No. 2357

WHY MERGERS REDUCE PROFITS AND RAISE SHARE PRICES: A THEORY OF PRE-EMPTIVE MERGERS

Sven-Olof Fridolfsson and Johan Stennek

INDUSTRIAL ORGANIZATION

Centre for Economic Policy Research

ISSN 0265-8003

WHY MERGERS REDUCE PROFITS AND RAISE SHARE PRICES: A THEORY OF PRE-EMPTIVE MERGERS

Sven-Olof Fridolfsson and Johan Stennek,
Research Institute for Industrial Economics

Discussion Paper No. 2357
January 2000

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: http://www.cepr.org

CEPR Discussion Paper No. 2357

January 2000

ABSTRACT

Why Mergers Reduce Profits and Raise Share Prices: A Theory of Pre-emptive Mergers *

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 pre-empt their partner merging with a rival. The stock value is increased, since the risk of becoming an outsider is eliminated. We also show that mergers increasing consumers' prices, while increasing competitors' profits, may reduce the competitors' share prices. Thus, event studies may not detect anti-competitive mergers. These results are derived in an endogenous-merger model, predicting the conditions under which mergers occur, the time of merger and the split of surplus.

JEL Classification: C78, G34, L13, L41
Keywords: mergers, acquisitions, defensive mergers, coalition

Sven-Olof Fridolfsson
Research Institute for Industrial Economics (IUI)
Box 5501, SE-114 85 Stockholm
SWEDEN
Tel: (468) 665 4554
Fax: (468) 661 7969
Email: sof@iui.se

Johan Stennek
Research Institute for Industrial Economics (IUI)
Box 5501, SE-114 85 Stockholm
SWEDEN
Tel: (468) 783 8436
Fax: (468) 661 7969
Email: johans@iui.se

* Our work has been much improved due to our discussions with Jonas Björnerstedt, Lars Persson and Frank Verboven. We are grateful for comments from Mats Bergman, Francis Bloch, Mattias Ganslendt, Massimo Motts, Sten Nyberg and seminar participants at the universities in Antwerp (UFSIA), Lund and Stockholm, as well as IUI, ICON, Stockholm School of Economics, EARIE '98 in Copenhagen and EEA '99 in Santiago de Campostela. We thank Christina Lönnblad for editorial assistance. Fridolfsson thanks Konkurrensverket for financial support. Stennek thanks UFSIA for an enjoyable visit during which some of this research was done, and Jan Wallander and Tom Hedelius Foundation for financial support.

Submitted 5 January 2000

NON-TECHNICAL SUMMARY

At present, we witness a wave of mergers and acquisitions (M&As) of historical proportions. In 1998, the total global value of M&As was around 2.4 trillion US dollars (*The Economist*, 1999). Despite their evident importance, M&As are still not well understood. The most puzzling and debated issues concern M&A performance and the welfare effects of M&As.

There are two types of empirical studies on 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 there are numerous event studies, their results are consistent. The target firms' shareholders benefit and the bidding firms' shareholders generally break even. The combined gains are mostly positive.

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, due to differences in methodology. For example, some studies concern absolute performance, while others concern relative performance. The studies have also used different measures of accounting return, such as return on equity and return on assets. However, a robust conclusion is that a large proportion of all mergers reduce profitability.

If both types of evidence is correct we are left with two puzzles: Why do unprofitable M&As occur? How can firm values increase when profits are reduced? This Paper attempts to solve the two puzzles. Our first explanation is called the pre-emptive merger motive (or the defensive merger motive). 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 pre-empt their partner merging with a rival. 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 merger reduces the profit flow, the aggregate value of the firms (the discounted sum of all *expected* future profits) is increased. 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 as showing the existence of an industry-wide anticipation of a

merger and that the new information in the merger announcement is which firms are insiders and which are outsiders.

We also propose a second explanation of the performance puzzles. In order to control for external shocks, some studies focus on how insiders' aggregate profits have changed in comparison with other firms' profits in the same product market (relative performance). There is a potential problem with this methodology. Since the reference firms may be direct competitors to the insiders (if they operate on the same geographical market), they may be exposed to an externality from the merger. In that case, 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 absolute profitability. Our model indicates that this bias may be of crucial importance. In equilibrium, if a merger reduces the insiders' aggregate profit in relation to the profit of the outsiders, it is a profitable merger. Thus, according to this model, if one observes that a merger reduces profits in relation to competitors, one should conclude that the merger is profitable, not unprofitable as is usually done.

Actually, the divergent empirical evidence on M&A performance has created a controversy regarding the benefits of merger control. However, the results of the present Paper indicate that the empirical evidence does not support very strong policy conclusions. First, based on the evidence that mergers increase the combined stock market value of the merging firms, some argue that 'antitrust opposition to take-overs imposes substantial costs on the stockholders of merging firms'. However, the pre-emptive merger hypothesis shows that increasing share prices are consistent with the merger reducing the firms' profitability. If antitrust could consistently block mergers motivated by pre-emption, share holders would be better off. Second, based on the evidence that a large proportion of all mergers reduce profitability, some advocate a policy preventing efficiency-reducing mergers and not only those harming competition. Actually, such a policy has already been used in the UK. However, our work indicates that such an ambitious policy might not be required. According to the pre-emptive merger hypothesis, unprofitable mergers occur when a merger has (strong) negative externalities on competing firms. But, a horizontal merger that is bad for competitors, is likely to be good for consumers. For example, if a merger reduces marginal costs (but increases fixed costs), the merger may reduce the price and hence benefit consumers. Pre-emptive mergers may even increase social welfare.

