Fridolfsson, Sven-Olof; Stennek, Johan

Working Paper

Why Mergers Reduce Profits, and Raise Share Prices

IUI Working Paper, No. 511

Provided in Cooperation with:
Research Institute of Industrial Economics (IFN), Stockholm

Suggested Citation: Fridolfsson, Sven-Olof; Stennek, Johan (1999) : Why Mergers Reduce Profits, and Raise Share Prices, IUI Working Paper, No. 511, The Research Institute of Industrial Economics (IUI), Stockholm

This Version is available at:
https://hdl.handle.net/10419/95030

Why Mergers Reduce Profits and Raise Share Prices*

Sven-Olof Fridolfsson and Johan Stennek

March 12, 1999
Revised on December 3, 2001

Abstract

We demonstrate a "preemptive merger mechanism" which may explain the empirical puzzle why mergers reduce profits, and raise share prices. A merger may confer strong negative externalities on the firms outside the merger. If being an "insider" is better than being an "outsider," firms may merge to preempt their partner merging with someone else. Furthermore, the pre-merger value of a merging firm is low, since it reflects the risk of becoming an outsider. These results are derived in a model of endogenous mergers which predicts the conditions under which a merger occurs, when it occurs, and how the surplus is divided.

Key Words: mergers & acquisitions; defensive merger; coalition formation; antitrust policy

JEL classification: G34; L13; C78.

*Our work has been much improved due to our discussions with Mats Bergman, Jonas Björnerstedt, Francis Bloch, Dan Eklöf, Mattias Ganslandt, Sten Nyberg, Lars Persson, Frank Verboven, and Nils Wahl. We are grateful for comments from seminar participants at the universities in Antwerp (UFSIA), Lund, and Stockholm, as well as IUI (Stockholm), Stockholm School of Economics, and EARIE '98 in Copenhagen. We thank Christina Lönnblad for editorial assistance. Fridolfsson thanks Konkurrensverket for financial support. Stennek thanks Jan Wallander och Tom Hedelius Stiftelse för samhällsvetenskaplig forskning for financial support. Both authors are at the Research Institute of Industrial Economics (IUI), Box 5501, S-114 85 Stockhom, Sweden. Fridolfsson is also at the Department of Economics, Stockholm University.

1 Introduction

Today, competitive forces drive a wave of mergers & acquisitions (M&As) of historical proportions. In 1997, the total global value of M&As was around 1.6 trillion US dollars (The Economist, 1998b). Despite their evident importance, M&As are still not very well understood. The most puzzling and debated issue concerns M&A performance.

There are two types of empirical studies of M&A performance. The so-called "event studies" investigate how the stock market values the merger when it is announced, by comparing share prices a few weeks before and after the event. Even though the event studies are numerous, their results are consistent. The target firms' shareholders benefit, and the bidding firms' shareholders generally break even. Moreover, the combined gains are mostly positive.[1] The "empirical industrial organization literature" tests M&A performance by comparing profit flows a few years before and after the transaction. Summarizing the results from these studies is more complex, but the emerging picture is pessimistic. According to Scherer and Ross (1990), there is widespread failure, considerable mediocrity, and only occasional success.[2] If the evidence of both types of studies is correct, we are left with two important puzzles: Why do unprofitable M&As occur? How can we reconciliate the increase in firm values with the reduction in profit flows?

[1] See Jensen and Ruback (1983), Jarrell, Brickley, and Netter (1988), Bradley, Desai, and Kim (1988), Stulz, Walking, and Song (1990), Bekovitch and Narayanan (1993), Huston and Ryngaert (1994), Schwert (1996), and Banerjee and Eckard (1998).

[2] Negative average performance is found in for example Meeks (1977), and Ravenscraft and Scherer (1987). Positive average performance is found in Healy, Palepu, and Ruback (1992). Many of the country studies reported in Mueller (ed.) (1980) indicate negative average performance. Complementary evidence shows that market shares often deteriorate as a result of merger (Mueller, 1985; Baldwin and Gorecki, 1990). Moreover, mergers and diversifications do not often produce the productivity gains often envisioned at the time of the transaction (Caves and Barton, 1990; Berger and Humphrey, 1992). This literature is reviewed by Caves (1989) and Scherer and Ross (1990).

These puzzles are not only of academic interest. The diverging evidence on M&A performance has caused a controversy regarding the benefits and proper design of antitrust policy. On the one hand, Mueller (1993, p. 160) argues in favor of a policy that prevents mergers that reduce efficiency, and not only those that harm 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]." On the other hand, Jensen and Ruback (1983, p. 28) argue that "antitrust opposition to takeovers imposes substantial costs on the stockholders of merging firms," and furthermore that the evidence indicates that "merger gains do not arise from the creation of market power but rather from the acquisition of some form of efficiencies." If merger control is costly to firms without benefiting consumers, it appears that merger control must be harmful to welfare. In short, the view that one takes on M&A performance affects the role that one wants to give to merger control.

This paper is an attempt to solve the two puzzles. We propose a hypothesis that we call the preemptive merger motive (or defensive merger motive), which may explain why unprofitable M&As occur, and why the share-prices nevertheless increase. Firm A may merge with firm B, even if the merger reduces their combined profit flow as compared with the status quo, if the relevant alternative is that firm B merges with firm C, and this alternative merger would reduce firm A's profit flow even more. Expressed differently, even if a merger reduces the profit flow compared to the initial situation, it may increase the profit flow compared to the relevant alternative – another merger. Furthermore, even though such a preemptive merger reduces the profit flow, the aggregate value of the firms – the discounted sum of all *expected* future profits – may actually increase. The reason is that the firms'

pre-merger value accounts for the risk that they may become outsiders. Under the hypothesis that the stock market is efficient – in the sense that share prices reflect firm values – our results demonstrate that the two strands of the empirical literature may be consistent. In particular, the event studies can be interpreted to show that there exists an industry-wide anticipation of a merger, and that the relevant information content of the merger announcement is which firms are insiders and which are outsiders.

Previous explanations of unprofitable mergers rely on the assumption that the owners of the firms lack the instruments to discipline their managers, and that the managers consistently overestimate their abilities (Roll, 1986), or that the managers have other motives than value maximization, such as the size of the organization they want to lead (Shleifer and Vishny, 1988). Neither the hubris nor the empire building hypothesis explains why the aggregate value of the firms increase while their combined profits decrease. More recently, Rau and Vermaelen (1998) find evidence that many merged firms (where the buyer has a high book-to-market value before the merger) under-perform on the stock market, in the three years after the merger. To explain their findings, the authors suggest that not only the management but also the market systematically over-extrapolates the past performance of successful managers. This over-extrapolation notion constitutes a competing hypothesis to the preemptive merger hypothesis.

A critique of the existing empirical evidence, and some suggestions for further empirical testing is given is section 4. Although the preemptive merger hypothesis does not generate any ready-for-use policy proposals (it may come as a surprise, but we argue inter alia that preemptive mergers do not necessarily harm social welfare), we do point out some implications of our work for competition policy in section 5.

To describe the acquisition process, we construct an extensive form model of coalitional bargaining. In particular, we construct a so-called game of timing to describe the bargaining process.[3] In the model, any firm can submit a merger proposal to any other firm(s) at any point in time. The recipient(s) of a proposal can either accept it or reject it. In the latter case, it can make a counterproposal in the future. As a consequence, firms endogenously decide whether to merge or not, when to merge, and how to split the surplus; keeping possible alternative mergers in mind.[4] This model is a generalization of the Rubinstein-Ståhl bargaining model, not only because it concerns coalition formation (with more than two agents, competing "pies," and so on), but also since the order of proposals is endogenous.[5]

A preemptive merger mechanism has also been demonstrated by Horn and Persson (1996) 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 merge in order to preempt international mergers

[3]Games of timing have previously been used for analyzing both preemption and its opposite "wars of attrition." Examples include studies of patent races (Fudenberg, Gilbert, Stiglitz, and Tirole, 1983), adoptation of new technology (Fudenberg and Tirole, 1985), exit from declining industries (Ghemawat and Nalebuff, 1985), choice of compatibility standards (Farrell and Saloner, 1988), and entry (Bolton and Farrell, 1990).

[4]This model can be used for studying many issues related to mergers. For example, in the two companion papers Fridolfsson and Stennek (1998a,b), we study the risk that markets become too concentrated from a social welfare point of view, and the reason why mergers occur in waves. 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 recently, Kamien and Zang (1990, 1991, and 1993) constructed a non-cooperative model of the acquisition process. See also Gowrisankaran (1999). The relation between our model and previous models is discussed in more detail in Fridolfsson and Stennek (1998b).

[5]Our model is also related to the literature on auctions of assets that cause externalities on other potential buyers, see for example Funk (1996), and Jehiel and Moldovanu (1996), and Persson (1998) for an application to mergers.

that would stiffen competition in the home market.

