ESSAYS ON ENDOGENOUS MERGER THEORY

Sven-Olof Fridolfsson

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Foreword

The Research Institute of Industrial Economics (IUI) has a long tradition in studying the determinants of market structures. This ambition is currently pursued within the project "Industrial Re-Organization: Understanding Changing Market Structures and Trading Patterns". In the five essays contained in this volume, Sven-Olof Fridolfsson applies game theoretical models of coalition formation to study mergers, one of the major means at firms' disposal to affect their competitive environment. This theoretical approach is pursued to provide an explanation for the empirical puzzle that mergers often reduce the profits and nevertheless increase the merging firms' share prices. The analysis also aims at a better understanding of the welfare consequences of mergers and their implications for an appropriate design of competition policy.

This book has been submitted as a doctoral thesis at the Department of Economics at Stockholm University and has been supervised by Johan Stennek at IUI. It is the 57$^{\text{th}}$ dissertation completed at IUI since its foundation in 1939.

Financial support from the Swedish Competition Authority as well as from the Marianne and Marcus Wallenberg Foundation is gratefully acknowledged.

Stockholm in March 2001

Ulf Jakobsson
Director of IUI

Preface

About eleven years ago, I started my unexpectedly long studies at university level. The first years went rather well, at least as compared with my prior studies. Being a person with limited memory, I quickly forgot the struggles through my early school years. Soon I thought new academic challenges were called for me and, quite naturally, I embarked on the Ph.D. program in economics at the Stockholm University. At that stage, I also recovered my memory. Needless to say, if I am almost reaching the end of some further struggling years, it is because I have received much support. Time has come to express my gratitude.

First and foremost, I am indebted to my advisor Johan Stennek. What Johan has meant for my academic progress is difficult to appreciate. As a teacher, he was decisive for my choice of research area. As a supervisor, his constructive criticism enabled me to transform some of my confusing thoughts into two single authored essays. Above all, I benefitted tremendously from him as the co-author of not less than three out of the five essays in this thesis. To put it simply, Johan, you have learned me most of what I know about research.

Throughout the thesis, I have also benefitted from long and rewarding discussions with Lars Persson. Besides guiding me through the literature, his advices helped me to focus on my most important ideas. At the later stages of this thesis, I was fortunate to find a careful reader in Jonas Björnestedt. By insisting on a more rigorous exposition, he significantly improved central parts of the arguments in this thesis. Furthermore, I want to thank Harry Flam for his help and encouragement and Christina Lönnblad for much needed editorial assistance.

I spent a large part of my graduate life at the Department of Economics, Stockholm University. I benefitted there from fruitful discussions with Mahmood Arai, Michael Lundholm, Xiang Lin, Sten Nyberg, Jonas Häckner and Martin Dufwenberg. Despite my bad memory, the years at the Department will remain memorable due to a large number of friends there and more generally at the Stockholm University. In particular, I want to thank Björn Carlén, Mikael Elhouar, Morten Søberg, Thomas Tangerås, Lars Vahtrik and Roger Vilhelmsson for their friendship and support.

I would also like to thank Ulf Jakobsson for giving me the opportunity to spend my two last years at the Research Institute of Industrial Economics (IUI).

Thanks to my daily interaction with Mattias Ganslandt, Magnus Henrekson, Helen Jakobson, Per-Johan Norbäck, Erik Mellander, Anna Sjögren, Per Skedinger, and Roger Svensson to mention a few, the IUI has been a stimulating research environment. In particular, I want to mention Assar Lindbeck and Jörgen Weibull whose vast knowledge of economics has been a rich source of inpiration.

Two persons influenced most my decision to pursue these studies, namely Magnus Allgulin and David Sundén. Whether it was a wise decision or not is a too complex matter to be settled in this preface. Fortunately, both of you took the same decision. Thanks to your companionship, even the two first years of (to put it mildly) demanding courses, will be worth remembering. Through David, I also met Giancarlo Spagnolo with whom I have been sharing a flat for four years. Besides becoming one of my best friends and learning me that pasta, to be eatable, must be al dente, you have also, through our numerous discussions, influenced my way of thinking about economics.

As I am converging towards the end of my studies, I am also, in some sense, ending my childhood. My thoughts go to my sister ... . Hélène, thank you for all the support you have provided to your younger brother. ... and, of course, to my parents. Finally, I got through high school and now I may even get a university degree. If I have reached this stage, it is due to your patience with me. I dedicate this thesis to you.

Last, but definitely not the least, Chloé. Sans ton soutien inconditionnel, cette thèse ne serait pas. Next, Bahamas.

Sven-Olof Fridolfsson — Stockholm, January 2001

PS: At the end, money matters. Generous financial support from Konkurrensverket as well as from the Marianne and Marcus Wallenberg Foundation is gratefully acknowledged.

Abstract

This thesis consists of a collection of essays on endogenous merger theory.

Essay I: The empirical puzzle why mergers reduce profits, and raise share prices is explained in this essay. If being an "insider" is better than being an "outsider," firms may merge to preempt their partner merging with a rival. The stock-value of the insiders is increased, since the risk of becoming an outsider is eliminated. These results are derived in an endogenous merger model.

Essay II: Anti-competitive mergers increase competitors' profits, since they reduce competition. Using a model of endogenous mergers, it is shown that such mergers nevertheless may reduce the competitors' share-prices. Thus, event-studies can not detect anti-competitive mergers.

Essay III: Anti-competitive mergers benefit competitors more than the merging firms. Such externalities are shown to reduce firms' incentives to merge (a holdup mechanism). Firms delay merger proposals, thereby foregoing valuable profits and hoping other firms will merge instead - a war of attrition. The final result, however, is an overly concentrated market. This essay also demonstrates a surprising intertemporal link: merger incentives may be reduced by the prospect of additional profitable mergers in the future. Merger control may help protect competition. Holdup and intertemporal links make policy design more difficult, however. Even reasonable policies may be worse than not controlling mergers at all.

Essay IV: In a framework where mergers are mutually excluding, firms are shown to pursue anti-competitive rather than (alternative) pro-competitive mergers. Potential outsiders to anti-competitive mergers refrain from pursuing pro-competitive mergers if the positive externalities from anti-competitive mergers are strong enough. Potential outsiders to pro-competitive mergers pursue anti-competitive mergers if the negative externalities from the pro-competitive mergers are strong enough. Potential participants in anti-competitive mergers are cheap targets due to the risk of becoming outsiders to pro-competitive mergers. Firms may even pursue an unprofitable and anti-competitive merger, when alternative mergers are profitable and pro-competitive.

Essay V: A government wanting to promote an efficient allocation of resources as measured by the total surplus, should strategically delegate to its competition authority a welfare standard with a bias in favour of consumers. A consumer bias means that some welfare increasing mergers will be blocked. This is optimal, if the relevant alternative to the merger is another change in market structure that will even further increase the total surplus. Furthermore, a consumer bias is shown to be optimal even though it increases the likelihood of forbidding mergers that maximize the total surplus.

Contents

Introduction

The theoretical literature on mergers, originating in Stigler (1950), has devoted much attention to the consequences of horizontal mergers. By means of oligopoly theory, this strain of research has investigated the profitability and the social desirability of a merger between an exogenously chosen group of firms. Depending on the context such as the number of merging firms, the nature of competition, the returns to scale or the degree of product differentiation, the merger may or may not benefit the merging firms (Salant, Switzer and Reynolds, 1983; Deneckere and Davidson, 1985a and Perry and Porter, 1985). Similarly, the merger's impact on social welfare depends on these different factors (Farrell and Shapiro, 1990).

This literature thus identifies the incentives for firms to participate in a merger. In the special case of a duopoly, it also provides a reasonable merger criterion, namely that a merger ought to be profitable in order to occur. This profitability criterion is, however, problematic in oligopolistic markets with more than two firms. In such markets, there are mutually excluding mergers. In general, it is therefore not possible to use this simple profitability criterion.

A satisfactory theory of merger formation thus requires an analysis of the process of merger formation in itself, that is, a theory where the firms endogenously decide whether or not to merge. A small but growing body of literature analyzes these merger decisions, using game theoretical models of coalition formation.[1] This approach views a merger as the formation of a coalition between formerly independent firms and attempts to predict which of several possible coalitions that will arise. The present thesis, which consists of five self-contained essays, contributes to this recent literature on the endogenous formation of mergers. It develops a model of endogenous merger formation where the process of forming coalitions is modelled as negotiations between independent firms. An important feature of this model is that the likelihood of a merger is not only determined by its profitability, but also by the value of being outside a merger. As a

[1] 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, 1993), Horn and Persson (2000a, 2000b) and Gowrisankaran (1999).

result, the process of merger formation may exhibit excessive incentives to merge in the sense that unprofitable mergers will take place. Conversely, it may also exhibits frictions in the sense that profitable mergers do not occur. These aspects of the process of merger formation are crucial throughout the thesis. It is argued that they constitute potential explanations for apparently contradictory empirical regularities. Furthermore, they will have an impact on the merger pattern and consequently on welfare. An appropriate design of merger control should therefore take these factors into account. The remainder of this introduction summarizes the results in each essay.