The second empirical issue concerns the welfare effects of horizontal mergers: are they mainly motivated by market power or efficiencies? Again, the two strands of the literature reach apparently contradictory results. The empirical industrial organization literature indicates that anti-competitive

effects dominate, since mergers raise consumers' prices. The event study literature focus on rivals' share prices. They argue that if a merger is mainly anti-competitive, it increases price and rivals' profits and therefore it should also increase rivals' share prices. They find no evidence that horizontal mergers are anti-competitive. In one paper, the event study procedure was turned around, to study a merger *known* to be anti-competitive. It was shown that the signs of the estimated coefficients are generally opposite their predicted values. Our model provides an explanation for why event studies fail to detect anti-competitive mergers. We show that the effect of an anti-competitive merger on rivals' stock values may be the opposite to what is generally believed, exactly as is suggested by the empirical evidence. If a merger increases the price and the competitors' profits, but becoming an insider is even more advantageous, the competitors' stock market value is reduced. Intuitively, the pre-merger value of the outside firm is high, since it reflects the chance of becoming an insider. Once the merger has taken place, this possibility is excluded and the outsider's share price is reduced. As in the case of a pre-emptive merger, the new information in the merger announcement is which firms are insiders and which are outsiders.

The results of the Paper may be reformulated as a critique of the existing empirical literature on mergers. First, in order to understand the informational contents of share prices, we argue that it is essential for future event studies to empirically discriminate between the efficient market hypothesis and the surprise hypothesis. Second, in profitability studies one must be careful not to control for external shocks by using firms that are likely to be exposed to an externality from the merger (e.g. competitors) as reference firms. Third, in future empirical work, it is desirable to integrate data on profitability and data on share prices. Fourth, 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.

1 Introduction

At present, we witness a wave of mergers and acquisitions (M&As) of historical proportions. In 1998, the total global value of M&As was around 2.4 trillion US dollars (The Economist, 1999). Despite their evident importance, M&As are still not well understood. The most puzzling and debated issues concern M&A performance, and the welfare effects of M&As.

There are two types of empirical studies on 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 there are numerous event studies, their results are consistent. The target firms' shareholders benefit, and the bidding firms' shareholders generally break even. 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, due to differences in methodology. For example, some studies concern absolute performance, while others concern relative performance. The studies have also used different measures of accounting return, such as return on equity, and return on assets. However, a robust conclusion is that a large proportion of all mergers reduce profitability.[2]

[1] The early literature was surveyed by Jensen and Ruback (1983), and Jarrell, Brickley and Netter (1988). In the early literature, there was some debate concerning the effect of merger on the aggregate value of the merging firms. Later contributions indicate more clearly that the effect is positive. See for example 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) show negative average performance. Surveys of this literature can be found in Caves (1989) and Scherer and Ross (1990). Bild (1998) reviews and synthesises the results, and provides an overview of various methodological issues. There is also complementary evidence in the form of case

If both types of evidence is correct we are left with two puzzles: Why do unprofitable M&As occur? How can firm values increase when profits are reduced? This paper attempts to solve the two puzzles. Our first explanation is called the preemptive merger motive (or the defensive merger motive). 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 a rival. 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 merger reduces the profit flow, the aggregate value of the firms (the discounted sum of all *expected* future profits) is increased. 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 as showing the existence of an industry-wide anticipation of a merger, and that the new information in the merger announcement is which firms are insiders and which are outsiders.

We also propose a second explanation of the performance puzzles. In order to control for external shocks, some studies focus on how insiders' aggregate profits have changed in comparison with other firms' profits in the same product market (relative performance). There is a potential problem with this methodology. Since the reference firms may be direct competitors to the insiders (if they operate on the same geographical market), they may be exposed to an externality from the merger. In that case, the change

studies, for example Kole and Lehn (1997), and interview studies.

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 absolute profitability. Our model indicates that this bias may be of crucial importance. In equilibrium, if a merger reduces the insiders' aggregate profit in relation to the profit of the outsiders, it is a profitable merger. Thus, according to this model, if one observes that a merger reduces profits in relation to competitors, one should conclude that the merger is profitable, not unprofitable as is usually done.

There are several other explanations of unprofitable mergers. Roll (1986) argues that the managers overestimating their ability the most, are also the 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. Fauli-Oller and Motta (1996) argue that unprofitable mergers are a side effect of strategic delegation. Neither the hubris hypothesis, the empire building hypothesis, nor the strategic delegation hypothesis explains why the aggregate stock-market value increases when profits decrease. Rau and Vermaelen (1998) show that many merged firms (if 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, they suggest that the market (not only the management) systematically over-extrapolates the past performance of successful managers. All hypothesis (hubris, empire-building, strategic delegation, relative-performance bias, preemption, over-extrapolation) may contribute to a full understanding of why unprofitable mergers occur (or seem to occur). The three latter may also explain why share-prices are increased.

The second empirical issue concerns the welfare effects of horizontal merg-

ers: are they mainly motivated by market power or efficiencies? Again, the two strands of the literature reach apparently contradictory results. The empirical industrial organization literature indicates that anti-competitive effects dominate, since mergers raise consumers' prices (Barton and Sherman, 1984; Kim and Singal, 1993). The event study literature focus on rivals' share-prices (Eckbo, 1983; Banerjee and Eckard, 1998). They argue that if a merger is mainly anti-competitive, it increases price and rivals' profits, and therefore it should also increase rivals' share-prices. They find no evidence that horizontal mergers are anti-competitive. McAfee and Williams (1988) turn the event study procedure around, and study a merger *known* to be anti-competitive. They show that the signs of the estimated coefficients are generally opposite their predicted values. Our model provides an explanation for why event studies fail to detect anti-competitive mergers. We show that the effect of an anti-competitive merger on rivals' stock-values may be the opposite to what is generally believed, exactly as is suggested by the empirical evidence. If a merger increases the price and the competitors' profits, but becoming an insider is even more advantageous, the competitors' stock market value is reduced. Intuitively, the pre-merger value of the outside firm is high, since it reflects the chance of becoming an insider. Once the merger has taken place, this possibility is excluded, and the outsider's share-price is reduced. As in the case of a preemptive merger, the new information in the merger announcement is which firms are insiders and which are outsider.