2 The Model

Time is infinite and continuous but divided into short periods of length Δ. Each period is divided into two phases. In the first phase, there is an acquisition game where all firms can simultaneously submit bids for other firms. Firms are only committed to their bids within a period. A firm receiving a bid can only accept or reject; if it rejects, it can give a (counter) offer at the beginning of the next period. We assume that no time elapses during the acquisition game, although it is described as a sequential game. We also make an auxiliary assumption about the bargaining technology. If more than one firm bid at the same time, then only one bid is transmitted, all with equal probability.[6]

In the second phase, there is a market game. Rather than specifying an explicit oligopoly model, we take the profit levels of each firm in each market structure as exogenous variables. To focus on the mechanisms we want to illustrate, we only consider an industry with three identical firms, each firm earning the profit flow $\pi(3)$. If a merger from triopoly to duopoly takes place, the merged firm earns profit flow $\pi(2^+)$, and the outsider earns $\pi(2^-)$. If a merger to monopoly occurs, the remaining firm earns profit flow $\pi(1)$.

[6] This is a simple and transparent way to circumvent an already 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). The effect on our results of this assumption is discussed in appropriate places below. One may think of this assumption in terms of the disclosure requirements of stock exchanges. A takeover is a significant event, and if the firms involved are listed on a stock exchange, they are required to notify the exchange promptly (that is, by telephone) of the transaction (Weston, Chung and Siu, 1998). However, the stock exchange administration can only process information about one takeover at a time, and will select one of the incoming telephone calls at random.

Our analysis shows how merger incentives (the acquisition phase) depend on the profit flows in the different market structures (the market phase). We make frequent use of Figure 1, which summarizes all possible profit flow configurations connected with triopoly and duopoly. The relationship between mergers and profit flows has been studied by the so-called exogenous merger literature.[7] According to this literature, mergers from triopoly to duopoly are per se profitable in many situations. That is, the insiders increase their aggregate profits compared to the outset, that is $\pi(2^+) > 2\pi(3)$, which is illustrated as regions B and C in Figure 1. However, a merger may also be per se unprofitable, if, for example, the outsider expands its production substantially in response to the merger, which is illustrated as regions A and D in Figure 1. Normally, a merger also confers an externality on the outsider. Since a merger reduces the number of competitors for the outsiders, there is a positive market power effect, so that $\pi(2^-) > \pi(3)$. This possibility is illustrated as the area to the right of the "zero-externality line," labeled $E_{32} = 0$. However, if the merging parties can substantially reduce their marginal costs, they become a more difficult competitor. This may harm the outsiders, so that $\pi(2^-) < \pi(3)$. Furthermore, in many cases the externality is strong in the sense that the effect on the outsider's profit is larger than the effect on the insiders' profits, that is $|\pi(2^-) - \pi(3)| > \left|\frac{1}{2}\pi(2^+) - \pi(3)\right|$. For example, area D contains all markets where a merger would be per se unprofitable, and even more unprofitable to the outsider. These are the (potential) mergers that will be focused in the present paper.

[7] This strain of research studies if an exogenously selected group of firms (called the insiders) would increase their profit by merging compared to an unchanged market structure. Depending on the details of the situation, such as the number of firms, the number of insiders, the nature of competition, returns to scale, the degree of product differentiation, the insiders (and the outsiders) would or would not profit due to a merger, see for example Salant, Switzer and Reynolds (1983), Deneckere and Davidson (1985), Perry and Porter (1985), Levy and Reitzes (1992, 1995), Boyer (1992), Nilssen and Sorgard (1998).

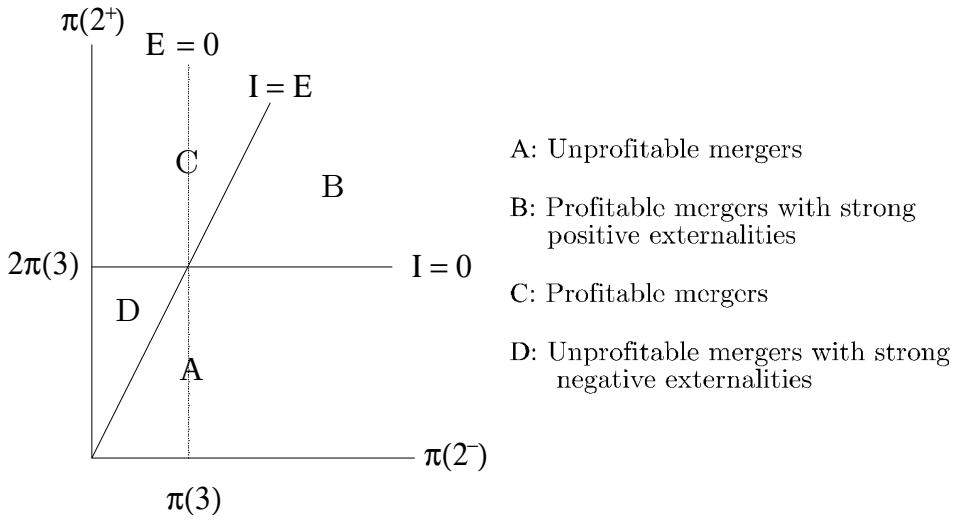

Figure 1: Mergers from triopoly to duopoly.

2.1 Mergers from Triopoly to Duopoly

In this section, we assume that firms can submit bids for only one other firm at a time. Moreover, mergers from duopoly to monopoly are not allowed. This section introduces the model. However, the results are of an independent interest if a merger for monopoly, but not for duopoly, would be blocked by competition authorities.

A firm's strategy describes the firm's behavior in the acquisition game: whether the firm submits a bid to some other firm, the size of that bid, and a reservation price at which the firm accepts to sell, if receiving a bid from some other firm. It specifies the behavior for all points in time, and for all possible "histories" at that time. We restrict our attention to Markov strategies, which means that firms do not condition their behavior on time (stationarity) or on the outcome of previous periods (history independence). We also restrict our attention to symmetric equilibria. These assumptions allow us to illustrate the preemptive merger mechanism in the simplest pos-

sible 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 biding for one specific firm in a given period, b denotes the size of this bid, and a denotes the lowest bid that a target firm will accept. For convenience, we only consider bids that would be accepted if submitted.

After a merger has occurred, the duopoly values of the merged firm (+) and the outsider firm (-) are given by

$$W\left(2^i\right) = \pi\left(2^i\right)/r \tag{1}$$

for $i \in \{+, -\}$, where r is the common continuous time discount factor, and $\pi\left(2^i\right)/r$ is the discounted value of all future profits. (Recall that, for the moment, monopoly is ruled out.) To simplify the exposition, we also define transition values for the point in time when the merger occurs. At that time, 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. In the triopoly, the expected 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, $\frac{1}{r}\pi(3)\left(1 - e^{-r\Delta}\right)$, 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 (V^{buy}), is multiplied by the probability to become a buyer (seller, outsider, triopolist) in the next period ($2q$). By definition q is the probability that a specific firm buys a specific other firm. Note that q is

determined by the probability of bidding through:

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

To see this, 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.

Let $EV(b)$ denote the expected value for firm i of bidding with certainty on firm j, and $EV(nb)$ denote the expected value for firm i of not bidding for any firm. To find expressions for $EV(b)$ and $EV(nb)$ that are easily interpreted, 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 ($j \neq i$) that submit a bid at a certain point in time. Note that m is a binomial random variable with parameters $(n-1)$ and $(n-1)p$.[8] Then,

$$EV(b) = V^{buy} E\left\{\tfrac{1}{m+1}\right\} + V^{sell} E\left\{\tfrac{m}{m+1}\right\} \tfrac{1}{n-1} + V^{out} E\left\{\tfrac{m}{m+1}\right\} \tfrac{n-2}{n-1}. \tag{5}$$

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

$$EV(nb) = W(3)\Pr\{m=0\} + V^{out}\left[1-\Pr\{m=0\}\right]\tfrac{n-2}{n-1} + V^{sell}\left[1-\Pr\{m=0\}\right]\tfrac{1}{n-1}. \tag{6}$$

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

Three equilibrium conditions complete the model. First, by subgame perfection, an offer is accepted if, and only if, the bid is at least as high as the value of the firm,[9] that is

$$a = W(3). \tag{7}$$

Second, for the bid to maximize the bidder's profit, it is necessary that

$$b = W(3). \tag{8}$$

The third equilibrium condition is that firms submit a bid if, and only if, this is profitable (recall that the probability of bidding for a particular other firm is restricted to be $p \leq 1/2$ by the symmetry assumption):

$$\begin{cases} \text{Immediate merger:} & p = \frac{1}{2} & \text{and} & EV(b) \geq EV(nb) & \text{or} \\ \text{No merger:} & p = 0 & \text{and} & EV(b) \leq EV(nb) & \text{or} \\ \text{Delayed merger:} & p \in (0, 1/2) & \text{and} & EV(b) = EV(nb). & \end{cases} \tag{9}$$

[9] The shareholders of a target firm are treated as a single individual in their decision to accept or reject a merger proposal. We consider this as a reduced form both for statutory mergers (where shareholders vote), and for tender offers (where shareholders make independent decisions about their own shares). For a statutory merger to be approved, shareholders must vote, and at least some fraction α must vote for accepting the proposal (Gilson and Black, 1995). 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 rejectance otherwise. In a tender offer, the buyer must acquire at least a fraction α of the target firm's shares in order to control this firm. Bagnoli and Lipman (1988) show that if $b > W(3)$, there exists equilibria where exactly this fraction α is tendered (assuming that the number of shareholders is finite).