Essay I: Why Mergers Reduce Profits and Raise Share Prices - A Theory of Preemptive Mergers

There are two types of empirical studies on merger 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. These studies find that the target firms' shareholders benefit, while the bidding firms' shareholders generally break even. The combined gains are mostly positive.[2] The empirical industrial organization literature, on the other hand, tests merger performance by comparing accounting profits a few years before and after the transaction. A robust result is that mergers lead to a significant reduction in the merging firms' profitability compared to a control sample consisting of firms from industries in general.[3]

If both types of empirical evidence is correct we are left with two puzzles: Why do unprofitable mergers occur? How can firm values increase when profits are reduced? This essay attempts to resolve these two puzzles by providing an explanation called the preemptive 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. Furthermore, even though a preemptive merger reduces profits, the aggregate value of the merging firms is increased. The reason is that the firms' pre-merger value accounts for the risk that

[2] The early literature is surveyed in Jarrell, Brickley and Netter (1988). A recent contribution is Banerjee and Eckard (1998).

[3] Surveys of this literature can be found in Caves (1989), Scherer and Ross (1990), and Bild (1998). The findings in this literature are, however, sensitive to the chosen control sample, as discussed in Essay I.

they may become outsiders. Under the hypothesis that the stock market is efficient (in the sense that share-prices reflect firm values) these 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. Finally, this essay also discusses some implications of these results for future empirical research.

Essay II: Why Event Studies Do Not Detect Anti-Competitive Mergers

The second essay concerns the welfare effects of horizontal mergers: are they mainly motivated by market power or efficiencies? Again, the two strands of the empirical 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.

This note provides an explanation for why event studies may fail to detect anti-competitive mergers. It is shown that the effect of an anti-competitive merger on rivals' stock-values may be the opposite to what is generally believed. 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.

Essay III: Should Mergers be Controlled?

One of the alleged motives for mergers between competitors is increased market power. As a result, markets may become too concentrated from a social welfare point of view. Stigler (1950) points out an important countervailing force, however. If market power is the main motive for a merger, it is usually more profitable to remain outside the merger than to participate. Thereby, firms may not have an incentive to participate in such mergers. This countervailing force, referred to as the holdup mechanism, has important implications for competition policy. It suggests that horizontal mergers are primarily formed for other reasons than market power, for instance cost synergies and other socially desirable goals. Controlling mergers may thwart or at least delay such gains.

This essay provides a formalization of Stigler's argument. It shows that strong positive externalities on outsiders reduce the incentives for two firms to merge, even if the merger is profitable. This holdup mechanism, however, takes the form of delay, rather than completely preventing market power driven mergers. Intuitively, firms delay their merger proposals and consequently forego valuable profits, since there is a chance that other firms might merge instead–much like a war of attrition. The final result, however, is excessive concentration.[4]

Since the holdup mechanism only creates temporary frictions for mergers driven by market power, merger control may play an important part for preserving competitive markets. To design merger control properly, the holdup mechanism must be taken into account. For example, the current use of divestiture as a remedy for anti-competitive mergers may reduce the holdup friction and may thereby both hasten welfare increasing and welfare deteriorating mergers. Furthermore, the endogenous merger analysis reveals that the incentives to merge are influenced by the prospect of future mergers. Merger incentives may actually be reduced by the prospect of additional profitable mergers in the future. Furthermore, holdup and intertemporal links make policy design more difficult. Two examples indicate that, in some markets, reasonable merger policies may be worse than not controlling mergers at all.

Essay IV: Anti-Competitive versus Pro-Competitive Mergers

Previous endogenous merger analyses have devoted much attention to the equilibrium level of concentration.[5] In contrast, this essay attempts to identify the equilibrium market structure for a given level of concentration. The main result indicates that firms often purse anti-competitive mergers, thereby preempting

[4]Kamien and Zang (1990) demonstrates another holdup mechanism that prevents profitable mergers involving three or more firms. The difference between their holdup mechanism and the one formalized in this thesis is further discussed in Essay III.

[5]A notable exception is Horn and Persson (2000a).

pro-competitive ones. This result thus suggests that the current antitrust practice, to evaluate the impact of mergers relative to the original market structure, may underestimate the benefits of blocking anti-competitive mergers.

The starting point of the analysis is that anti-competitive mergers typically benefit outsiders, while the opposite is true for pro-competitive mergers. In turn, the signs and magnitudes of these externalities on outsiders favor anti- rather than pro-competitive mergers through three different mechanisms. First, potential outsiders to anti-competitive mergers refrain from pursuing pro-competitive mergers if the positive externality from the anti-competitive merger is large enough. Second, potential outsiders to pro-competitive mergers pursue anti-competitive mergers to preempt the pro-competitive merger that would hurt them. Third, external effects also have an indirect influence on firms' merger decisions. Since firms' pre-merger values incorporate the risk of becoming an outsider, potential outsiders to pro-competitive mergers with negative externalities have low pre-merger values. As a result, such firms tend to be cheap to buy so that other firms, including firms that are potential participants in pro-competitive mergers, tend to find it profitable to buy the former firms. Thereby, they preempt the pro-competitive merger and instead induce an anti-competitive one.

Essay V: A Consumers' Surplus Defense in Merger Control

In many jurisdictions, protecting consumers' interests is an important goal for competition policy.[6] A concern for the distribution of wealth, combined with a belief that consumers are, on average, less wealthy than firm owners, is a possible motive for this focus on consumers' interests. This motive has, however, been criticized by economists on at least two grounds (see e.g. Williamson, 1968). First, it has been questioned whether competition policy has important distributional effects. Second, even if it has distributional effects, there are other instruments such as taxes and transfers that are more appropriate for affecting distribution. On these grounds, many economists argue that competition policy ought to promote allocative efficiency only (see e.g. Crampton, 1994 and Jenny, 1997).

This essay shows that the policy objective, the so-called welfare standard, has an impact on which mergers that are proposed by firms. As a result, a government

[6]For example in the US, a merger that increases market concentration might be challenged unless it is expected to deliver such cost-savings that it is also beneficial to consumers (1992 Horizontal Merger Guidelines).

that wants to promote an efficient allocation of resources as measured by the total surplus, that is the sum of the consumers' and the producers' surpluses, should strategically delegate a welfare standard with a consumer bias. This result is derived in a simple duopoly model where firms compete à la Cournot and where the relevant alternative to a merger may be some other transfer of assets between the two firms. In such a world, a consumer bias means that some welfare increasing mergers for monopoly will be blocked. This is optimal, if the relevant alternative to the merger is another change in market structure that will even further increase the total surplus. Furthermore, a consumer bias is shown to be optimal even though it increases the likelihood of forbidding mergers to monopoly that maximize the total surplus. This result thus indicates that the current practice of protecting the consumers' interests can be motivated on the ground of promoting allocative efficiency.

References

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.

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

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

Crampton, P.: Alternative Approaches to Competition Law: Consumers' surplus, Total Surplus, Total Welfare and Non-Efficiency Goals, *World Competition* 17, 1994, 55-86.

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

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

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

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

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

Horn, Henrik; Persson, Lars: Endogenous Mergers in Concentrated Markets, Forthcoming in *International Journal of Industrial Organization*, 2000a.

Horn, Henrik; Persson, Lars: The Equilibrium Ownership of an International Oligopoly, Forthcoming in *Journal of International Economics*, 2000b.

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.

Jenny, Frederic: Antitrust in a Global Economy, in B. Hawk (ed.) Fordham Corporate Law Institute, 1997.

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.

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

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

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.

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

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

US Department of Justice; Federal Trade Commission: *1992 Horizontal Merger Guidelines*, Washington: US Department of Justice, April 1997.

Williamson, Oliver E.: Economies as an Antitrust Defense: The Welfare Trade-offs, *American Economic Review*; 58, 1968, 18-36.

Essay I

Why Mergers Reduce Profits, and Raise Share-Prices - A Theory of Preemptive Mergers[1]

This essay is co-authored with Johan Stennek.