To describe the acquisition process, we construct an extensive form model of coalitional bargaining. In particular, we construct a so-called game of timing.[3] Any firm can submit a merger proposal to any other firm(s) at any

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

point in time. The recipient(s) of a proposal can either accept 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 generalizes Rubinstein-Ståhl bargaining. The order of proposals is made endogenous by modelling bargaining as a game of timing.

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. A firm receiving a bid can only accept or reject it; 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 bids at the same time, only one bid is transmitted, all with equal probability.[5]

(Bolton and Farrell, 1990).

[4] In two companion papers, Fridolfsson and Stennek (1998a,b), we use the same model to study the risk of markets becoming 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 recent contributions include Kamien and Zang (1990, 1991, and 1993), Horn and Persson (1996), Gowrisankaran (1999), and Nilssen and Sorgard (1998).

[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). The effect of this assumption on our results is discussed in appropriate places below. One may think of our assumption 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.

To focus on the mechanisms we want to illustrate, we consider an industry which initially consists of three identical firms. For expositional simplicity, we assume that firms can submit bids for one other firm at a time only. Moreover, mergers from duopoly to monopoly are not allowed. One way of interpreting these restrictions is that mergers for monopoly are blocked by competition authorities. However, our results hold true also without these restrictions (Fridolfsson and Stennek, 1999).

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. In the triopoly, each firm earns 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 $\pi(2^-)$.

Our analysis shows how merger incentives (the acquisition phase) depend on profit flows in the different market structures (the market phase). The exact effects of mergers on insiders' and outsiders' profit flows have been studied by the exogenous merger literature.[6] According to this literature, a merger may be profitable, in the sense that $\pi(2^+) > 2\pi(3)$, for example due to increased market power or efficiency gains. In Figure 1, this possibility is illustrated as the area above the line labeled $I = 0$. However, a merger may also be unprofitable, if, for example, the outsider expands production substantially in response to the merger, or if the new organization is more complex to manage, or if there are substantial restructuring costs. In Figure 1, this possibility is illustrated as the area below the $I = 0$ line. Normally, a merger also confers an externality on the outsider. Since a merger reduces

[6] This literature studies whether an exogenously selected group of firms (insiders) would increase their profit by merging compared to an unchanged market structure. Depending on the details of the situation the insiders (and the outsiders) would or would not profit from a merger, see Salant, Switzer and Reynolds (1983), Deneckere and Davidson (1985), Perry and Porter (1985), Levy and Reitzes (1992, 1995), Boyer (1992).

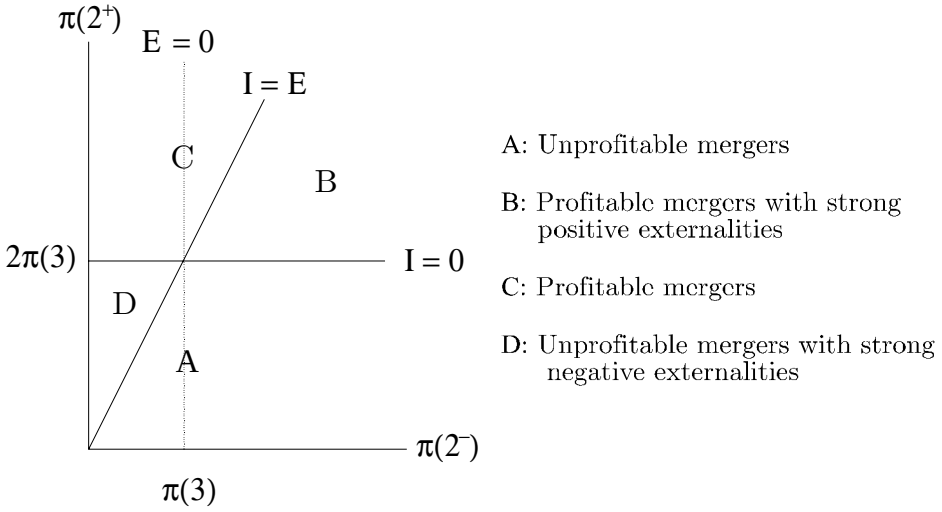

Figure 1: A classification of different mergers.

the number of competitors for the outsiders, there is a positive market power effect, so that $\pi(2^-) > \pi(3)$. In Figure 1, this possibility is illustrated as the area to the right of the "zero-externality line," labeled $E = 0$. However, if the merging parties can reduce their marginal costs substantially, they become a more difficult competitor. This may harm the outsiders, so that $\pi(2^-) < \pi(3)$. In Figure 1, this possibility is illustrated as the area to the left of the $E = 0$ line. 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 $|\pi(2^-) - \pi(3)| > \left|\frac{1}{2}\pi(2^+) - \pi(3)\right|$. Area D contains all markets where a merger is unprofitable, and even more unprofitable to the outsider. Area B contains all markets where a merger is profitable, but even more profitable to the outsider. We show that the incentives to merge are very different depending on which area (A, B, C or D) the firms find themselves.[7]

[7]All possible profit configurations can be generated by means of a simple oligopoly model. Consider a linear homogenous good Cournot triopoly. Inverse demand is given by

A firm's strategy describes the firm's behavior in the acquisition game: whether and how much to bid, and a reservation price at which to accept an offer. The strategy specifies the behavior for all periods, and for all possible "histories." 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 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 one 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 that a target firm will accept. For convenience, only bids that would be accepted if submitted are considered.