Let the average net gain of becoming an insider, compared to remaining in triopoly, be denoted by

$$I_{32} \equiv \frac{1}{2}\left(V^{buy} + V^{sell}\right) - \frac{1}{r}\pi\left(3\right) = \frac{1}{r}\left[\frac{1}{2}\pi\left(2^{+}\right) - \pi\left(3\right)\right]. \tag{10}$$

Similarly, the net gain of becoming an outsider, compared to remaining in a triopoly, that is the externality, is denoted by

$$E_{32} \equiv V^{out} - \frac{1}{r}\pi\left(3\right) = \frac{1}{r}\left[\pi\left(2^{-}\right) - \pi\left(3\right)\right]. \tag{11}$$

Lemma 1 (a) *Consider mergers from triopoly to duopoly, when mergers for monopoly are forbidden. Consider the set of symmetric Markov perfect equilibria as* $\Delta \to 0$. *A no-merger equilibrium exists if, and only if,* $I_{32} \leq 0$. *An immediate-merger equilibrium exists if, and only if,* $I_{32} \geq E_{32}$. *A delayed-merger equilibrium exists if, and only if,* $\Theta \equiv 3I_{32}/\left(E_{32} - I_{32}\right) > 0$, *that is if, and only if, the externality is strong,* $|E_{32}| > |I_{32}|$, *and has the same sign as the internal effect,* $sign\left\{E_{32}\right\} = sign\left\{I_{32}\right\}$.

Proof: See Appendix A.

The parameter configurations under which the different types of equilibria exist are illustrated in Figure 1. There exists a no-merger equilibrium if and only if $I_{32} \leq 0$, that is $\pi\left(2^{+}\right)/2 \leq \pi\left(3\right)$. This is indicated as areas A and D (including the boundaries). There exists an immediate-merger equilibrium if and only if $I_{32} \geq E_{32}$, that is $\pi\left(2^{+}\right)/2 \geq \pi\left(2^{-}\right)$. This is indicated as areas C and D (including the boundaries). There exists a delayed-merger equilibrium in areas B and D (excluding the boundaries). Hence, there exists an equilibrium for all points in the parameter room.[10]

[10] Actually, a delayed merger equilibrium also exists in the non-generic case when $I_{32} = E_{32} = 0$. 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.

For the points in area D, all three types of equilibria exist. Can we select one equilibrium as more reasonable than the others? The no-merger equilibrium Pareto-dominates the immediate-merger equilibrium. Hence, if the firms can make an agreement not to merge, and be fully confident that it is followed, the reasonable prediction is that unprofitable mergers do not occur. On the other hand, risk-considerations point at the immediate-merger equilibrium. Actually, a firm will bid with certainty, for almost all conjectures about the other firms' bidding probabilities (as $\Delta \to 0$).[11] In this sense, the immediate-merger equilibrium strongly risk-dominates the no-merger equilibrium (see Harsanyi and Selten, 1988).

However, in our view, one should not select the immediate-merger equilibrium in the whole of area D. Rather, the immediate-merger equilibrium is reasonable for small Θ, while the no-merger equilibrium is reasonable for large Θ. In Figure 2, all markets with a given $\Theta = 3I/(E-I) > 0$ can be found on a straight line through the point $I = E = 0$. Along the $I = 0$ line, $\Theta = 0$, and along the $E = I$ line, $\Theta = +\infty$. Along a line relatively close to area C and relatively far away from area A, Θ is relatively low. Now, consider an industry positioned at the point α (characterized by the low Θ_α). In this industry, a merger reduces the outsider's profit to zero, while it only marginally reduces the insiders' aggregate profit. Hence, in this industry, a merger is a relatively cheap insurance against the risk of becoming an outsider. Expressed differently, even a small (subjectively perceived) risk that the other firms will merge should induce a firm to bid. Consider, on the

[11] This follows directly from the proof of Lemma 1. Let $p^m(\Delta)$ denote the probability of bidding in the mixed strategy (or delayed-merger) equilibrium. Then, if a firm conjectures that the other firms bid with a probability larger than $p^m(\Delta)$ the firm will bid, while if the firm conjectures that the other firms bid with a probability smaller than $p^m(\Delta)$ the firm will not bid. Moreover, $p^m(\Delta)$ converges to zero as Δ goes to zero. Hence, the measure of conjectures implying no bid goes to zero as Δ goes to zero.

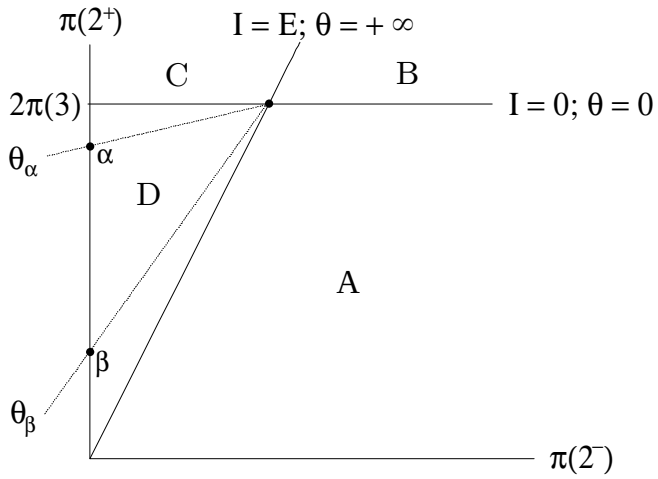

Figure 2: The reasonable equilibrium in area D depends on Θ.

other hand, an industry positioned at the point β (characterized by the high Θ_β). In this case, the merger also reduces the insiders' profits close to zero. Hence, only a large (subjectively perceived) risk that the other firms will merge should induce a firm to bid. This intuition is formalized in Appendix B. In particular, let h be the (continuous-time) hazard rate with which a merger occurs by mistake. Then, if $h > r\Theta$, firms bid with certainty. Hence, for a fixed mistake hazard rate h and interest rate r, if Θ is sufficiently small, the immediate merger equilibrium is selected.

Lemma 1 (a) demonstrates the crucial role of strong externalities. First, an unprofitable merger may occur, if being an outsider is even more unprofitable. This is what we call a preemptive (or defensive) merger, and its implications are elaborated in section 3. Second, a profitable merger may not occur immediately, if being an outsider is even more profitable. The implications of this point are elaborated in a companion paper (Fridolfsson and Stennek, 1998a). Lemma 1 (a) thus demonstrates that per se profitability is not the relevant criterion for the study of mergers, contrary to the implicit

assumption of the exogenous merger literature.

The model also predicts how the surplus is split.

Lemma 1 (b) *In an immediate merger equilibrium, there exists a first mover advantage, that is* $V^{buy} > V^{sell}$. *In a delayed-merger equilibrium (as* $\Delta \to 0$*), the insiders split the surplus equally, that is* $V^{buy} = V^{sell}$.

Proof: See Appendix A.

The first mover advantage in immediate merger equilibria 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 for him to become an outsider in the next period. Becoming an outsider yields an even lower value. This risk may be exploited by the first mover. In a delayed merger equilibrium, there is a first-mover advantage if the merger is privately profitable, and a second-mover advantage if the merger is privately unprofitable. However, as $\Delta \to 0$, the insiders split the surplus equally. To our knowledge, no previous model of mergers has succeeded in predicting how the surplus is split by merging firms.[12]

Finally, the model predicts when a (delayed) merger will occur. It can be shown that the probability for a merger to have occurred at time t is $G(t) = 1 - e^{-\Theta r t}$. Note that the probability for a merger to have occurred at $t = 0$ is zero, and that the probability for a merger to have occurred is one, when $t \to \infty$. The expected time to merger is $\int_0^\infty r\Theta e^{-\Theta r t} t dt = 1/(r\Theta)$.

[12] Kamien and Zang (1990, 1991, 1993) cannot predict how the surplus is split, because they construct the bargaining model as a Nash demand game. Firm F makes a bid b, and firm G announces a reservation price a simultaneously. If $b = a$, they have split the surplus in a consistent way, and the merger will be carried out, otherwise not. Hence, any split of the surplus is an equilibrium. Our model, on the other hand, is more like the Rubinstein-Ståhl bargaining model.

2.2 Allowing for Monopoly

This section starts by studying mergers from duopoly to monopoly. As a second step, we analyze how the mergers from triopoly to duopoly are altered by the possibility of a subsequent monopolization. The main reason for this exercise is to confirm that the main result of the previous section is robust; preemptive mergers to duopoly, as well as to monopoly, may occur in equilibrium.[13] The reader may without problem skip this section, and turn directly to the results in Section 3.