1 Introduction

At present, we witness a wave of mergers and acquisitions (M&As) of historical proportions. In 1999, the worldwide value of M&As was more than 3.4 trillion US dollars (The Economist, 2000). Despite their evident importance, M&As are still not well understood. One of the most puzzling and debated issues concerns M&A performance.

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.[2]

The empirical industrial organization literature tests M&A performance by comparing accounting profits a few years before and after the transaction. Summarizing the results from these studies is slightly more complex, due to differences

[1]Our work has been much improved thanks to our discussions with Jonas Björnerstedt, Lars Persson, and Frank Verboven. We are grateful for comments from Mats Bergman, Francis Bloch, Mattias Ganslandt, Chantale LaCasse, Massimo Motta, Rainer Nitsche, Sten Nyberg, and seminar participants at the universities in Antwerp (UFSIA), Barcelona (Autonoma), Copenhagen, Lund, and Stockholm, Stockholm School of Economics, EARIE '98 in Copenhagen, EEA'99 in Santiago de Campostela, the CEPR/IUI workshop on mergers, and the 9th WZB/CEPR-Conference in Industrial Organization. We thank Christina Lönnblad for editorial assistance.

[2]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).

in methodology. However, a robust result is that mergers lead to a significant reduction in the merging firms' profitability compared to a control sample consisting of firms from industries in general.[3]

If both types of empirical 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 resolve the two puzzles.

Our 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–which in this case is another merger. Furthermore, even though a preemptive merger reduces profits, 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.

Looking closer at the empirical evidence from accounting profit studies, the picture is more complex. To control for exogenous shocks, all modern accounting profit studies relate the change in the insiders' profits to the change in the profits of a control sample. In some studies, the control sample consists of firms from industries in general. In these studies, the merging firms perform significantly worse than the control group (e.g. Meeks, 1977; Ravenscraft and Scherer, 1987). In contrast, when compared to control firms from the same industry, the effect of mergers is mainly insignificant, and in the cases where it is significant the results favor the merging sample (e.g. Healy, Palepu and Ruback, 1992). Since some shocks are industry specific, the latter methodology may provide a better control. However, there is a problem with this line of research. If the control

[3]Surveys of this literature can be found in Caves (1989), Scherer and Ross (1990), and Bild (1998). There is also complementary evidence of reduced profitability in the form of case studies, for example Kole and Lehn (1997), and interview studies.

firms are competitors to the insiders, they are exposed to externalities 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 profitability. Our model indicates that this bias is crucial for how the results should be interpreted. We show that the preemptive merger hypothesis is a potential explanation for why the merging firms profitability is increased relative to competitors. Increased relative profitability should thus not be taken as proof that mergers create value. We also discuss the studies (e.g. Mueller, 1980) finding a negative, albeit insignificant, effect of mergers relative to firms in the same industry. We show that if a merger reduces the insiders' profits in relation to the profits of the outsiders, it is a profitable merger. Thus, according to this model, if one observes reduced profits in relation to competitors, one should conclude that the merger is profitable, not unprofitable as is usually done. The negative impact of mergers on profits may thus have been exagerated.

The previous literature contains several other explanations for why unprofitable mergers occur. Roll (1986) argues that the managers overestimating their ability (or profit opportunities in general) 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. 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, over-extrapolation and preemption) may contribute to a full understanding of why unprofitable mergers occur. The two latter may also explain why share-prices are increased.

To describe the acquisition process, we construct an extensive form model of coalitional bargaining.[4] In particular, we construct a so-called game of timing.[5]

[4]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 (2000a, 2000b), Gowrisankaran (1999).

[5]Games of timing have previously been used for studying preemption, including patent races (Fudenberg, Gilbert, Stiglitz, and Tirole, 1983), adoption of new technology (Fudenberg

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 or reject it. In the latter case, it can make a counterproposal in the future. As a consequence, firms endogenously decide whether and when to merge, and how to split the surplus while keeping alternative mergers in mind.

2 The Model

The acquisition process is described as a repeated multi-agent bargaining game. For expositional simplicity, we consider an industry which initially consists of three identical firms, and assume that mergers to monopoly are illegal. However, our results hold true also without these restrictions (Fridolfsson and Stennek, 1999).

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. 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.[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. 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 effects of

and Tirole, 1985), compatibility standards (Farrell and Saloner, 1988), and entry (Bolton and Farrell, 1990).

[6] 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.

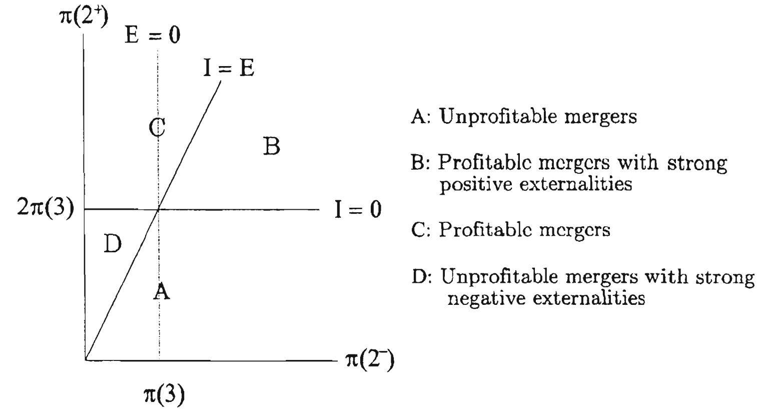

Figure 1: A classification of different mergers.

mergers on insiders' and outsiders' profit flows have been studied by the exogenous merger literature.[7] 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 the number of competitors, there is a positive market power effect, so that $\pi(2^-) > \pi(3)$. In Figure 1, this possibility is illustrated as the area 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 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

[7]This literature studies whether an exogenously selected group of firms (insiders) would increase their profit by merging compared to the situation in an unchanged market structure. Depending on the details of the situation the insiders (and the outsiders) would or would not profit from a merger, see Szidarovszky and Yakowitz (1982), Salant, Switzer and Reynolds (1983), Deneckere and Davidson (1985), Perry and Porter (1985), Levy and Reitzes (1992, 1995), Boyer (1992).

on the outsider's profit is larger than the effect on the insiders' profits, that is $|\pi(2^-) - \pi(3)| > |\frac{1}{2}\pi(2^+) - \pi(3)|$. 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. In the following analysis, we show that the incentives to merge are very different depending on the area (A, B, C or D) in which the firms find themselves.[8]

A firm's strategy describes the firm's behavior in the acquisition phase: 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 any given period (given that the triopoly remains in that period), b denotes the size of this bid, and a denotes the lowest bid a target will accept. Note that $0 < p < 1/2$ is a mixed strategy. 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 merger. After a merger has occurred, the duopoly values of the merged firm (+) and the outsider firm (-) are given by

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

for $i \in \{+, -\}$, where r is the common discount rate, and $\pi(2^i)/r$ is the dis-

[8] 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 $p = 1 - q_1 - q_2 - q_3$. 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).

counted 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, is multiplied by the probability of becoming a buyer (seller, outsider, triopolist) in that period. By definition, q is the probability that a specific firm buys another specific firm. It is given by:[9]

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

Assuming that the stock market is 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 $(n-1)p$.[10] Then,

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

[9] 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.

[10] That is

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

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

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

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,[11] that is

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

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):

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

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.

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

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

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

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

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

Lemma 1 *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 A.[12]

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 $\pi\left(2^{+}\right)/2 \leq \pi\left(3\right)$. This is illustrated as areas A and D (including the boundaries). There exists an immediate-merger equilibrium if, and only if, $I \geq E$, that is $\pi\left(2^{+}\right)/2 \geq \pi\left(2^{-}\right)$. This is illustrated 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 space.[13]

Finally, we should mention an extension of the model in Essay IV. 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 (sometimes large) probability. Intuitively, if the negative externality from the profitable merger is large, some firms have an incentive to preempt the profitable merger.

[12] 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.

[13] 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-dominance (Harsanyi and Selten, 1988) points at the immediate-merger equilibrium (see Fridolfsson and Stennek, 2000).