We now define the continuation values of the firms after a merger, at the date of a merger, and before a merger. 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 discount rate, and $\pi\left(2^i\right)/r$ is the

$p = 1 - q_1 - q_2 - q_3$. 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, at a restructuring cost of f. 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, $f < -\frac{1}{72} + \frac{17}{36}c - \frac{1}{72}c^2$. The merger 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 $c = 0.1$ 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). Assume second that $c = 0.3$ so that there is a fixed negative externality. When f is very high it is even worse to be an insider (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).

discounted value of all future profits. At the time a merger occurs, 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 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 of becoming a buyer (seller, outsider, triopolist) in the next period ($2q$). By definition, q is the probability that a specific firm buys another specific firm. 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. Hence:

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

Assuming that stock markets are efficient, the evolution of the stock market value of a firm is described by the evolution of the expected discounted value of the firm. For example, a buying firm is initially worth $W(3)$, then V^{buy} at the announcement date, and finally $W(2^{+})$ thereafter.

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,

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

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,

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

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 triopoly ($n=3$) 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

[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.

[9] The shareholders of a target firm are treated as a single individual. This is a reduced

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

Second, for the bid to be accepted it is necessary that $b \geq a$. Hence, for the bidder to maximize his value, 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 another specific firm is restricted to $p \leq 1/2$ by the symmetry assumption):

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

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

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

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

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

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 exists equilibria where exactly this fraction β is tendered (assuming that the number of shareholders is finite).

Lemma 1 *Consider the set of symmetric Markov perfect equilibria as* $\Delta \to 0$. *A no-merger equilibrium exists if, and only if,* $I \leq 0$. *An immediate-merger equilibrium exists if, and only if,* $I \geq E$. *A delayed-merger equilibrium exists if, and only if, the externality is strong,* $|E| > |I|$, *and has the same sign as the internal effect,* $sign\{E\} = sign\{I\}$.

All proofs are relegated to Appendix 1.

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 $I \leq 0$, that is $\pi(2^+)/2 \leq \pi(3)$. This is indicated as areas A and D (including the boundaries). There exists an immediate-merger equilibrium if and only if $I \geq E$, that is $\pi(2^+)/2 \geq \pi(2^-)$. 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). (Another way to express this condition is that a delayed merger equilibrium exists if, and only if, $\Theta \equiv 3I/(E-I) > 0$.) Hence, there exists an equilibrium for all points in the parameter space.[10]

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

[10] Actually, a delayed merger equilibrium also exists in the non-generic case when $I = E = 0$. 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.

[11] This follows directly from the proof of Lemma 1. Let $p^m(\Delta)$ denote the probability of

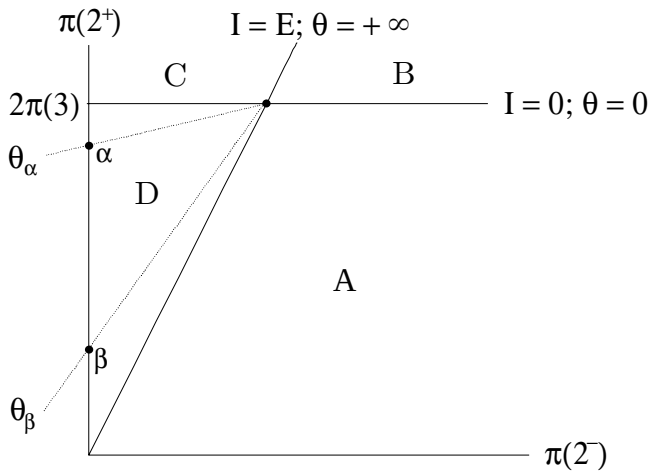

Figure 2: The reasonable equilibrium in area D depends on Θ.

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 selection should depend on the parameter $\Theta \equiv 3I/(E-I)$ which is strictly positive in area D. In Figure 2, all markets with a given Θ are located 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

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.

a small (subjectively perceived) risk that the other firms will merge should induce a firm to bid. Consider, on the 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. Hence, the immediate-merger equilibrium is reasonable for small Θ, while the no-merger equilibrium is reasonable for large Θ. This intuition is formalized in Appendix 2. In particular, let h be the (continuous-time) hazard rate with which a merger (is subjectively believed to) occur 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.

Finally, we should mention an extension of the model. Assume that one merger is profitable while the two other mergers are unprofitable. Then, only the immediate-merger equilibrium survives. Since one merger is profitable, a no-merger equilibrium does not exist. Moreover, in the immediate-merger equilibrium, the unprofitable mergers occur with strictly positive (and for some parameters large) probability. Intuitively, if the negative externality from the profitable merger is larger than the negative externalities from the unprofitable ones, some firms have an incentives to preempt the profitable merger.

Lemma 1 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).

The model also predicts how the insiders split the surplus.

Lemma 2 *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* $V^{buy} = V^{sell}$.