The duopoly consists of the merged entity and the outsider which earn profit flows $\pi(2^+)$ and $\pi(2^-)$ respectively. If a merger takes place, the market structure is turned into a monopoly earning profit flow $\pi(1)$. Let the average surplus resulting from the merger to monopoly be denoted by $I_{21} \equiv [\pi(1) - \pi(2^+) - \pi(2^-)]/(2r)$. The acquisition game is the same as in the previous section, and we only present the results. A no-merger equilibrium exists if and only if $I_{21} \leq 0$. An immediate-merger equilibrium exists if and only if $I_{21} \geq 0$. Such an equilibrium is characterized by $W(2^i) = \pi(2^i)/r + I_{21}$ for both the merged firm and the outsider. Hence, all per se profitable mergers from duopoly to monopoly occur immediately, and non-profitable mergers do not occur at all. Merging firms split the surplus equally.

Now, consider mergers from triopoly to duopoly when the duopoly might transform into monopoly. Let $I_{21}^* \equiv max\{0, I_{21}\}$. There is only one difference to the case in the previous section, namely that the duopoly values include the possibility of subsequent monopolization. Hence, equation (1) is substituted by $W(2^i) = \pi(2^i)/r + e^{-r\Delta} I_{21}^*$ for both the merged firm and the outsider,

[13] Fridolfsson (1988) extends this analysis to the case when firms may bid for both competitors at the same time. Preemptive mergers occur in equilibrium in this case as well.

where $e^{-r\Delta}I_{21}^{*}$ is the gain from the merger to monopoly, which is realized after one period. As a consequence, the average net gain of becoming an insider (when $\Delta \rightarrow 0$) is given by $I_{32}\left(I_{21}^{*}\right) = \frac{1}{r}\left[\frac{1}{2}\pi\left(2^{+}\right) - \pi\left(3\right)\right] + \frac{1}{2}I_{21}^{*}$. Similarly, the net gain of becoming an outsider, that is the externality, is $E_{32}\left(I_{21}^{*}\right) = \frac{1}{r}\left[\pi\left(2^{-}\right) - \pi\left(3\right)\right] + I_{21}^{*}$.

In order to focus on preemptive mergers, we only present the results in the case mergers from triopoly to monopoly are per se unprofitable, that is $I_{31} \equiv \left[\pi\left(1\right)/3 - \pi(3)\right]/r < 0$.[14] (A merger to monopoly may be unprofitable if, for example, they are costly to arrange.) The results are illustrated in Figure 3. The region where the duopoly is stable ($I_{21} \leq 0$), lies to the north-east of Line $I_{21} = 0$. This region is, in turn, partitioned into equilibrium-areas A, B, C, and D, exactly as in the case when mergers from duopoly to monopoly were ruled out by assumption. Hence, there are preemptive mergers to the stable duopoly in area D, as discussed in the previous section. The more interesting region is the one where the duopoly is unstable ($I_{21} > 0$). This region lies to the south-west of Line $I_{21} = 0$, and it is partitioned into equilibrium-areas A', C' and D'. A no-merger equilibrium exists if, and only if, the average net gain of becoming an insider is negative, that is $I_{32}\left(I_{21}^{*}\right) \leq 0$. After simplification, the condition is $\pi\left(2^{+}\right) \leq \left[4\pi\left(3\right) - \pi\left(1\right)\right] + \pi\left(2^{-}\right)$. This is indicated as regions A' and D' in Figure 3. An immediate-merger equilibrium exists if, and only if, the average net gain of becoming an insider is higher than the net gain of becoming an outsider, that is $I_{32}\left(I_{21}^{*}\right) \geq E_{32}\left(I_{21}^{*}\right)$. After simplification, the condition is $\pi\left(2^{+}\right) \geq \pi\left(1\right)/3 + \pi\left(2^{-}\right)$. This is indicated as regions C' and D' in Figure 3. A delayed-merger equilibrium exists if, and only if, the externality is strong, that is $\left|E_{32}\left(I_{21}^{*}\right)\right| > \left|I_{32}\left(I_{21}^{*}\right)\right|$, and has the same sign as the internal effect, that is $sign\left\{E_{32}\left(I_{21}^{*}\right)\right\} = sign\left\{I_{32}\left(I_{21}^{*}\right)\right\}$. This is

[14] The case when $I_{31} > 0$ is analyzed in Fridolfsson and Stennek (1998a).

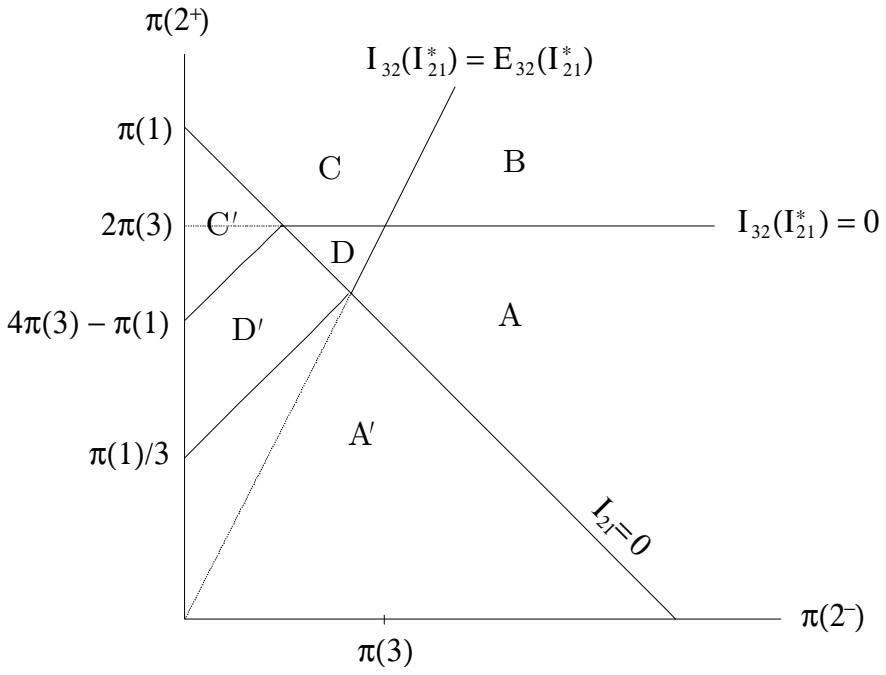

Figure 3: Allowing for monopoly; case $I_{31} < 0$.

indicated as region D' in Figure 3. Hence, mergers from triopoly to monopoly (via duopoly) occur, despite the fact that the aggregate profit in the triopoly is higher than the monopoly profit (areas C' and D'). The intuition is the same as for preemptive mergers to duopoly.

3 Results

The condition for a merger to occur immediately is not that the merger is per se profitable. Rather, the condition 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) the other firms also have an incentive to merge. Thus, the relevant alternative to a merger is not status quo, but another merger. As a consequence:

Proposition 1 *Mergers that are per se unprofitable may occur in equilibrium, if being an outsider is even more disadvantageous.*

This result shows that the competitive structure may be such that it is actually in a firm's interest to merge even though the profit would be higher if no merger occurred.

To complete the preemptive (or defensive) merger hypothesis, we should indicate why a merger may be unprofitable for the merging firms, and even more unprofitable for the outsider. One example is a merger with important marginal cost synergies (so that outsiders lose), but which is costly to arrange (so that the insiders lose). Both conditions deserves to be commented. First, in a homogenous good oligopoly, marginal cost savings must be substantial in order for a merger to lower price and thus harm competitors (Farrell and Shapiro, 1990). For instance, a pure reallocation of production between plants is not sufficient. Some sort of synergy, for example, due to complementary patents is required. On a market with spatially differentiated products, on the other hand, the reduction of marginal cost that follows from the reduction of output in segments where competition is eliminated, can often be sufficient to harm competitors (Boyer, 1992). Second, the costs associated with mergers can indeed be substantial, for example due to problems of melting together different company cultures. To mention one example, the cost for the merger between Pharmacia and Upjohn is estimated at 1.6 billion dollars during 1995-97 (Affarsvarlden, 1998).[15]

[15]Another reason why a merger may be unprofitable, and even more unprofitable for the outsider, is that a merger may reduce the opportunities for relative performance evaluations, and thus aggravate internal control problems in each firm. For example, if the insider centralizes the administration of the two plants, he loses information that is useful for the control of the administration. But, the elimination of a duplicated function should at least partially offset that loss. The outsider, on the other hand, only loses information. A third reason for preemptive mergers may be that the insiders increase their ability to lobby for standards that increases the outsider's marginal costs. Such lobbying is costly

That preemption is sometimes the primary motive behind one firm's acquisition of the control rights over another, is suggested by Northwest Airline's acquisition of 51 percent of the voting rights in Continental Airline. Northwest has 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).

This "virtual merger" points at a potential objection to our preemptive merger hypothesis. Northwest continues to operate the firms under separate management. In this way, Northwest can protect itself against becoming an outsider, but avoiding the costly and contentious process of merging employees and different types of airplanes. A "virtual merger" may even allow the firms some of the synergistic gains–at least if these are on the demand side–associated with a full merger. Thus, Northwest and Continental Airlines agreed to form a "strategic global alliance," stitching together their routs, reservation codes, and frequent-flier programs.