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:

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

To make the preemptive (or defensive) merger hypothesis more concrete, we supply an example of why a merger may be unprofitable for the merging firms, and even more unprofitable for the outsider. Consider a horizontal merger. If the merger generates important marginal cost synergies, the outsiders will lose. If the merger is costly to arrange, the insiders may lose.[14] 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, synergies are not required for hurting competitors (Boyer, 1992). Second, the one-time costs of restructuring 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). Finally, note that this example of a preemptive merger is not inconsistent with the empirical evidence showing that horizontal mergers increase consumer prices. First, if the merger induces the outsider to exit, the price may increase even though the insiders marginal costs have decreased. Second, Boyer (1992) shows that mergers in spatially differentiated market may hurt conpetitors at the same time as the average price is increased.[15]

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

[15] A preemptive merger mechanism has also been demonstrated by Horn and Persson (2000b), using a cooperative game theory model. They study an international oligopoly and the so-called

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 attempted acquisition of Scania. Håkan Frisinger, the chairman of the board of Volvo, confirmed that the primary motive behind the attempted transaction was to preempt other firms with an interest in Scania (Dagens Nyheter, 1999).[16] 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, strategic motives may be so strong so as to induce firms to agree to unprofitable mergers.[17]

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.*

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. Nilssen and Sorgard (1998) discuss the preemption motive in an exogenous merger model.

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

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

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 profitability of the merger. Hence, in order to interpret event study evidence correctly, it is important to empirically discriminate between the efficient market hypothesis and the surprise hypothesis.

The preemptive merger hypothesis also has a residual implication, namely that the outsider's value decreases, that is, $W(2^-) \leq W(3)$. 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 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. Even more striking is that the firms' market values were reduced a few weeks before the merger announcements. According to Banerjee and Eckard this is the time when the market should have started to anticipate the mergers. This pattern is exactly what the preemptive merger hypothesis suggests.[18]

[18] Banerjee and Eckard (1998) argue that the reduction in the competing firms' values, at the time when the anticipations should have been formed, is inconsistent with the hypothesis that the stock market anticipated the mergers. That claim is only true, however, if the mergers were profitable.

4 Looking Closer at Profit Studies

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 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 likely to include the event triggering the merger.

To control for exogenous shocks, all modern studies relate the change in the insiders' profits to the change in the profits of a control sample. The literature can be divided into two parts depending on how the control sample is constructed. In some studies, the control sample consists of firms from industries in general (e.g. Meeks, 1977; Ravenscraft and Scherer, 1987). In other studies the control sample consists of firms from the same industry as the merging firms (e.g. Healy, Palepu and Ruback, 1992). As it turns out, the construction of the control group is important for the results. Merging firms perform significantly worse than the control group, in the studies including firms from industries in general. In contrast, when compared to control firms from the same industry, the effect of mergers is mainly insignificant, and in the cases where it is significant the results favor the merging sample (Bild, 1998).

The latter methodology is likely to control for external shocks more efficiently since some shocks are industry specific. There is, however, also a problem with this methodology. Since the firms in the control group may be competitors to the insiders (if they operate on the same geographical market), they are exposed to externalities 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 profitability. Below, we provide two results from our merger model, indicating that this bias is of crucial importance for interpreting the empirical literature.

First, we focus on the studies that find a positive (and significant) effect of mergers, as compared to firms in the same industry. Our point is that these results may be explained by the preemptive merger hypothesis.

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

The proof is straightforward: a preemptive merger occurs exactly because becomming an outsider lowers profits more than becomming an insider. Propositions 3 thus shows that raising profits relative to other firms in the same industry should not be taken as proof that a merger creates value. The Proposition also provides a potential explanation for the difference in the results between the studies where the control sample is made up of firms from the merging parties' industries, and those studies where the control sample consists of firms from other industries.

Second, we focus on the studies that find a negative (but insignificant) effect of mergers, as compared to firms in the same industry (e.g. some country studies in Mueller, 1980). 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, on the other hand, 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 4 *In equilibrium, if a merger reduces the insiders' profits in relation to the profit of the outsider, 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. Proposition 4 thus indicates that the negative impact of mergers on profits may have been overestimated.

Bear in mind, however, that we illustrate the bias problem in an extreme way. We assume that it is the outsider of the theoretical model that makes up the control sample, and we have not formally included external shocks in the model. In reality, the attractiveness of including firms from the same industry in the control sample depends on the relative strength of externalities and external shocks, and the extent to which external shocks are industry specific. The important conclusion is that one must be careful in the construction of the control group. If possible, one should avoid to control for external shocks by using firms that are likely to be exposed to an externality from the merger, for example firms that are active in both the same product market and the same geographical market.

5 The Distribution of Surplus

In this section we discuss how the merging parties split the surplus from the merger. In terms of firm values, there is always a positive surplus, even if the merger reduces profits. It is easy to show that, in an immediate merger equilibrium, there exists a first mover advantage, that is $V^{buy} > V^{sell}$. 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, that is $V^{buy} = V^{sell}$. To our knowledge, no previous model of mergers has succeeded in predicting how the surplus is split by merging firms.[19]

The first mover advantage in the immediate merger equilibrium 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.

There is a fundamental problem in comparing the predictions of the model with the empirical evidence. The reason is that a bid may be equally well interpreted as an offer to sell as an offer to buy. Hence, the result 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 gains are split between buyers and sellers.

If one interprets the bidder as the buyer, the predictions of the model are at odds with the event study results which indicate that the seller takes the whole surplus.[20] However, our results can be aligned with the empirical evidence

[19]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.

[20]Interpreting bids as offers to buy rather than offers to sell may be motivated in the following

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, $V^{sell} = [2W(2^{+}) - W(3)]/3 \geq W(3) = V^{buy}$. Hence, the target firm's shareholders benefit, while the bidding firm's shareholders break even, exactly as suggested by the stylized facts.[21]

6 Policy Implications

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, shareholders 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, in Fridolfsson and Stennek (2000b), that is Essay II, we show that event studies cannot detect anti-competitive mergers, since such mergers may reduce outsiders' stock market value. This result is an immediate corollary of Lemma 1 of the

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.

[21] 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.

present paper. 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, 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 reduc-

[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.

tions 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.

7 Concluding Remarks

We demonstrate a preemptive merger mechanism (or a defensive merger mechanism) that may explain the empirical puzzle why mergers reduce profits, and raise share-prices. In Fridolfsson and Stennek (2000b), we also demonstrate why mergers may reduce 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 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 firms in the same industry may produce biased estimates. The reason is that mergers confer externalities on, for example, competitors. Finding other methods of controlling for external shocks is an important challenge for future empirical work. At a minimum, one must be careful not to control for external shocks by including firms that are likely to be exposed to an externality from the merger (e.g. competitors) in the control sample.

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

[23] 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.

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.

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.

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 Mergers Go Wrong, *The Economist*, July 22nd, 2000, 17.

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: Why Mergers Reduce Profits and Raise Share Prices, The Research Institute of Industrial Economics, Working Paper No. 511, 1999.

Fridolfsson, Sven-Olof; Stennek, Johan: Why Mergers Reduce Profits, and Raise Share Prices: A Theory of Pre-emptive Mergers, Center for Economic Policy Research, Discussion Paper No. 2357, January 2000.

Fridolfsson, Sven-Olof; Stennek, Johan: Why Event Studies do no Detect Anticompetitive Mergers, The Research Institute of Industrial Economics, mimeo., 2000b.

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.

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 Concentrated Markets, Forthcoming in *International Journal of Industrial Organization*, 2000a.

Horn, Henrik; Persson, Lars: The Equilibrium Ownership of an International Oligopoly, Forthcoming in *Journal of International Economics*, 2000b.

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.

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.: 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.

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.

Szidarovszky, F.; Yakowitz, S.: Contributions to Cournot Oligopoly Theory, *Journal of Economic Theory* v28, n1, October 1982, 51-70.

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

A Proofs

A.1 Preliminaries

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

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

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

Proof: See Fridolfsson and Stennek (1999).

Lemma 3 *Let*

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

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

A.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:

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

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,

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

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

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 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

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

where ξ is defined in Lemma 3 above. Consider the interesting case, characterized by $\pi(3)/r \neq [W(2^+) + W(2^-)]/3$.[24] In this case, $W(3) \neq [W(2^+) + W(2^-)]/3$,

[24]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.[25] 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 2. 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 2.

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 2.

Assume first that $\Theta > 0$.[26] 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 as depicted in Figure 2. Since

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

[25] 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.

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

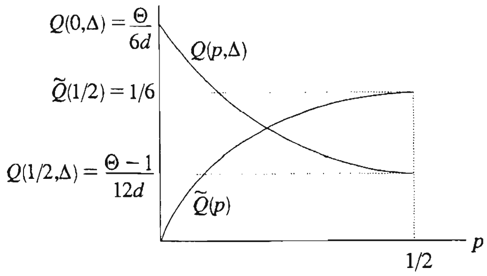

Figure 2: The delayed merger equilibrium.

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 2. Moreover, it follows from equation (18) that $p, q \to 0$ as $\Delta \to 0$ ($d \to \infty$), which is visualized in Figure 2 by the intercept of the curve $Q(p,\Delta)$ tending to 0.