The 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 for him to become an outsider in the next period, and becoming an outsider yields an even lower value. This risk is exploited by the first mover. In a delayed merger equilibrium, there is a first-mover (second-mover) advantage if the merger is profitable (unprofitable). As $\Delta \to 0$, the insiders split the surplus in equal parts. To our knowledge, no previous model of mergers has succeeded in predicting how the surplus is split by merging firms.[12] Lemma 2 is contrasted to the empirical evidence in the end of the next section.

3 The Preemptive Merger Hypothesis

The condition for a merger to occur immediately is not that it is 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 direct consequence of Lemma 1:

[12] Kamien and Zang (1990, 1991, 1993) cannot predict the split, since they describe the bargaining as a Nash demand game. A bid b and a reservation price a are announced simultaneously. If $b = a$, the merger occurs. Hence, any split is an equilibrium. Our model is more similar to Rubinstein-Ståhl bargaining.

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 two examples of why a merger may be unprofitable for the merging firms, and even more unprofitable for the outsider. The first example is a horizontal merger with important marginal cost synergies (so that the outsiders lose), which is costly to arrange (so that the insiders lose).[13] Both conditions deserve to be commented. 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, the reduction of marginal cost that follows from the reduction of output in segments where competition is eliminated, can be sufficient to harm competitors (Boyer, 1992).[14] Second, the costs associated with mergers can indeed be substantial, for example due to problems of melting together different company cultures. As an example, the cost for the merger between Pharmacia and Upjohn is estimated at 1.6 billion dollars during 1995-97, as a contrast to the equity value at 5.5 billion dollars (Affarsvarlden, 1998).

The second example of a preemptive merger situation concerns vertical mergers to raise the rivals' costs. A downstream firm may buy a supplier to foreclose other downstream firms' access to the input market (Ordover, Saloner and Salop, 1990). Note that the reason for such a merger is closely related to its negative externality on the competitor. Our analysis suggests

[13] This example is formalized in footnote 7 above.

[14] Boyer also shows that outsiders are hurt despite an increase in the *average* price.

that downstream firms may buy the supplier even if vertical integration is inefficient in itself, and even if the gains from foreclosure are dominated by reduced internal efficiency. The reason is that the relevant alternative is that a rival integrates with the supplier. (To show this formally, the model needs to be slightly extended since all firms are not identical.) Hence, by allowing for bidding-competition, our work extends and strengthens the previous analysis of foreclosure.[15]

There are several cases that illustrate that preemption sometimes is the primary motive behind one firm's acquisition of the control rights over another. Northwest Airline acquired 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). A more recent example is Volvo's acquisition of Scania. Håkan Frisinger, the chairman of the board of Volvo, confirmed that the primary motive behind the transaction is to preempt other firms with an interest in Scania (Dagens Nyheter, 1999). We should emphasize that we do not claim that these two mergers are unprofitable. That we do not know. The cases only illustrate that strategic motives, and preemption in particular, are important for merger incentives in the real world. Our results show that, in principle, such motives may be so strong so as to induce firms to agree to unprofitable mergers.[16]

[15] 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 (a profitable) merger to preempt international mergers that would stiffen competition in the home market.

[16] This 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, Northwest protects itself against becoming an outsider, avoiding the costly process of merging employees and different types of airplanes. Unfortunately, a virtual merger (buying a competitor without integrating the firms) is not always an option. Once

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 [$W(2^+) \geq 2W(3)$]. Assuming that share-prices reflect the sum of the discounted expected future profits:

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

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 new information in the merger announcement is which firms are insiders and which are outsiders.

Proposition 2 thus shows that rising share-prices should not be taken as proof that a merger creates value. Share-prices and profits may go in opposite directions. However, this result 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 that a merger is coming. Assume, in particular, that the stock market expects the triopoly to continue for ever. 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 prof-

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).

itability of the merger. Hence, in order for event study evidence to be taken as proof of a merger's success, it is important to empirically discriminate between the efficient market hypothesis and the surprise hypothesis.

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 the outsiders' share-prices. 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, 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 has been produced by Banerjee and Eckard (1998). They show that the competitors during the Great Merger Wave of 1897 - 1903 suffered significant value losses.[17] 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.

Finally, we discuss how the merging parties split the surplus (in terms of firm values, there is a positive surplus). Note that a bid may be equally well interpreted as an offer to sell as an offer to buy. Hence, the prediction of Lemma 2, that $V^{buy} > V^{sell}$ in immediate-merger equilibria, should be interpreted to say that the bidder (not necessarily the buyer) receives more than the respondent (not necessarily the seller). Thus, our results are not directly comparable to the event study literature, which is focused on how

[17] Banerjee and Eckard (1999) argue that their results are inconsistent with the "anticipation hypothesis." The reason is that the firms' market values are *reduced* a few weeks before the merger announcement (that is, when they argue that anticipations should be formed). However, that pattern is exactly what the preemptive merger hypothesis suggests. The pattern is thus consistent with the "anticipation hypothesis."

gains are split between buyers and sellers. Furthermore, if one is willing to interpret the bidder as the buyer, Lemma 2 is at odds with the event study results which indicate that the seller takes the whole surplus.[18] However, our results can be sharpened by slightly varying the model. The assumption that only one bid is transmitted eliminates much of the bidding competition that occurs 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, then bidding competition is restored, and 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.[19]

4 Externalities and Relative Performance

So far, we have taken the empirical picture as given. 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.

Although we have not emphasized this point earlier, our model predicts that mergers are associated with changes in the external conditions of the market. Immediate (or delayed) mergers must occur immediately after (or

[18] Interpreting bids as offers to buy rather than offers to sell may be motivated in the following way. The firm that makes a bid has spent more time on figuring out exactly how the integrated firm should be operated. Hence, the bidder should have an advantage in managing the merged entity.