Unfortunately, however, a "virtual merger" is not always an option. Just buying a competitor, without integrating the firms, may not protect a firm against the preemptive merger problem. Once the competitor is bought, the buying firm 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 should also be understood by the competitors. Hence, joint ownership may entail joint management, at least at the level of pricing and output determination. Second, once the price and quantity decisions of the two units are coordinated, the owner may even want to integrate the production processes. For example, attaining variable cost synergies, at

but entails a strategic advantage vis-à-vis the outsider (Salop and Scheffman, 1983).

the expense of increased fixed costs (or costs associated with the integration), may be a strategically profitable "top dog" strategy, as shown by the following example.

Example 1 *Consider a linear homogeneous good Cournot triopoly. Inverse demand is given by* $p = 1 - q_1 - q_2 - q_3$. *There are constant returns to scale and the common marginal cost is* c. *Equilibrium quantities are* $q = (1-c)/4$ *and equilibrium triopoly profits are* $\pi(3) = (1-c)^2/16$. *Assume now that one firm buys another, and that quantity decisions are coordinated, but that the plants are not integrated so that the cost structure of each plant is unchanged. In this case, the market is a symmetric duopoly, with equilibrium profits* $\pi(2) = (1-c)^2/9$. *Assume now that the insider integrates his two plants, and that, as a result, the marginal cost in each plant is reduced to zero, but that he must pay a fixed cost of administration* f. *The equilibrium profits in this asymmetric equilibrium are given by* $\pi(2^+) = (1+c)^2/9 - f$ *and* $\pi(2^-) = (1-2c)^2/9$. *The restructuring is privately profitable and will occur after a merger if* $\pi(2^+) > \pi(2)$. *A merger leading to restructuring is privately unprofitable if* $2\pi(3) > \pi(2^+)$. *Finally, being an insider is better than being an outsider in a merger that leads to restructuring if* $\pi(2^+)/2 > \pi(2^-)$. *All these conditions are satisfied, for example if* $c = 0.5$, *and* $f = 0.22$. *An interesting feature of this example is that the unprofitable merger increases social welfare, defined as the sum of consumers' surplus and producers' surplus. In the triopoly social welfare is equal to* $(15/32)(1-c)^2$, *while in the duopoly it is equal to* $(1/18)(8 - 8c + 11c^2) - f$. *Substituting in the numerical values produces the claimed result.*

Hence, in order to avoid a preemptive merger by means of delegation, the owner must be able to commit not to internalize price and output decisions among his firms.

A preemptive merger also affects the merging firms' share prices. In our model, a per se unprofitable merger [$\pi(2^+) \leq 2\pi(3)$], raises the combined value of the merging firms [$W(2^+) \geq 2W(3)$]. Assuming that share prices reflect the sum of the discounted expected future profits:

Proposition 2 *Mergers reducing the profit flow increase the combined stock market value of the merging firms.*

Proof: See Appendix A.

Intuitively, the pre-merger value of a merging firm, $W(3)$, is low since it reflects the risk of the firm becoming an outsider. This result demonstrates that the studies of share prices and the studies of 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, and that the relevant information content of the merger announcement is which firms are insiders and which are outsiders.

Finally, we should discuss how the buyer and the seller split the surplus (in terms of firm values, there is a positive surplus). In delayed preemptive mergers, there exists a second mover advantage (when $\Delta > 0$). This feature is consistent with the empirical evidence from event studies: target firms earn more than the bidders. On the other hand, there exists a first mover advantage in immediate preemptive mergers. However, our results about how the buyer and the seller split the surplus can be sharpened, varying the model slightly. The assumption that only one bid is transmitted eliminates much of the bidding competition that may occur in reality. In particular, two firms may bid for the same firm at the same time. As a consequence, there may be a Bertrand-like competition for targets. If we assume that the highest bid goes through (with equal probability, if there are many highest bids),

then bidding competition is restored. In that case, the target receives all surplus in immediate merger equilibria. In particular, $V^{sell} = W(2^+) - W(3)$ and $V^{buy} = W(3)$. Hence, the target firm's shareholders benefit, while the bidding firm's shareholders break even, exactly as suggested by the stylized facts.

There exists a small literature on "preemptive takeover bidding" which attempts 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. We view our preemptive merger hypothesis and the preemptive takeover bidding mechanisms as complementary explanations of why targets earn more than bidders.[16]

4 Empirical Issues

Even though our preemptive merger hypothesis was provoked by two empirical puzzles, further empirical investigation is needed. In this section we point out some important empirical problems associated with the study of M&A performance, and in particular some objections against the existing empirical literature based on (accounting) profits. Finally, we discuss some residual implications of the preemptive merger hypothesis that may be used for further empirical testing.

First, although we have not emphasized this point earlier, our model predicts that mergers are associated with changes in the external conditions of

[16] Grossman and Hart (1980) argue informally that in widely held firms, (atomistic) shareholders will not tender for less than the expected post-takeover value of their shares. This mechanism also suggests that the target takes the whole surplus. However, the logic of this argument has been questioned by Bagnoli and Lipman (1988).

the market. Immediate (or delayed) mergers must come immediately after (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 the external conditions gives rise to an identification problem; one needs to separate the effect of the merger on profits form the effect of the external conditions. The identification problem is likely to be especially severe in the studies based on profits. Since these studies must be extended for several years around the transaction, it is likely that they also include the event that triggered the merger. Hence, it may well be that the claimed adverse effect of mergers on profits just reflect a spurious correlation. Against this alternative explanation, it can be said that many profit flow studies have attempted to control for such external shocks.

Second, in order to control for external shocks, several papers study how the insiders' aggregate profit has changed in comparison with other firms' profits in the same product market. In our work, where we emphasize the roles of externalities, we have noted a problem with this methodology. The reason is that the reference firms may be direct competitors to the insiders (if they operate on the same geographical market). In that case, they may be exposed to an externality from the merger. Hence, what appears to be an unprofitable merger, may simply be a profitable merger with a strong positive externality. Similarly, mergers that appear to be profitable may be unprofitable mergers with a strong negative externality (that is preemptive mergers). Hence, one must be careful not to control for external shocks by using direct competitors as reference firms.

Previous work suggests that there are many different motives for M&As. Also our work indicates that there may be different types of mergers. Hence,

the current empirical methodology to study the average effect of mergers is not fully satisfactory. It would be better to describe the full profitability distribution, for example by classifying the mergers (with reference to Figures 1 and 2) as type B, C, or D (and perhaps even as type A). Furthermore, to test the preemptive merger hypothesis more carefully, it would be desirable to collect both share price and profit flow data for the same set of mergers, and also to collect these data both for insiders and outsiders.

The preemptive merger hypothesis has two residual implications. The first prediction is that the outsider's value decreases, that is, $W(2^{-}) \leq W(3)$. Unfortunately, the available evidence on this point is not conclusive. Stillman (1983) finds no statistically significant effect on outsiders' share prices. Eckbo (1983) finds a statistically significant increase. However, the latter study is also inconclusive: in those cases where competition authorities announce an investigation of the merger, the outsiders' share prices are not affected in a significant way. Schumann (1993) confirms this pattern. The most favorable evidence for the preemption hypothesis that we are aware of is produced by Banerjee and Eckard (1998). They show that the competitors during the Great Merger Wave of 1897 - 1903 suffered significant value losses. The second residual implication is that the outsider's profit should be reduced. Unfortunately, we are not aware of any useful evidence to confront this prediction. In our view, further testing of the preemptive merger hypothesis should expand the empirical evidence on outsiders.

5 Policy Issues

If the preemptive merger hypothesis survives further careful empirical tests, it has some implications for antitrust policy. First, the preemptive merger

hypothesis shows that raising share-prices are consistent with the merger reducing the firms' efficiency. In our view, this means that the event-study evidence should not be taken to imply that antitrust opposition to takeovers imposes costs on the stockholders of merging firms (which was argued by Jensen and Ruback, 1983). Second, if a preemptive merger increases fixed costs but reduces variable costs, then the preemptive merger might reduce price and hence benefit consumers. As shown in Example 1 above, a preemptive merger may even raise social welfare. Hence, the evidence that mergers may reduce profits do not necessarily imply that antitrust or any other policy should be used to prevent such mergers (which was argued by Mueller, 1993).

Third, Farrell and Shapiro (1990) argue that competition authorities may not need to check that mergers are privately profitable; since the merger is proposed, it must be profitable. As a consequence, the competition authorities can concentrate on evaluating the effects of mergers on consumers and competitors. If the externalities are also positive, then 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. Previous explanations for unprofitable mergers rely on the assumption that the owners of the firms lack the instruments to discipline their managers, and that the managers consistently overestimate their abilities (Roll, 1986), or that the managers are motivated by a desire to build a corporate empire (Shleifer and Vishny, 1988), or that the market consistently over-estimates the abilities of successful managers (Rau and Vermaelen, 1998). If the hubris, empire-building, or over-extrapolation explanations are correct, then the problem with unprofitable M&As is not necessarily an issue to be handled by competition policy, and the externality approach may

be appropriate. Rather, improvements in the owners' ability to control their management are warranted. Our preemptive merger hypothesis, on the other hand, depicts profit flow reductions as a result of the competitive forces in the product market. This opens up for a discussion of whether competition policy should be used for preventing privately unprofitable mergers. In particular, should competition agencies have the authority to block a proposed (socially inefficient) merger arguing *inter alia* (and presumably in conflict with the firms) that it is privately unprofitable? Actually, in the U.K., the Monopolies and Mergers Commission has condemned mergers because of their likely adverse effects upon the firms' efficiency (Whish, 1993).