A.3 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: $W(2^+) = \pi(2^+)/r = 2[\pi(2^+)/2r] = 2W(3)$.

A.4 Proof of Proposition 4

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 4, 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.

Essay II

Why Event Studies Do Not Detect Anti-Competitive Mergers

This essay is co-authored with Johan Stennek.

1 Introduction

The most debated question about horizontal mergers is if they are motivated by market power or efficiency gains such as cost savings.

One strand of the empirical literature shows that prices tend to rise (Barton and Sherman, 1984; Kim and Singal,1993), and that the merging firms' (insiders') market shares tend to fall as a result of horizontal mergers (Mueller, 1985). These studies indicate that increased market power dominates possible efficiency gains (from a consumer's perspective).

The event study literature suggest the opposite conclusion. The event studies examine how the competitors' (outsiders') share-prices move in response to the announcement of a horizontal merger. If share-prices increase, the merger is deemed anticompetitive. The reason is that an anticompetitive merger raises the product price, thereby increasing the outsiders' profits. Stillman (1983), Eckbo (1983) and Schumann (1993) show that competitors do not benefit from horizontal mergers. Banerjee and Eckard (1998) show that competitors suffered significant value losses.

McAfee and Williams (1988) use the event study approach to study a merger *known* to be anticompetitive, and show that outsiders' share-prices are nevertheless reduced. This finding casts doubts on event studies being able to detect anticompetitive mergers. 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.

We provide an additional explanation for why event studies fail to detect anticompetitive mergers. If it is more profitable to become an insider than an outsider, firms compete to become insiders, even if also the outsiders' profits are increased. When such a merger is announced, the competitors' stock market values are reduced. Intuitively, the pre-merger value of an outsider is high, since it reflects the possibility of becoming an insider. Once the merger has taken place, this possibility is eliminated, and outsiders' share-prices are reduced. The new information in the merger announcement is not that a merger has occurred. Rather, it is which firms are insiders and which are outsiders. Therefore, changes in share prices reveal the difference in the value of becoming an insider vs. an outsider, but not the value of becoming an insider or an outsider relative to remaining in status quo. This result is derived in a simplified version of the model of endogenous mergers in Essay I.

2 The Model

For expositional simplicity, we consider an industry which initially consists of three identical firms, and assume that mergers to monopoly are illegal.

Time is infinite and continuous but divided into short periods of length Δ. The common discount rate is r. Each period is divided into two phases. In the first phase, there is an acquisition game, in which one firm is randomly selected to submit a bid for another firm. A firm receiving a bid can only accept or reject it; if it rejects, it can give a (counter) offer in the next period (if selected).

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 to duopoly takes place, the insider earns profit flow $\pi(2^+)$, and the outsider earns $\pi(2^-)$. We assume that mergers from triopoly to duopoly are profitable, that is $\pi(2^+) > 2\pi(3)$. If the merger is anticompetitive (that is, if it increases price), the outsider's profit is increased, that is $\pi(2^-) > \pi(3)$. If insiders reduce their marginal costs substantially, they become a more difficult competitor, and price is reduced. Then, the outsider's profit is reduced. Note that a (pro-) anti-competitive merger has a (negative) positive externality on the outsider.

We restrict attention to symmetric Markov perfect equilibria, 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 any given period, b denotes the size of this bid, and a denotes the lowest bid that a target firm will accept.

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

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

for $i \in \{+, -\}$. In the triopoly, the expected value of any firm is given by

$$\begin{aligned} W(3) = & \tfrac{1}{r}\pi(3)\left(1 - e^{-r\Delta}\right) \\ & + e^{-r\Delta}\left[\tfrac{2}{3}p\left(W\left(2^+\right) - b\right) + \tfrac{2}{3}pb + \tfrac{2}{3}pW\left(2^-\right) + (1-2p)\,W(3)\right]. \end{aligned} \tag{2}$$

The second term is the discounted expected value of all future profits. The value of being a buyer ($W(2^+) - b$), seller (b), outsider ($W(2^-)$) and triopolist ($W(3)$), is multiplied by the probability of becoming a buyer, seller, outsider and triopolist in the next period. For example, the probability of becoming a buyer is $(2p)/3$, since a firm is selected to bid with probability $1/3$, and since it bids for each of the two other firms with probability p.

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. Second, a bidder does not offer more. Hence: $b = a = W(3)$. Third, a firm bids if, and only if, bidding maximizes its value. If the firm does not bid, its value is $W(3)$. If it bids, the value is $W(2^+) - b$. Hence, in equilibrium,

$$\begin{cases} p = \frac{1}{2} & \text{and} \quad W(2^+) - b \geq W(3) \quad \text{or} \\ p = 0 & \text{and} \quad W(2^+) - b \leq W(3) \quad \text{or} \\ p \in (0, 1/2) & \text{and} \quad W(2^+) - b = W(3). \end{cases} \tag{3}$$

Lemma 1 *Assume that mergers from triopoly to duopoly are profitable, that is* $\pi(2^+) > 2\pi(3)$. *Consider the set of symmetric Markov perfect equilibria as* $\Delta \to 0$. *A merger occurs immediately if, and only if, it is better to be an insider than an outsider, that is* $\frac{1}{2}\pi(2^+) - \pi(3) \geq \pi(2^-) - \pi(3)$. *A merger occurs after delay if, and only if, it is better to be an outsider than an insider, that is* $\frac{1}{2}\pi(2^+) - \pi(3) \leq \pi(2^-) - \pi(3)$.

Proof: Consider an equilibrium with $p = 0$. By (2), $W(3) = \pi(3)/r$. Therefore, condition (3) requires that $\pi(2^+) \leq 2\pi(3)$, violating the assumption that mergers are profitable. Consider $p = 1/2$. By (2), $W(3) = \left[\pi(2^+) + \pi(2^-)\right]/(3r)$ as $\Delta \to 0$. Therefore, (3) requires that $\pi(2^+) \geq 2\pi(2^-)$. Consider $p \in (0, 1/2)$. Solve for p and $W(3)$ using equations (2) and (3). Then, $p = -\frac{3}{4}\left(\frac{1-e^{-r\Delta}}{e^{-r\Delta}}\right)\left(\frac{\pi(2^+)-2\pi(3)}{\pi(2^+)/2-\pi(2^-)}\right)$. It is required that $\pi(2^+)/2 < \pi(2^-)$ for $p > 0$. QED.

Assuming that the stock market is efficient, the evolution of the stock market value of a firm is described by the evolution of its expected discounted value. Hence:

Proposition 1 *An anticompetitive merger [$\pi(2^-) > \pi(3)$] reduces the outsiders' stock market value [$W(2^-) < W(3)$], if becoming an insider is more advantageous than becoming an outsider [$\pi(2^+)/2 > \pi(2^-)$].*

Proof: Mergers characterized by $\pi(2^-) > \pi(3)$ and $\frac{1}{2}\pi(2^+) \geq \pi(2^-)$ occur immediately. In such an equilibrium, $W(3) = \frac{1}{3}[\pi(2^+) + \pi(2^-)]/r$. Hence, $W(2^-) = \pi(2^-)/r < W(3)$ if, and only if, $\frac{1}{2}\pi(2^+) > \pi(2^-)$. QED.

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 eliminated, and the outsider's share-price is reduced. The new information in the merger announcement is which firms are insiders and which are outsider.

3 Concluding Remarks

By showing that anticompetitive mergers may reduce competitors' share prices, we reconcile the diverging empirical evidence on the welfare effects of horizontal mergers. We conclude that event studies cannot detect anticompetitive mergers.

The diverging empirical evidence on M&A's has created a controversy regarding the benefits of merger control. Based on the evidence from event studies, indicating that even mergers challenged by antitrust authorities do not increase competitors share-prices, Eckbo and Wier (1985) argue that "all but the 'most overwhelmingly large' mergers should be allowed to go forward." Our results show that this opposition toward merger control is not well-founded.

Our results also indicate that competition authorities should be cautious when using event study techniques to assess proposed mergers' effects on competition. While an increase in competitors' share prices indicate that a merger is anticompetitive, a decrease in their share prices does not indicate that a merger is procompetitive.

References

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.

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.

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

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

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

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

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

Essay III

Should Mergers be Controlled?[1]

This essay is co-authored with Johan Stennek.

1 Introduction

In 1999, the worldwide value of mergers and acquisitions exceeded 3.4 trillion US dollars (The Economist, 2000). While many of the transactions in this current wave are motivated by legitimate responses to changing business conditions such as global competition, deregulation, and over capacity, a larger share involves direct competitors than in the past (Pitofsky, 1997). Thus, this current wave revives the old controversy over the costs and benefits of merger control.

