in each case, it is once more easy to show that the system of equations (14) and (15) has no solutions.

C Additional Lemmata

Lemma 2 *Let* $m \sim Bin(n-1, (n-1)p)$. *When* $p > 0$,

$$E\left\{\frac{1}{m+1}\right\} = \frac{1}{n(n-1)p}\left[1 - (1-(n-1)p)^n\right].$$

When $p = 0$, $E\left\{\frac{1}{m+1}\right\} = 1$.

Proof: See Fridolfsson and Stennek (1999).

Lemma 3 *Let*

$$\eta(p, \delta) \equiv \frac{1}{3}\frac{\delta\left[1-(1-2p)^3\right]}{1-\delta+\delta\left[1-(1-2p)^3\right]}.$$

For all $\delta \in (0,1)$, $\eta(0, \delta) = 0$, $\eta(1/2, \delta) = \delta/3$, *and* $\eta(p, \delta)$ *is monotonically increasing in* p. *Moreover,* $\lim_{\delta \to 1} \eta(p, \delta) = 1/3$ *for all* $p > 0$, *so that* $\eta(p, \delta)$ *is* Γ*-shaped as* $\delta \to 1$.

Proof: The two first properties follow immediately from the definition of $\eta(p, \delta)$. Moreover,

$$\frac{\partial \eta(p,\delta)}{\partial p} = \frac{2\delta(1-\delta)(1-2p)^2}{\left(1-\delta+\delta\left[1-(1-2p)^3\right]\right)^2} \geq 0,$$

[33] In this proof, we do not treat the non-generic profit configurations given by the two lines in Figure 1 (that is, $\pi(2^+) = 2\pi(3)$ or $\pi(2^+) = 2\pi(2^-)$). Fridolfsson and Stennek (1999) provide a proof for these cases.

since $\delta < 1$. Finally, note that for all $p > 0$, $\lim_{\delta \to 1} \eta(p, \delta) = \eta(p, 1) = 1/3$.

Lemma 4 *Let*

$$\xi(p) \equiv \frac{1}{6} \frac{\Pr\{m=0\} - E\left\{\frac{1}{m+1}\right\}}{\frac{1}{3}\Pr\{m=0\} + E\left\{\frac{1}{m+1}\right\}}. \tag{16}$$

For $n = 3$, $\xi(0) = 0$, $\xi\left(\frac{1}{2}\right) = -\frac{1}{6} \leq 0$ *and* $\xi'(p) \leq 0$.

Proof: By Lemma 2 and the fact that $\Pr\{m = 0\} = (1-2p)^2$, it follows that

$$\xi(p) = \frac{-p(3-4p)}{6(2-5p+4p^2)},$$

since $n = 3$. The two first properties follow immediately. Moreover,

$$\xi'(p) = -\frac{1}{3} \frac{3-8p+4p^2}{(2-5p+4p^2)^2} \leq 0,$$

since $p \in [0, 1/2]$.

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