[19] 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.

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 gives rise to an identification problem; the effect of the merger on profits must be separated from 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, they are also likely to include the event triggering the merger.

To control for external shocks, several studies (e.g. Ravenscraft and Scherer, 1987; Mueller, 1980) focus on how insiders' aggregate profits have changed in comparison with other firms' profits in the same product market. There is a potential problem with this methodology. Since the reference firms may be direct competitors to the insiders (if they operate on the same geographical market), the outsiders are exposed to an externality from the merger. As a result, 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 absolute profitability.

The importance of this bias can be further studied in our model. Consider Figure 1. In equilibrium, mergers occur in regions B, C and D, but not in region A. In regions D and C, it is better to be an insider than an outsider. Thus, the relative profitability of the insiders is increased as a result of the merger. To be precise, before the merger the insiders' relative profitability is $\pi(3)/\pi(3) = 1$, after the merger the relative profitability is $\frac{1}{2}\pi(2^+)/\pi(2^-) > 1$. In region B, it is better to be an outsider than an insider. Thus, the relative profitability of the insiders is decreased as a result of the merger. Consequently, the only mergers that occur in equilibrium and reduce relative

profits are those in area B of Figure 1. Hence:

Proposition 3 *In equilibrium, if a merger reduces the insiders' aggregate profit in relation to the profit of the outsiders, it is a profitable merger.*

Thus, according to this model, if one observes that a merger reduces profits in relation to competitors, one should conclude that the merger is profitable, not unprofitable as is usually done. Bear in mind, however, that we illustrate the problem in an extreme way. We assume that it is the outsider that is used as a reference firm, and we have not formally included external shocks in the model. In reality, the attractiveness of relative performance measurement depends on the relative strength of external shocks and externalities. The important conclusion is that one must be careful not to control for external shocks by using firms that are likely to be exposed to an externality from the merger, for example direct competitors, as reference firms.

We should point out that this critique also works the other way around. A merger that increases relative profits may (but need not) be an unprofitable merger with strong negative externalities (that is, a preemptive merger).

5 The Welfare Effects of Horizontal Mergers

The second empirical issue concerns the welfare effects of horizontal mergers: are they mainly motivated by market power or efficiencies? Again, the two strands of the literature reach apparently contradictory results.

The industrial organization literature studies the effect of mergers on product prices and market shares. There are surprisingly few such studies, but they unambiguously indicate that prices tend to rise, and that insiders'

market shares tend to fall as a result of horizontal mergers.[20] These studies indicate that increases in market power dominate (from a consumer's perspective) possible efficiency gains associated with horizontal mergers.

Eckbo (1983), Eckbo and Wier (1985), Banerjee and Eckard (1998) and others use event studies to evaluate the welfare effects of horizontal mergers, by examining how the outsiders' share-prices move in response to the announcement of a horizontal merger, and a subsequent announcement of an antitrust complaint. If the outsiders' share-prices increase (decrease) at the time of the first (second) announcement, then the merger is deemed anti-competitive. The reason is that an anti-competitive merger raises the product price, thereby increasing the outsiders' profits. Eckbo (1983) finds little evidence of horizontal mergers being anti-competitive. This is surprising, since the sample only includes mergers that were challenged as anti-competitive.

This latter approach has been criticized by McAfee and Williams (1988). They turn the event study procedure around and ask whether rival firms' stock prices move in the predicted directions when a horizontal merger with ex post known anti-competitive effects is announced and, subsequently, challenged. The empirical results show no evidence of the merger being anti-competitive. Indeed, the signs of the estimated coefficients are generally opposite to their predicted values, given that the merger was anti-competitive. This finding casts doubts on event studies being able to detect anti-competitive mergers, and the policy implications of such studies. McAfee and Williams argue that their result is likely due to the fact that the outsiders, in their sample, were large multi-product firms that derived only a small fraction of their revenues from the affected market.

Our model provides an additional explanation why event studies may

[20] Barton and Sherman (1984), and Kim and Singal (1993) study product prices. Mueller (1985) studies market shares.

fail to detect anti-competitive mergers. In fact, we show that the effect of an anti-competitive merger on the rivals' stock value may be the opposite to what is generally believed, exactly as is suggested by McAfee's and Williams' empirical study. If a merger increases the price and has a positive externality on the outsider $[\pi(2^-) > \pi(3)]$, but becoming an insider is even more advantageous $[\pi(2^+)/2 > \pi(2^-)]$, then the outsiders' value is always reduced $[W(2^-) < W(3)]$. The two conditions are fulfilled in area C to the right of the line E=0 in figure 1. Assuming that the stock market is efficient:

Proposition 4 *An anti-competitive merger may increase the outsiders' profits and reduce the outsiders' stock market value.*

Intuitively, the pre-merger value of the outside firm is high, since it reflects the possibility of becoming an insider. Once the merger has taken place, this possibility is excluded, and the outsider's share-price is reduced. As in the case of a preemptive merger, the new information in the merger announcement is which firms are insiders and which are outsider.

6 Concluding Remarks

We demonstrate a preemptive merger mechanism (or a defensive merger mechanism), and a relative-performance bias, that may explain the empirical puzzle why mergers reduce profits, and raise share-prices. We also demonstrate why mergers may reduce competitors' share-prices even though their profits are increased (as for example in an anti-competitive merger). These results may be reformulated as a critique of the existing empirical literature on mergers.

First, we have demonstrated that mergers may affect firm values (the sum of expected discounted profits) and profits in the opposite directions.