One of the alleged motives for mergers between competitors is increased market power and, as a result, markets might become too concentrated from a social welfare point of view. Stigler (1950) points out an important countervailing force, however. If market power is the main motive for a merger, remaining outside the merger is usually more profitable than participating. Firms may thus not have an incentive to participate in such mergers, even if they are profitable. This countervailing force, referred to as the holdup mechanism, has important implications for competition policy. It suggests that horizontal mergers are primarily formed for other reasons than market power, for instance cost synergies and other socially desirable goal, and that controlling mergers may thwart, or at least delay, such gains.

The oligopoly models studied by Szidarovszky and Yakowitz (1982), Salant, Switzer, and Reynolds (1983), Perry and Porter (1985), and Deneckere and Davidson (1985) support the idea that outsiders gain from a merger (positive externalities). In many cases, outsiders gain more than insiders do (strong positive

[1]Our work has been much improved thanks to discussions with Jonas Björnerstedt, Francis Bloch, Lars Persson, Anna Sjögren, and Frank Verboven. We are grateful for comments from seminar participants at Stockholm University, University of Antwerp (UFSIA), IUI (Stockholm), Stockholm School of Economics, EARIE '98 in Copenhagen and EEA '99 & ESEM '99 in Santiago de Compostela. We thank Christina Lönnblad for editorial assistance.

externalities), since outsiders benefit from the price increase, but need not reduce output themselves. More recently, Kamien and Zang (1990 and 1993) studied a non-cooperative model of the acquisition process which exhibits a holdup mechanism. They show that positive externalities indeed prevent firms from agreeing to certain profitable mergers involving *three* firms or more. Consider a triopoly firm attempting to buy both competitors at the same time. By unilaterally rejecting the offer, each target becomes a duopolist. Therefore, both targets will require compensation for a duopoly profit and not only for the triopoly profit.

Like Kamien and Zang, we explicitly analyze the acquisition process as a non-cooperative coalition formation game.[2] We demonstrate that *strong* positive externalities reduce the incentives for *two* firms to merge, even if the merger is profitable. We also show that this holdup mechanism takes the form of delay, rather than completely preventing anti-competitive mergers. The intuition is that firms delay the merger proposals and consequently forego valuable profits, since there is a chance that other firms might merge instead–much like a war of attrition. The final result, however, is excessive concentration.

To describe the acquisition process, we construct an extensive form model of coalitional bargaining. In particular, we construct a so-called game of timing. 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 or reject it. In the latter case, the recipient can make a counterproposal in the future. As a consequence, firms endogenously decide whether and when to merge, and how to split the surplus while keeping alternative mergers in mind. There are two important differences between our analysis and the one by Kamien and Zang. First, they cannot predict how merging firms split their surplus. Second, by focusing on asymmetric equilibria, Kamien and Zang in effect exogenously assign specific roles to the firms, that is, they choose which firms are buyers, sellers, and outsiders, respectively. This means that they overlook two important problems in the merger process. The market mechanism itself must split the surplus, and select the buyer when different roles yield different payoffs. In our model, these are the problems materializing as holdup mechanisms.

[2]The idea to use the theory of coalition formation for studying mergers originates with Stigler (1950). The first formal work was made by Salant, Switzer, and Reynolds (1983, section IV), Mackay (1984) and Deneckere and Davidson (1985b). Two more recent contributions include Gowrisankaran (1999) who uses simulation techniques to analyze endogenous mergers in a context where entry, exit, and internal expansion are allowed, and Horn and Persson (2000a, 2000b) who analyze endogenous mergers when firms differ, by using a cooperative approach.

Since the holdup mechanism only creates temporary frictions to monopolization, merger control may play an important part for preserving competitive markets. To design merger control properly, the holdup mechanism must be taken into account. Consider the current use of divestiture as a remedy for anti-competitive mergers. In the US, most cases are today resolved by consent decree, where the deal is allowed to close so long as a package of assets sufficiently large to address competitive concern is set aside for divestiture (Baer, 1996). Also in Europe, mergers are approved on condition that the merging firms divest part of their assets. For example, the merger in 1992 between Nestlé and Perrier involved the divestiture of Perrier's subsidiary Volvic to the competitor BSN (Compte, Jenny and Rey, 1996). We show that such divestiture requirements eliminate the holdup mechanism. Requiring divestiture introduces a channel for transferring wealth from competitors to the merging firms. As a result, the merging firms can appropriate the positive externalities and mergers are proposed immediately. If the competition authorities are well informed, eliminating the holdup mechanism increases welfare. Welfare increasing mergers are hastened, while welfare reducing mergers can still be blocked. In practice, however, competition authorities have limited information, and the divestiture policy is applied to mergers violating a more or less arbitrary threshold level of concentration. In such circumstances, the divestiture policy also hastens welfare deteriorating mergers.

We also demonstrate a surprising inter-temporal link. Merger incentives may be reduced by the prospect of additional profitable mergers in the future. The prospect of a future merger increases the value of becoming an insider in the first merger, which tends to hasten it. The prospect of a future merger may, however, increase the value of becoming an outsider in the first merger even more. If so, the first merger will be delayed by the prospect of the future merger. This intertemporal link between mergers creates additional problems for the appropriate design of merger control. We provide two examples indicating that, in some markets, reasonable merger policies are worse than not controlling mergers at all.

First, in some markets, a policy prohibiting mergers in concentrated market structures hastens mergers in less concentrated ones. By prohibiting mergers from duopoly to monopoly, the value of first merging from triopoly to duopoly is reduced, which tends to reduce the incentives for merging to duopoly. More interestingly, the value of becoming an outsider in the triopoly-to-duopoly merger is reduced even more. As a result, forbidding mergers to monopoly reduces the holdup friction in mergers to duopoly. In an industry where social welfare is higher the less concentrated is the market, forbidding mergers to monopoly is expected to be better than not controlling mergers at all. This need not be the case, however, due to the intertemporal link. On the one hand, forbidding merger to monopoly decreases the concentration in the final market structure (duopoly rather than monopoly) which is a welfare gain. On the other hand, the triopoly remains for a shorter period of time, which is a welfare cost.

Second, even the policy to allow a merger if, and only if, the merger increases social welfare is, in some cases, worse than not controlling mergers at all. The reason is that such a case-by-case policy does not take the intertemporal links between mergers into account. Consider an industry where monopoly is socially inferior to duopoly due to dead weight losses. Duopoly and monopoly are socially preferred to triolopy due to cost reductions in the merged firm as well as the outsider (technological spillovers). In such an industry, a merger from triopoly to duopoly may be unprofitable since the merging firms lose market shares. A merger from duopoly to monopoly is profitable, due to increased market power. Moreover, a merger from triopoly to duopoly would occur, if a subsequent merger to monopoly were to be approved, otherwise not. As a result, a laisser faire policy leads to monopoly while, in contrast, the case-by-case policy implies that no mergers are carried out. Consequently, the triopoly persists, even though it is the least advantageous outcome from a welfare point of view. Unfortunately, taking the intertemporal link into account is difficult. That would require much more information than the case-by-case policy. Moreover, there is a commitment problem. Once a merger from triopoly to duopoly has occurred, it is actually optimal to block the merger to monopoly.

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 rejecting, 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

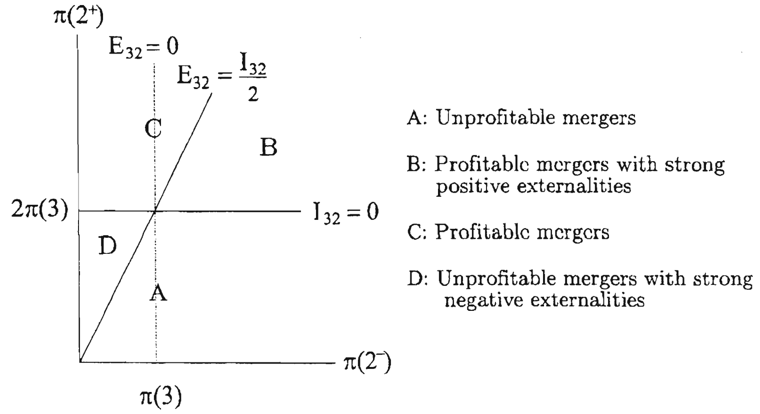

Figure 1: case when mergers to monopoly are illegal.

bids at the same time, only one bid is transmitted, all with equal probability.[3]

In the second phase, there is a market game. Rather than specifying an explicit oligopoly model, the profit levels of each firm in each market structure are taken 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 $\pi(1)$.