As we see it, there are important objections to such a policy. First, such a control of mergers is different from the control that aims at protecting competition and consumers' welfare. More importantly it may be argued that antitrust authorities do not have the necessary expertise to perform such a task. Against this argument can be said that many antitrust authorities are presumed to have the (related) knowledge needed to deal with efficiency defences.

Second, one may argue that the firms themselves should be able to avoid the preemptive merger problem. One such method, that could be used under some circumstances, is the idea of "virtual" mergers discussed above. Another possibility would be for the firms of an industry to sign a no-merger contract. Such a contract could, however, be undesirable for other purposes. For example, it would eliminate the claimed disciplining power of the capital market on the internal efficiency of the firms.

6 Concluding Remarks

We demonstrate a preemptive merger mechanism (or defensive merger mechanism) that may explain the empirical puzzle why mergers reduce profits, and raise share prices. An unprofitable merger may occur if mergers confer strong negative externalities on the firms outside the merger. If being an "insider" is better than being an "outsider," firms may merge to preempt their partner merging with someone else. Furthermore, the pre-merger value of a merging firm is low, since it reflects the risk of becoming an outsider.

References

Affarsvarlden: Sjuka Pharmacia & Upjohn, *Affarsvarlden*, February 25, 1998, pages 6-7.

Bagnoli, Mark; Lipman, Barton L.: Succesful Takeovers without Exclusion, *Review of Financial Studies*; 1(1), Spring 1988, pages 89-110.

Banerjee, Ajeyo; Eckard, Woodrow E: Are Mega-Mergers Anti-Competitive? Evidence from the First Great Merger Wave, *Rand Journal of Economics*; 29(4), Winter 1998, pages 803-27.

Berger, Allen N.; Humphrey, David B.: Megamergers in Banking and the Use of Cost Efficiency as an Antitrust Defense, *Antitrust Bulletin*; 37(3), Fall 1992, pages 541-600.

Berkovitch, Elazar; Narayanan, M. P.: Motives for Takeovers: An Empirical Investigation, *Journal of Financial and Quantitative Analysis*; 28(3), September 1993, pages 347-62.

Boyer, Kenneth D.: Mergers That Harm Competitors, *Review of Industrial Organization*; 7(2), 1992, pages 191-202.

Bolton, Patrick; Farell, Joseph: Decentralization, Duplication, and Delay, *Journal of Political Economy*; 98(4), August 1990, pages 803-26.

Bradley, Michael; Desai, Anand; Kim, E. Han: Synergistic Gains from Corporate Acquisitions and Their Division between the Stockholders of Target and Acquiring Firms, *Journal of Financial Economics*; 21(1), May 1988, pages 3-40.

Caves, Richard E.: Mergers, Takeovers, and Economic Efficiency: Foresight vs. Hindsight, *International Journal of Industrial Organization*; 7(1), Special Issue, March 1989, pages 151-74.

Caves, Richard E.; Barton, David R.: *Efficiency in U.S. manufacturing industries*, Cambridge, Mass. and London: MIT Press, 1990.

Deneckere, Raymond; Davidson, Carl: Incentives to Form Coalitions with Bertrand Competition, *Rand Journal of Economics*; 16(4), Winter 1985, pages 473-86.

Deneckere, Raymond; Davidson, Carl: Coalition Formation in Noncooperative Oligopoly Models, mimeo., Northwestern University, 1985(b).

Eckbo, B. Espen: Horizontal Mergers, Collusion, and Stockholder Wealth, *Journal of Financial Economics*; 11(1-4), April 1983.

The Economist: Airlines: Flying in Formation, *The Economist*, January 31st, 1998, pages 73-74.

The Economist: All Fall Down, *The Economist*, February 28th, 1998(b), pages 69-72.

Farrell, Joseph; Saloner, Garth: Coordination through Commitees and Markets; *Rand Journal of Economics*; 19(2), Summer 1988, pages 235-52.

Farrell, Joseph; Shapiro, Carl : Horizontal Mergers: An Equilibrium Analysis, *American Economic Review*; 80(1), March 1990, pages 107-26.

Fishman, Michael J.: A Theory of Preemptive Takeover Bidding, *Rand Journal of Economics*; 19(1), Spring 1988, pages 88-101.

Fridolfsson, Sven-Olof: Double Bidding, mimeo. IIES, Stockholm University, October 1998.

Fridolfsson, Sven-Olof; Stennek, Johan: How Merger Control May Hasten Anti-Competitive Mergers, mimeo. IIES, Stockholm University, October 1998(a).

Fridolfsson, Sven-Olof; Stennek, Johan: Endogenous Merger Waves, mimeo. IIES, Stockholm University, March 1998(b).

Fudenberg, Drew; Gilbert, R.; Stiglitz, Joseph; Tirole, Jean: Preemption, Leapfrogging and Competition in Patent Races, *European Economic Review*; 22(1), June 1983, pages 3-31.

Fudenberg, Drew; Tirole, Jean: Preemption and Rent Equilization in the Adoption of New Technology, *Review of Economic Studies*; 52(3), July 1985, pages 383-401.

Funk, Peter: Auctions with Interdependent Valuations, *International Journal of Game Theory*; 25(1), 1996, pages 51-64.

Ghemawat, Pankaj; Nalebuff, Barry: Exit, *Rand Journal of Economics*; 16(2), Summer 1985, pages 184-94.

Gowrisankaran, Gautam: A Dynamic Model of Endogenous Horizonal Mergers, *Rand Journal of Economics*; 30(1), Spring 1999, Forthcomming.

Grossman, Sanford J.; Hart, Oliver D.: Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation, *Bell Journal of Economics*; 11, 1980, pages 42-64.

Healy, Paul M.; Palepu, Krishna G.; Ruback, Richard S.: Does Corporate Performance Improve after Mergers? *Journal of Financial Economics*; 31(2), April 1992, pages 135-75.

Horn, Henrik; Persson, Lars: Endogenous Mergers in an International Oligopoly, mimeo. IIES, Stockholm University, March 1996.

Houston, Joel F.; Ryngaert, Michael D.: The Overall Gains from Large Bank Mergers, *Journal of Banking and Finance*; 18(6), December 1994, pages 1155-76.

Jarrell, Gregg A.; Brickley, James A. M.; Netter, Jeffry: The Market for Corporate Control: The Empirical Evidence Since 1980, *Journal of Economic Perspectives*; 2(1), Winter 1988, pages 49-68.

Jehiel, Philippe; Moldovanu, Benny: Strategic Nonparticipation, *Rand Journal of Economics*; 27(1), Spring 1996, pages 84-98.

Jensen, Michael C.; Ruback, Richard S.: The Market for Corporate Control: The Scientific Evidence, *Journal of Financial Economics*;11(1-4), April 1983, pages 5-50.

Kamien, Morton I.; Zang, Israel: The Limits of Monopolization through Acquisition, *Quarterly Journal of Economics*; 105(2), May 1990, pages 465-99.

Kamien, Morton I.; Zang, Israel: Competitively Cost Advantageous Mergers and Monopolization, *Games and Economic Behavior*; 3(3), Au-

gust1991, pages 323-38.

Kamien, Morton I.; Zang, Israel: Monopolization by Sequential Acquisition, *Journal of Law, Economics and Organization*; 9(2),October 1993, pages 205-29.

Levy, David T.; Reitzes, James D.: Anticompetitive Effects of Mergers in Markets with Localized Competition, *Journal of Law, Economics and Organization*; 8(2), April 1992, pages 427-40.

Meeks, G.: *Dissapointing Marriage: A Study of the Gains from Merger*, Cambridge University Press, Cambridge, 1977.

Mueller, Dennis C. (ed.): *The Determinants and Effects of Mergers: An International Comparison.* Cambridge, Massachusetts, Oelgeschlager, Gunn & Hain Publishers Inc., 1980.

Mueller, Dennis C.: Mergers and Market Share, *Review of Economics and Statistics*; 67(2), May 1985, pages 259-67.

Mueller, Dennis C.: Merger Policy and the 1992 Merger Guidelines, *Review of Industrial Organization*; 8(2) 1993, pages 151-62.

Nilssen, Tore; Sorgard, Lars: Sequential Horizontal Mergers, *European Economic Review*; 42, 1998, pages 1683-1702.

Perry, Martin K.; Porter, Robert H.: Oligopoly and the Incentive for Horizontal Merger, *American Economic Review*; 75(1), March 1985, pages 219-27.

Persson, Lars: *Asset Ownership and Imperfectly Competitive Markets*, Institute for International Economic Studies, Stockholm University, Monograph Series, No. 35, 1998.

Ravenscraft, David J.; Scherer, Frederic M.: *Mergers, sell-offs, and economic efficiency*, Washington, D.C.: Brookings Institution, 1987, pages xiii, 290.

Rau, P. Raghavendra; Vermaelen, Theo: Glamour, Value and the Post-Acquisition Performance of Acquiring Firms, *Journal of Financial Economics* 49, 1998, pages 223-53.