We have also shown that if the stock market understands merger dynamics, the change in firms' stock market values reflect the change in their true values. However, if the merger comes as a surprise, the change in firms' stock market values reflect 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 hypothesis and the surprise hypothesis.

Second, we have shown that the current practice to control for external shocks by measuring M&A performance relative to the performance of reference firms may produce biased estimates. The reason is that mergers confer externalities on outsiders, for example competitors. Finding other methods of controlling for external shocks is an important challenge for future empirical work. At a minimum, one must be careful not to control for external shocks by using firms that are likely to be exposed to an externality from the merger (e.g. competitors) as reference firms.

Third, some empirical studies of M&A performance use share-price data, and other studies use accounting profits. In the past, the two types of data have been viewed as substitutes. However, our results indicate that they are complements. Relying on share-price data only, one may not detect that unprofitable mergers occur. Relying on profitability data only, one may not detect the reasons for why they occur.[21] Below, we argue that both of these issues are important for public policy. Examples include antitrust and the rules affecting the internal control of firms. Hence, in future empirical work, it is desirable to integrate the two types of data.

Similarly, we have demonstrated the importance of externalities for firms'

[21] For example, one may suspect 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 hypothesis.

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 two residual implications of the hypothesis that can be useful for further testing, namely that outsiders lose both in terms of profits and share-prices, both in absolute and in relative terms.

If our work survives further careful empirical tests, it has implications for the ongoing debate on antitrust policy. Actually, the diverging empirical evidence on M&A's has created a controversy regarding the benefits of merger control. However, the results of the present paper indicate that the empirical evidence does not support very strong policy conclusions.

First: Is antitrust costly for shareholders? Event studies indicate that mergers increase the combined stock market value of the merging firms. Based on this evidence, Jensen and Ruback (1983) argue that "antitrust opposition to takeovers imposes substantial costs on the stockholders of merging firms". However, the preemptive merger hypothesis shows that increasing share-prices are consistent with the merger reducing the firms' profitability. If antitrust could consistently block mergers motivated by preemption, share holders would be better off.

Second: Is antitrust good for consumers? 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, our work indicates that event studies cannot detect anti-competitive mergers, since such mergers may reduce outsiders' stock market value. Hence, the opposition toward merger control expressed by Eckbo and

Wier is not well-founded.

Third: Should antitrust authorities block unprofitable mergers? Accounting profit evidence indicate that a large proportion of all mergers are unprofitable. Based on this evidence, 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 (strong) negative externalities on competing firms. But, a horizontal merger that is bad for competitors, is likely to be good for consumers. For example, if a merger reduces marginal costs (but increases fixed costs), the merger may reduce the price and hence benefit consumers. Preemptive mergers may even increase social welfare.[22]

Fourth: 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,

[22]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 the sum of consumers' surpluses and producers' profits, are increased by that merger.

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 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). 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. This opens up for a discussion of whether competition policy should be used for preventing privately unprofitable mergers. In our view, however, there are important objections to such a policy. 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.

References

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

Bagnoli, Mark; Lipman, Barton L.: Succesful Takeovers without Exclusion, *Review of Financial Studies*; 1(1), Spring 1988, 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, 803-27.

Barton, David M.; Sherman, Roger: The Price and Profit Effects of Horizontal Merger: A Case Study, *Journal of Industrial Economics*, 33(2),

1984, 165-77.

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

Bild, Magnus: *Valuation of Takeovers*, Doctoral Dissertation, EFI, Stockholm School of Economics, 1998.

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

Bolton, Patrick; Farell, Joseph: Decentralization, Duplication, and Delay, *Journal of Political Economy*; 98(4), August 1990, 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, 3-40.

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

Dagens Nyheter: Scania får inte hamna i fel händer, *Dagens Nyheter*, March 9, 1999.

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

Eckbo, B. Espen; Wier, P: Antimerger Policy under the Hart-Scott-Rodino Act: A Reexamination of the Market Power Hypothesis, *Journal of Law and Economics*; (28) 1985, 119- 49

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

The Economist: How to Merge, *The Economist*, January 9th, 1999, 19-21.

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

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

Fauli-Oller, Ramon; Motta, Massimo: Managerial Incentives for Takeovers, *Journal of Economics and Management Strategy*; v5 n4, Winter 1996, pp. 497-514.

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

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).

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

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

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

Gowrisankaran, Gautam: A Dynamic Model of Endogenous Horizontal 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, 42-64.

Harsanyi, John C.; Selten, Reinhard: *A General Theory of Equilibrium Selection in Games*, The MIT Press, Cambridge, Massachussetts, 1988.

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

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, 49-68.

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

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

Kamien, Morton I.; Zang, Israel: Competitively Cost Advantageous Mergers and Monopolization, *Games and Economic Behavior*; 3(3), August1991, 323-38.

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

Kim, E. Han; Singal, Vijay: Mergers and Market Power: Evidence from the Airline Industry, *American Economic Review*; 83(3), June 1993, sidorna 549-69.

Kole, Stacey; Lehn, Kenneth: Workforce Integration and the Dissipation of Value in Mergers: The Case of USAir's Acquisition of Piedmont Aviation, mimeo. University of Rochester, 1997.

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, 427-40.

McAfee, R. Preston; Williams, Michael A.: Can Event studies Detect Anticompetitive Mergers?, *Economics Letters*; 28(2), 1988, 199-203.

Meeks, G.: *Disappointing 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, 259-67.

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

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

Ordover, Janusz A.; Saloner, Garth; Salop, Steven C.: Equilibrium Vertical Foreclosure, *American Economic Review*; v80 n1 March 1990, pp. 127-42.