Our analysis shows how merger incentives (the acquisition phase) depend on 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 mergers from triopoly to duopoly (when mergers to monopoly cannot take place). The effects of mergers on insiders' and outsiders' profit flows have been studied by the exogenous merger literature.[4] According to this litera-

[3]This is a simple and transparent way of circumventing an already well-known problem. Under certain conditions, the bargaining game behaves as a so-called preemption game. If all players decide to move simultaneously, technical difficulties may arise. 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 Fridolfsson and Stennek (2000), that is, Essay I.

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

ture, 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 $I_{32} = 0$. However, a merger may also be unprofitable if, for example, the outsider expands production substantially in response to the merger, 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 $I_{32} = 0$ line. Normally, a merger also confers an externality on the outsider. Since a merger reduces the number of competitors, there is a positive market power effect, so that $\pi(2^-) > \pi(3)$. In Figure 1, this possibility is illustrated as the area to the right of the "zero-externality line," labeled $E_{32} = 0$. However, if the merging parties can reduce their marginal costs substantially, they become a more difficult competitor. This may harm outsiders, so that $\pi(2^-) < \pi(3)$. In Figure 1, this possibility is illustrated as the area to the left of the $E_{32} = 0$ 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. In the following analysis, we show that the incentives to merge are very different depending on the area (A, B, C or D) in which the firms find themselves.[5]

Working backwards, we start by analyzing firms' incentives to merge from duopoly to monopoly. Since the acquisition game is the same as the one presented below (for the case of mergers from triopoly to duopoly) and the analysis is straightforward, we only present the result. Let the profitability of a merger from duopoly to monopoly be denoted by

$$I_{21} \equiv \left[\pi(1) - \pi(2^+) - \pi(2^-)\right]/r. \tag{1}$$

In equilibrium, the two firms do not merge if, and only if, $I_{21} \leq 0$; they merge immediately if, and only if, $I_{21} \geq 0$. The expected split of the surplus is equal, that is each firm receives $I_{21}/2$.

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

[5] All possible profit configurations can be generated by means of a simple oligopoly model (see Essay I).

Next, we analyze firms' incentives to merge from triopoly to duopoly, taking into account the possibility of subsequent mergers to monopoly. (The case when firms can buy more than one firm at a time is discussed at the end of Section 3.) In the triopoly, 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.

Conforming to the fundamental idea of endogenous merger analysis, we restrict our attention to symmetric equilibria. If we were to study asymmetric equilibria, we would, in effect, exogenously assign a role (buyer, seller or outsider) to each firm. Hereby, we would neglect an important friction in the merger process, namely that the market itself must select the roles of different firms, when different roles yield different payoffs. We also 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).[6] 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, b denotes the size of this bid, and a denotes the lowest bid a target will accept. For convenience, we only consider bids that would be accepted if submitted.

We now define the continuation values of the firms after a merger from triopoly to duopoly, at the date of merger and before merger. After a merger to duopoly has occurred, the values of the merged (+) firms and the outside (-) firm are given by

$$W\left(2^{i}\right) = \pi\left(2^{i}\right)/r + e^{-r\Delta} I_{21}^{*}/2, \tag{2}$$

for $i \in \{+, -\}$, where r is the common discount rate, $\pi\left(2^{i}\right)/r$ is the discounted value of all future profits in the duopoly, and $I_{21}^{*} \equiv max\{0, I_{21}\}$ is the additional value of the firms in the duopoly due to the opportunity to merge to monopoly in the next period. At the time a merger occurs, the values of the buying, selling,

[6] With non-Markov strategies, a plethora of outcomes can be supported in the models studied by Chatterjee, Dutta, Ray, and Senegupta (1993) and Ray and Vohra (1995). (The main difference between their approach and ours is that they exogenously specify the order of proposers in the bargaining game.) Such multiplicity is also likely to exists in our model. The Markov perfect equilibrium could be motivated by its simplicity, and the fact that it is easier to coordinate on (Maskin and Tirole, 1995).

and outsider firms are given by

$$\begin{aligned} V^{buy} &= W\left(2^{+}\right) - b, & \text{(3a)} \\ V^{sell} &= b, & \text{(3b)} \\ V^{out} &= W\left(2^{-}\right), & \text{(3c)} \end{aligned}$$

respectively. In the triopoly, the expected value of any firm is given by

$$W(3) = \frac{1}{r}\pi(3)\left(1 - e^{-r\Delta}\right) + e^{-r\Delta}\left[2qV^{buy} + 2qV^{sell} + 2qV^{out} + (1-6q)\,W(3)\right]. \tag{4}$$

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, is multiplied by the probability of becoming a buyer (seller, outsider, triopolist) in that period. By definition, q denotes the probability of a specific firm buying another specific firm, and is given by[7]

$$q = \frac{1 - (1-2p)^3}{6}. \tag{5}$$

Let $EV(b)$ denote the expected value for firm i of bidding with certainty on firm j, and $EV(nb)$ 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 ($j \neq i$) submitting a bid at a given point in time. Note that m is a binomial random variable with parameters $(n-1)$ and $(n-1)p$. Then,

$$EV(b) = V^{buy}E\left\{\tfrac{1}{m+1}\right\} + V^{sell}E\left\{\tfrac{m}{m+1}\right\}\tfrac{1}{n-1} + V^{out}E\left\{\tfrac{m}{m+1}\right\}\tfrac{n-2}{n-1}. \tag{6}$$

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

$$EV(nb) = W(3)\Pr\{m=0\} + V^{out}\left[1 - \Pr\{m=0\}\right]\tfrac{n-2}{n-1} + V^{sell}\left[1 - \Pr\{m=0\}\right]\tfrac{1}{n-1}. \tag{7}$$

[7] 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 of no firm making a bid. The status quo only remains if no firms submit a bid, since all bids are designed to be accepted.

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, that is

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

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

$$b = W(3). \tag{9}$$

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 specific other firm is restricted to $p \leq 1/2$ by the symmetry assumption):

$$\begin{cases} \text{Immediate merger:} & p = \frac{1}{2} & \text{and} & EV(b) \geq EV(nb) & \text{or} \\ \text{No merger:} & p = 0 & \text{and} & EV(b) \leq EV(nb) & \text{or} \\ \text{Delayed merger:} & p \in (0, 1/2) & \text{and} & EV(b) = EV(nb). \end{cases} \tag{10}$$

To describe the equilibrium structure, we let the profitability of a merger from triopoly to duopoly, that is the internal effect, be denoted by

$$I_{32} \equiv \left[\pi\left(2^{+}\right) - 2\pi(3)\right]/r. \tag{11}$$

The gain from becoming an outsider, that is the externality, is denoted by

$$E_{32} \equiv \left[\pi\left(2^{-}\right) - \pi(3)\right]/r. \tag{12}$$

The profitability of a merger from triopoly to monopoly is denoted by

$$I_{31} \equiv \left[\pi(1) - 3\pi(3)\right]/r. \tag{13}$$

Throughout the paper, mergers to monopoly are assumed to be profitable, that is, $I_{21}, I_{31} > 0$.

The incentives to merge from triopoly to duopoly are influenced by the possibility of a subsequent merger to monopoly. To take the intertemporal link into account, we define the average gain of becoming an insider as

$$I \equiv \left[I_{32} + I_{21}^{*}/2\right]/2, \tag{14}$$

and the gain of becoming an outsider as

$$E \equiv E_{32} + I_{21}^{*}/2. \tag{15}$$

Note that I is defined as an average gain (is divided by 2) while I_{32}, I_{21} and I_{31} are defined as total gains.

Lemma 1 *Consider mergers from triopoly to duopoly. 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,* $|E| > |I|$ *and* $sign\{E\} = sign\{I\}$.

All proofs are relegated to Appendix A. It is easy to demonstrate that an equilibrium exists for all possible parameter configurations. The implications of the equilibrium structure is discussed in the next section, focusing on delayed and no-merger equilibria.

The model also predicts when a delayed merger will occur. Note that there are t/Δ time periods between time 0 and time t. Hence, the triopoly remains until time t with probability $(q_0(\Delta))^{t/\Delta}$, where q_0 depends on the period length. Define the cumulative distribution function that indicates the probability of a merger not having occurred before time t, as

$$G_0(t) \equiv \lim_{\Delta \to 0} (q_0(\Delta))^{t/\Delta}.$$

Lemma 2 *In delayed merger equilibria,* $G_0(t) = e^{-\Theta r t}$, *where* $\Theta \equiv 3I/(E - I) > 0$.