Reitzes, James D.; Levy, David T.: Price Discrimination and Mergers, *Canadian Journal of Economics*; 28(2), May 1995, pages 427-36.

Roll, Richard: The Hubris Hypothesis of Corporate Takeovers, *Journal of Business*; 59(2), Part 1, April 1986, pages 197-216.

Salant, Stephen W.; Switzer, Sheldon; Reynolds, Robert J.: Losses from Horizontal Merger: The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium, *Quarterly Journal of Economics*; 98(2), May 1983, pages 185-99.

Salop, Steven C.; Scheffman, David T.: Raising Rivals' Costs, *American Economic Review*; 73(2), May 1983, pages 267-71.

Shleifer, Andrei; Vishny, Robert W.: Value Maximization and the Acquisition Process, *Journal of Economic Perspectives*; 2(1), Winter 1988, pages 7-20.

Scherer, F. M.; Ross, David: *Industrial Market Structure and Economic Performance*, Third Edition, Houghton Ni- in Company, Boston, 1990.

Schumann, Laurence: Patterns of Abnormal Returns and the Competitive Effects of Horizontal Mergers, *Review of Industrial Organization*; 8(6), December 1993, pages 679-96.

Schwert, G. William: Markup Pricing in Mergers and Acquisitions, *Journal of Financial Economics*; 41(2), June 1996, pages 153-92.

Stigler, George J.: Monopoly and Oligopoly by Merger, *American Economic Review, Papers and Proceedings* 40, 1950, pages 23-34.

Stillman, Robert: Examining Antitrust Policy toward Horizontal Mergers, *Journal of Financial Economics*;11(1-4), April 1983.

Stulz, Rene M.; Walkling, Ralph A.; Song, Moon H.: The Distribution of Target Ownership and the Division of Gains in Successful Takeovers, *Journal of Finance*; 45(3), July 1990, pages 817-33.

Weston, J. Fred; Chung, Kwang S.; Siu, Juan A.: *Takeovers, Restructuring, and Corporate Governance*, Second Edition, Prentice Hall, New Jersey, 1998.

Whish, Richard: *Competition Law, Third Edition*, Butterworths, London, 1993.

A Proofs

A.1 Preliminaries

Lemma 2 *Let* $m \sim Bin\left(n-1,(n-1)\,p\right)$. *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: Consider the case when $p > 0$. Let $s \sim Bin(t, r)$. Then, by definition

$$E\left\{\frac{1}{s+1}\right\} = \sum_{s=0}^{t} \frac{t!}{s!\,(t-s)!} r^s (1-r)^{t-s} \left(\frac{1}{s+1}\right).$$

Note that $s!\left(\frac{1}{s+1}\right) = (s+1)!$. Hence:

$$E\left\{\frac{1}{s+1}\right\} = \frac{1}{r}\sum_{s=0}^{t} \frac{t!}{(s+1)!\,(t-s)!} r^{s+1} (1-r)^{t-s}.$$

Let $a - 1 = t$:

$$E\left\{\frac{1}{s+1}\right\} = \frac{1}{r}\sum_{s=0}^{a-1} \frac{(a-1)!}{(s+1)!\,(a-1-s)!} r^{s+1} (1-r)^{a-1-s}.$$

Let $b = s + 1$:

$$E\left\{\frac{1}{s+1}\right\} = \frac{1}{r}\sum_{b=1}^{a} \frac{(a-1)!}{b!\,(a-b)!} r^{b} (1-r)^{a-b}.$$

Multiply and divide by a:

$$E\left\{\frac{1}{s+1}\right\} = \frac{1}{ra}\underbrace{\sum_{b=1}^{a} \frac{a!}{b!\,(a-b)!} r^{b} (1-r)^{a-b}}_{=1-\Pr\{b=0\} \text{ where } b\sim Bin(a,r)}.$$

Since $1 - \Pr\{m = 0\} = 1 - (1-r)^a$, we have

$$E\left\{\frac{1}{s+1}\right\} = \frac{1}{ra}\left[1-(1-r)^a\right] = \frac{1}{r}\frac{1}{t+1}\left[1-(1-r)^{t+1}\right].$$

Now let $s = m$ and $t = n-1$ and $r = (n-1)\,p$ to get the required expression.

Finally, when $p = 0$, m deterministically equals 0. QED.

Lemma 3 *Let*

$$\xi(p) \equiv \frac{1}{6}\frac{\Pr\{m=0\} - E\left\{\frac{1}{m+1}\right\}}{\frac{1}{3}\Pr\{m=0\} + E\left\{\frac{1}{m+1}\right\}}. \tag{12}$$

Then, since $n = 3$,

i. $\xi(0) = 0$

ii. $\xi\left(\frac{1}{2}\right) = -\frac{1}{6} \leq 0.$

iii. $\xi'(p) \leq 0.$

iv. $\lim_{p\to 0} \xi'(p) = -1/4 < \infty.$

Proof: By Lemma 2, it follows that

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

since $n = 3$. Properties $i.$ and $ii.$ follow immediately. Moreover

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

Properties $iii.$ and $iv.$ follow, since $p \in [0, 1/2]$. QED.

A.2 Proof of Lemma 1(a)

We start the proof by rewriting the definitions of $W(3)$, $EV(b)$, and $EV(nb)$. Let $d = e^{-r\Delta}/\left(1-e^{-r\Delta}\right)$, substitute (2a)-(2c) into (3) and rearrange:

$$W(3) - \frac{1}{r}\pi(3) = 2qd\left[W\left(2^+\right) + W\left(2^-\right) - 3W(3)\right]. \tag{13}$$

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

$$E\left\{\frac{1}{m+1}\right\} = \frac{1-(1-2p)^3}{6p}. \tag{14}$$

Note also that $E\left\{\frac{m}{m+1}\right\} = 1 - E\left\{\frac{1}{m+1}\right\}$. Hence,

$$EV(b) = V^{buy}E\left\{\frac{1}{m+1}\right\} + \left[1 - E\left\{\frac{1}{m+1}\right\}\right]\left[V^{sell} + V^{out}\right]\left(\frac{1}{2}\right). \tag{15}$$

$$EV(nb) = W(3)\Pr\{m=0\} + [1-\Pr\{m=0\}]\left[V^{out} + V^{sell}\right]\left(\frac{1}{2}\right). \tag{16}$$

An immediate-merger equilibrium is characterized by $p = 1/2$. By equation (4), we have $q = 1/6$. By equation (13), we have $W(3) = [W(2^+) + W(2^-)]/3$ when $\Delta \to 0$ (that is $d \to \infty$), since $W(3)$ is bounded. By equation (14), $E\left\{\frac{1}{m+1}\right\} = 1/3$. By equation (15), we have $EV(b) = [W(2^+) + W(2^-)]/3$. By equation (16), we have $EV(nb) = W(2^+)/6 + 4W(2^-)/6$ since $\Pr\{m=0\} = 0$. Hence, by equation (1), $EV(b) \geq EV(nb)$ if and only if $\pi(2^+) \geq 2\pi(2^-)$.

A no-merger equilibrium is characterized by $p = 0$. By equation (4), we have $q = 0$. By equation (13), we have $W(3) = \pi(3)/r$. By Lemma 2, $E\left\{\frac{1}{m+1}\right\} = 1$. By equation (15), we have $EV(b) = W(2^+) - \pi(3)/r$. By equation (16), we have $EV(nb) = \pi(3)/r$ since $\Pr\{m = 0\} = 1$. Hence, by equation (1), $EV(b) \leq EV(nb)$ if and only if $\pi(2^+) \leq 2\pi(3)$.

A delayed merger equilibrium is characterized by $p \in (0, 1/2)$. Equating the expected value of bidding, given by equation (15), and the expected value of not bidding, given by equation (16), and rearranging, we have that

$$W(3) = \frac{W(2^+)}{2} - 2\xi(p)\left[\frac{W(2^+)}{2} - W\left(2^-\right)\right] \tag{17}$$

where ξ is defined in Lemma 3 above.

Consider first, the interesting case, characterized by $\pi(3)/r \neq [W(2^+) + W(2^-)]/3$. We start to show that Θ is finite. By (13), it follows that $\pi(3)/r \neq [W(2^+) + W(2^-)]/3$. To prove this, assume the opposite. Then the right-hand side of equation (13) is zero. Hence $W(3) = \pi(3)/r$. In turn, $\pi(3)/r = [W(2^+) + W(2^-)]/3$ which is a contradiction. In a similar way, we can prove that $W(3) \neq \pi(3)/r$. By (17), it follows that $W(2^+)/2 \neq W(2^-)$ for all $p \in (0, 1/2)$, since $\xi(p) \leq 0$. Consequently, by equation (1), $\Theta = 3\frac{\pi\left(2^+\right) - 2\pi(3)}{\pi(2^-) - \pi(2^+)/2}$ is finite.