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

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

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

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

Roll, Richard: The Hubris Hypothesis of Corporate Takeovers, *Journal of Business*; 59(2), Part 1, April 1986, 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, 185-99.

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

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

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

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

Singal, Vijay: Airline Mergers and Competition: An Integration of Stock and Product Price Effects, *Journal of Business*, 69(2), April 1996, 233-68.

Stigler, George J.: Monopoly and Oligopoly by Merger, *American Economic Review, Papers and Proceedings* 40, 1950, 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, 817-33.

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

1 Proofs

1.1 Preliminaries

Lemma 3 *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: See Fridolfsson and Stennek (1999).

Lemma 4 *Let*

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

Then, since $n = 3$,

$$\begin{aligned} &i. \quad \xi(0) = 0 \\ &ii. \quad \xi\left(\tfrac{1}{2}\right) = -\tfrac{1}{6} \leq 0. \\ &iii. \quad \xi'(p) \leq 0. \\ &iv. \quad \lim_{p \to 0} \xi'(p) = -1/4 < \infty. \end{aligned}$$

Proof: By Lemma 3, 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 $p \in [0, 1/2]$.

1.2 Proof of Lemma 1

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 3, 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,

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

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

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

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), and the fact that $V^{sell} = b = W(3)$ 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 3, $E\left\{\frac{1}{m+1}\right\} = 1$. 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 4 above. Consider the interesting case, characterized by $\pi(3)/r \neq [W(2^+) + W(2^-)]/3$.[23] In this case, $W(3) \neq [W(2^+) + W(2^-)]/3$,

[23] The case when $\pi(3)/r = [W(2^+) + W(2^-)]/3$ is analyzed in Fridolfsson and Stennek (1999). This case is non generic. The equality and the condition for a delayed-merger equilibrium to exist are both fulfilled if, only if, $I = E = 0$. In this case, any $p \in (0, 1/2)$ is a (delayed) equilibrium.

and Θ is finite.[24] 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:

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

The function $Q(p, \Delta)$ is depicted in Figure 3. Its form is explained below.

According to equation (4):

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

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 as depicted in Figure 3.

The equilibrium values of p are determined by

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

which is given by the intersection of the two curves in Figure 3.

Assume first that $\Theta > 0$.[25] Since $\xi(0) = 0$ and $\xi\left(\frac{1}{2}\right) = -\frac{1}{6}$ (according to Lemma 4), 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

[24] By (13), it follows that $W(3) \neq [W(2^+) + W(2^-)]/3$. 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), $\Theta = 3\frac{\pi(2^+) - 2\pi(3)}{\pi(2^-) - \pi(2^+)/2}$ is finite.

[25] The same analysis is valid also in the non-generic case $\Theta = 0$, as shown in Fridolfsson and Stennek (1999).

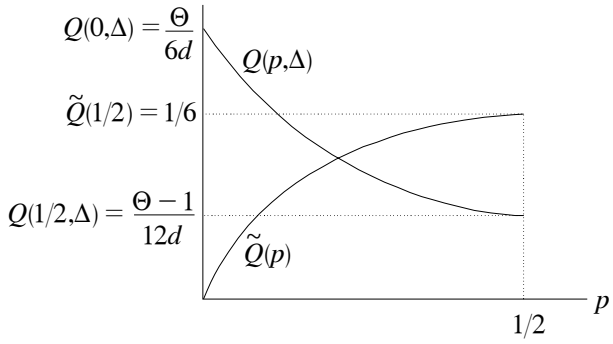

Figure 3: The delayed merger equilibrium.

$\xi'(p) \leq 0$ (according to Lemma 4) 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 as depicted in Figure 3. Since

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

where the second inequality is true for d sufficiently big (Δ sufficiently small), it follows by continuity and monotonicity that there exists a unique $p > 0$, such that $Q(p,\Delta) = \widetilde{Q}(p)$, corresponding to the intersection of the two curves in Figure 3. Moreover, it follows from equation (18) that $p, q \to 0$ as $\Delta \to 0$ ($d \to \infty$), which is visualized in Figure 3 by the intercept of the curve $Q(p,\Delta)$ tending to 0.

1.3 Proof of Lemma 2

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 $V^{buy} = V^{sell}$.

1.4 Proof of Proposition 2

Consider 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 the case of delayed merger: $W(2^+) = \pi(2^+)/r = 2[\pi(2^+)/2r] = 2W(3)$.

1.5 Proof of Proposition 3

This proposition focuses on mergers in area B in Figure 1. In this area, mergers are profitable $[\pi(2^+) > 2\pi(3)]$, but it is better to be an outsider $\pi(2^+) < 2\pi(2^-)$. Hence, relative profitability has been reduced from $2\pi(3)/\pi(3) = 2$ to $\pi(2^+)/\pi(2^-) < 2$. To prove the second part of Proposition 3, note by Lemma 1 that mergers in area B are delayed mergers. Moreover, in a delayed merger equilibrium, $W(2^+) > 2W(3)$. To see this, note that the second term of the right-hand side in equation (17) is negative.

1.6 Proof of Proposition 4

First, note that mergers characterized by $\pi(2^-) > \pi(3)$ and $\frac{1}{2}\pi(2^+) \geq \pi(2^-)$ occur immediately. Second, by the proof of Lemma 1, in an immediate merger equilibrium $W(3) = \frac{1}{3}[\pi(2^+) + \pi(2^-)]/r$. Hence, $W(2^-) = \pi(2^-)/r < W(3)$ if, and only if, $\frac{1}{2}\pi(2^+) > \pi(2^-)$.

2 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 occured 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 remain. 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.