Use (13) to solve for q:

$$q = \frac{W(3) - \frac{1}{r}\pi(3)}{W(2^+) + W(2^-) - 3W(3)}\frac{1}{2d}.$$

Use (17) to eliminate $W(3)$, and (1) to eliminate $W(2^i)$, and rearrange:

$$q = \frac{\left[\frac{1}{2}\pi(2^+) - \pi(3)\right] + \xi(p)\,2\left[\pi(2^-) - \frac{1}{2}\pi(2^+)\right]}{\left[\pi(2^-) - \frac{1}{2}\pi(2^+)\right] - \xi(p)\,6\left[\pi(2^-) - \frac{1}{2}\pi(2^+)\right]}\frac{1}{2d}.$$

Divide by $\left[\pi(2^-) - \frac{1}{2}\pi(2^+)\right]$ and use the definition of Θ:

$$q = Q(p, \Delta) \equiv \frac{\Theta + 6\xi(p)}{1 - 6\xi(p)}\frac{1}{6d(\Delta)}. \tag{18}$$

Moreover, according to equation (4):

$$q = \widetilde{Q}(p) \equiv \frac{1-(1-2p)^3}{6}$$

The equilibrium values of p are determined by

$$Q(p) = \widetilde{Q}(p). \tag{19}$$

Note that $\widetilde{Q}(0) = 0$ and $\widetilde{Q}\left(\frac{1}{2}\right) = \frac{1}{6}$ and that the function $\widetilde{Q}(p)$ is monotonically increasing.

Assume first that $\Theta > 0$. Since $\xi(0) = 0$ and $\xi\left(\frac{1}{2}\right) = -\frac{1}{6}$ (according to Lemma 3) it follows that $Q(0,\Delta) = \frac{2\Theta}{12}\frac{1}{d}$ and $Q\left(\frac{1}{2},\Delta\right) = \frac{\Theta-1}{12}\frac{1}{d}$. Since $\xi'(p) \leq 0$ (according to Lemma 3) and $Q_p(p,\Delta) = \frac{\xi'(p)}{(1-6\xi)^2}[1+\Theta]\frac{1}{d}$ it follows that $Q(p,\Delta)$ is monotonically decreasing. Since

$$Q(0,\Delta) = \frac{2\Theta}{12}\frac{1}{d} > 0 = \widetilde{Q}(0)$$
$$Q\left(\frac{1}{2},\Delta\right) = \frac{\Theta-1}{12}\frac{1}{d} < \frac{1}{6} = \widetilde{Q}\left(\frac{1}{2}\right)$$

where the second inequality is true for d sufficiently big (Δ sufficiently small), it follows by continuity and monotonicity that there exists a unique p such that $Q(p,\Delta) = \widetilde{Q}(p)$. Moreover, it follows from equation (18) that $p, q \to 0$ as $\Delta \to 0$ ($d \to \infty$).

Assume now that $\Theta = 0$; then the above analysis is still valid. However, note that $Q(0,\Delta) = \frac{2\Theta}{12}\frac{1}{d} = 0$ so that $p = 0$, which contradicts $p \in (0, 1/2)$. Assume now that $-1 \leq \Theta < 0$. Then $Q(0,\Delta) < 0$ and since $Q(p,\Delta)$ is monotonically decreasing, there does not exist any p such that $Q(p,\Delta) = \widetilde{Q}(p)$. Assume now that $\Theta < -1$. Then $Q\left(\frac{1}{2},\Delta\right) = \frac{\Theta-1}{12}\frac{1}{d} < 0$ and since $Q(p,\Delta)$ is monotonically increasing, there does not exist any p such that $Q(p,\Delta) = \widetilde{Q}(p)$.

Finally, consider a delayed merger equilibrium characterized by $\pi(3)/r = [W(2^+) + W(2^-)]/3$. By (13), it follows that $\pi(3)/r = [W(2^+) + W(2^-)]/3$

and $W(3) = \pi(3)/r$ since $1 + 6qd \neq 0$. By (17), it follows that $W(2^+)/2 = W(2^-)$ since $\xi(p) \leq 0$. By equation (1), $W(2^+)/2 = W(2^-)$ if and only if $I_{32} = E_{32}$. Since $W(2^+)/2 = W(2^-)$ it follows by equation (17) that $W(3) = W(2^+)/2$. But $W(3) = \pi(3)/r$, and consequently it follows that $W(2^+)/2 = \pi(3)/r$ which, by equation (1), is equivalent to $I_{32} = 0$ (hence both the nominator and the denominator of Θ are zero). Hence $EV(b) = EV(nb)$, that is, equation (17) is satisfied, if and only if $I_{32} = E_{32} = 0$. Note also that in this case, any $p \in (0, 1/2)$ is an equilibrium. Hence, unless $p \to 0$ as $\Delta \to 0$, this delayed merger is essentially immediate. Moreover, since $I_{32} = E_{32} = 0$ characterize a non-generic parameter configuration, we disregard this possibility. QED.

A.3 Proof of Lemma 1(b)

Remember that $V^{buy} = W(2^+) - W(3)$ and $V^{sell} = W(3)$. Moreover, $W(2^+) = \pi(2^+)/r$.

Consider immediate merger equilibria. According to the proof of Lemma 1, $W(3) = (\pi(2^+) + \pi(2^-))/3r$. Hence, $V^{sell} = (\pi(2^+) + \pi(2^-))/3r$, and $V^{buy} = W(2^+) - W(3) = (2/3)\pi(2^+)/r - (1/3)\pi(2^-))/r$. Hence, $V^{buy} - V^{sell} = (1/3)[\pi(2^+) - 2\pi(2^-))]/r > 0$.

Consider delayed merger equilibria. According to the proof of Lemma 1, $W(3) = \pi(2^+)/2r$, so that $V^{buy} = V^{sell}$. QED.

A.4 Proof of Proposition 2

First, we show that per se unprofitable mergers may occur in equilibrium. This is an immediate consequence of lemma 1. (A) Immediate merger equilibria exist if and only if $\frac{1}{2}\pi(2^+) \geq \pi(2^-)$, which do not preclude that

$\pi(2^+) \leq 2\pi(3)$. (B) Delayed merger equilibria exist if, and only if, $\Theta > 0$, which does not preclude that $\pi(2^+) \leq 2\pi(3)$.

Second, we show that the value of the firms is increased. Consider (A) the case of an immediate unprofitable merger. By lemma 1, such an equilibrium exists if $\pi(2^+) \geq 2\pi(2^-)$. Then $W(2^+) \geq 2W(3)$ is equivalent to $\pi(2^+)/r \geq \frac{2}{3}[\pi(2^+) + \pi(2^-)]/r$, which is equivalent to $\pi(2^+) \geq 2\pi(2^-)$, which is true. Consider (B) the case of delayed merger: $W(2^+) = \pi(2^+)/r = 2[\pi(2^+)/2r] = 2W(3)$. QED.

B Equilibrium Selection

Assume that there exists a small probability that a firm bids for a particular other firm by mistake in a given period. Denote this probability by ε. (It is assumed that the firm bids $b = W(3)$ also when the bid occurs by mistake. Including a probability that firms do not bid by mistake does not change the argument.) Our selection depends on how quickly ε converges to zero as Δ converges to zero. To describe this relation, assume that

$$\lim_{(\Delta,\varepsilon)\to(0,0)} \frac{\varepsilon}{\Delta} = h/6,$$

for some $h \geq 0$. In fact, h is the hazard rate at which a merger by mistake occurs. To see this, note that $\varepsilon \approx (h/6)\Delta$ for small Δ. Moreover, assume that all firms chose not to bid with the remaining probability, that is $1 - 2\varepsilon$. Then the probability that no merger occurs in a given period is $(1-2\varepsilon)^3$. Note that there are t/Δ time periods between time 0 and time t. Hence, the triopoly remains until time t with probability $\left((1-(h/3)\Delta)^3\right)^{t/\Delta}$. As $\Delta \to 0$, the probability that a merger has occurred at time t is described by the cumulative distribution function $F(t) = 1 - e^{-ht}$. Thus, the merger hazard rate is $F'(t)/(1-F(t)) = h$.

Let $p^m(\Delta)$ denote the probability of bidding in the mixed strategy (or delayed-merger) equilibrium. If the mistake probability is relatively large, in particular if $\varepsilon > p^m$, all firms bid with certainty. Hence, the equilibrium structure (as $\Delta \to 0$) depends on how quickly ε converges to zero, in relation to the speed at which $p^m(\Delta)$ converges to zero. If $\varepsilon(\Delta) > p^m(\Delta)$ for all Δ, all firms bid with certainty for all Δ. Thus, the immediate merger-equilibrium is selected. On the other hand, if $\varepsilon(\Delta) < p^m(\Delta)$, all three equilibria are selected. Moreover, one may show that $p^m \approx \frac{r\Theta}{6}\Delta$ for small Δ. Thus, $\varepsilon(\Delta) \gtreqless p^m(\Delta)$ is equivalent to $h \gtreqless r\Theta$ for small Δ. Hence:

Observation 1 *Consider the equilibrium structure as* $(\Delta, \varepsilon) \to (0,0)$. *If* $h > r\Theta$ *only the immediate merger-equilibrium remains. If* $h < r\Theta$ *all three equilibria remain.*

Thus, if the mistake hazard rate, h, is large in relation to $r\Theta$, the immediate merger equilibrium is the reasonable prediction.