The probability of a merger having occurred at time t is $G(t) = 1 - e^{-\Theta r t}$. Note that the probability of a merger having occurred at $t = 0$ is zero, and that the probability of a merger having occurred is one, when $t \to \infty$. The expected time before merger is $\int_0^\infty r\Theta e^{-\Theta r t} t dt = 1/(r\Theta)$.[8]

The model predicts how the surplus will be split. In particular, in a delayed merger equilibrium, the insiders split the surplus equally. As far as we know, no previous model of mergers has succeeded in predicting how the surplus will be split by merging firms.[9]

[8]The probability of a merger taking place in the time interval $(t, t + dt)$, given that no merger has occurred before t, is constant and given by $g(t)\,dt/G_0(t) = r\Theta dt$, where $g(t) = r\Theta e^{-\Theta r t}$ is the merger density.

[9]Kamien and Zang (1990, 1991, 1993) cannot predict how the surplus will be split, since

3 Holdup

By holdup we mean that a profitable merger does not occur or occurs with a delay. In this section, we present two distinct holdup mechanisms that are immediate consequences of Lemma 1. For convenience, the first mechanism is presented in two separate propositions.

Consider the case when mergers from duopoly to monopoly are blocked by competition authorities (which is as if $I_{21}^* = 0$). In this case, the equilibrium structure of Lemma 1 is described by Figure 1. There exists a no-merger equilibrium if, and only if, $I_{32} \leq 0$, that is, $\pi(2^+) \leq 2\pi(3)$, which is illustrated as areas A and D. There exists an immediate-merger equilibrium if, and only if, $I_{32}/2 \geq E_{32}$, that is, $\pi(2^+)/2 \geq \pi(2^-)$, which is illustrated as areas C and D. A delayed-merger equilibrium exists in areas B and D. Since mergers to duopoly are profitable in area B, this delay is a form of holdup.

Proposition 1 *Assume that mergers to monopoly are illegal. Consider a market where mergers from triopoly to duopoly are profitable, that is $I_{32} > 0$, but it is better to be an outsider than an insider, that is $E_{32} > I_{32}/2$. A merger occurs with probability one in the long run. However, the expected waiting time is strictly positive, and equal to $1/[r\Theta]$ as $\Delta \to 0$.*

Proposition 1 is particularly relevant for anti-competitive mergers since, in these cases, it is better to be an outsider than an insider. The proposition shows that strong externalities counteract, but do not completely offset, the incentives for such mergers. The intuition is that firms delay their merger proposals, and consequently forego valuable profits, since other firms might merge instead. We see this as a formalization of Stigler's (1950) holdup mechanism. Despite the holdup mechanism, however, the final result is excessively concentrated markets.

Next, consider the case when mergers from duopoly to monopoly are allowed by the competition authorities. In this case, the equilibrium structure of Lemma 1 is illustrated in Figure 2. Note that if $I_{21} < 0$, the duopoly would be stable. This region lies to the north-east of Line $I_{21} = 0$ and is, in turn, partitioned into equilibrium-areas A, B and C, as in the case when mergers to monopoly

they construct their bargaining model as a Nash demand game. Firm F makes a bid b, and firm G simultaneously announces a reservation price a. 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 closer to the Rubinstein-Ståhl bargaining model.

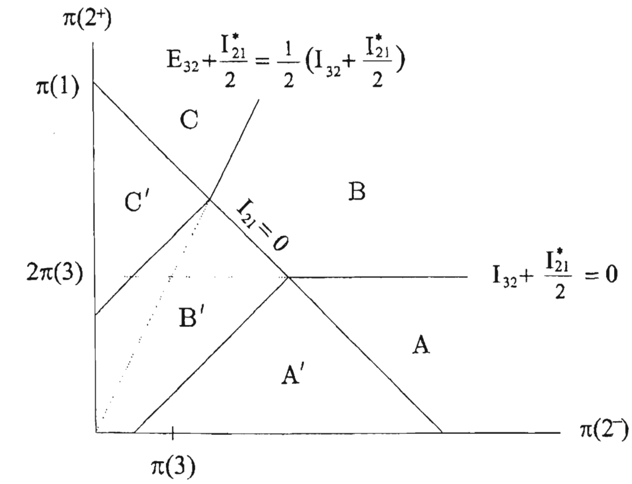

Figure 2: case $I_{31} > 0$.

were ruled out by assumption. Under our assumption that $I_{21} > 0$, the duopoly is unstable. This region lies to the south-west of Line $I_{21} = 0$. A no-merger equilibrium exists if, and only if, $I_{32} + I_{21}/2 \leq 0$. In terms of profit flows, the condition is $\pi(2^+) \leq [4\pi(3) - \pi(1)] + \pi(2^-)$, which is illustrated as area A'. An immediate-merger equilibrium exists if, and only if, $(I_{32} + I_{21}/2)/2 \geq E_{32} + I_{21}/2$. In terms of profit flows, the condition is $\pi(2^+) \geq \pi(1)/3 + \pi(2^-)$, which is illustrated as area C'. Similarly, a delayed merger equilibrium exists in area B'. Since the sequence of mergers from triopoly to monopoly is profitable, the delay in area B' is a form of holdup.

Proposition 2 *Consider a market where mergers from triopoly (and duopoly) to monopoly are profitable and where the gain from becoming an insider is positive, that is* $(I_{32} + I_{21}/2)/2 > 0$, *but the gain from becoming an outsider is even larger, that is* $E_{32} + I_{21}/2 > (I_{32} + I_{21}/2)/2$. *A merger from triopoly to monopoly (via duopoly) occurs with probability one in the long run. However, the expected waiting time is strictly positive, and equal to* $1/[r\Theta]$ *as* $\Delta \to 0$.

Propositions 1 and 2 constitute two examples of the same mechanism; the difference is that, in the latter case, it is the monopoly that is delayed.

When merger to monopoly is allowed, being an outsider (in the merger to duopoly) may be better than being an insider for two distinct reasons. One reason is that the merger from triopoly to duopoly is mainly motivated by market power, so that there is a strong positive externality, that is $E_{32} > I_{32}/2$. The other reason is that the outsider captures a larger share of the surplus in the subsequent merger to monopoly than do the insiders (per firm), that is $I_{21}/2 > I_{21}/4$.

The holdup mechanism described in Propositions 1 and 2 is a form of coordination failure in the acquisition game. All firms are better off by a merger compared to the original situation. The fundamental problem is that different roles (buyer, seller, outsider) give different payoffs. The holdup friction is the result of the firms' desire to become outsiders; in equilibrium, the firms delay their bids, hoping that other firms will merge instead.

Another way of seeing that it is indeed the allocation of roles that creates holdup, is to consider asymmetric equilibria where one firm is *exogenously* selected for each role. One firm is exogenously appointed to stay as an outsider and receive profit flow $\pi(2^-)$. The other firms are appointed as insiders and can share profit flow $\pi(2^+)$. Such asymmetric equilibria (only) exist in areas B and B' of Figures 1 and 2. Moreover, an asymmetric merger is achieved immediately. Thus, when the firms do not need to allocate roles, there is no holdup. However, in such an equilibrium the values of the different firms (in the triopoly) differ according to which role they have exogenously been assigned. Why, one may ask, are the insiders willing to accept their roles? Why does a buyer not delay a merger proposal, to see if the appointed outsider gives in, and makes an offer first?[10]

Kamien and Zang (1990, 1993) do not identify this holdup mechanism since they allocate roles exogenously. To be more precise, Kamien and Zang (1990) provide a static model of the acquisition game, and prove the existence of another holdup mechanism. In particular, a triopoly firm attempting to buy both its competitors must offer each firm a duopoly profit, since each firm would become a duopolist by *unilaterally* rejecting the offer. Hence, a profitable merger to monopoly, that is a merger characterized by $\pi(1) > 3\pi(3)$, does not occur if $\pi(1) < \pi(3)+2\pi(2)$. There are three differences between our holdup mechanism, described in Proposition 1, and the holdup mechanism in Kamien and Zang

[10] Insisting on symmetric equilibria entails that we must accept studying mixed strategy equilibria. We interpret the mixed strategy equilibrium in terms of Harsanyi's (1973) purification theorem, which shows that any mixed strategy equilibrium can "almost always" be obtained as the limit of a pure-strategy equilibrium in a given sequence of slightly perturbed games.

(1990). Our mechanism affects two-firm mergers, while their holdup mechanism affects mergers involving three firms or more. Second, ours is due to strong positive externalities, while theirs is the result of positive externalities. Third, our mechanism takes the form of delay, while Kamien's and Zang's is absolute–the merger does not even occur in the long run.

There is also a second holdup mechanism in our model.

Proposition 3 *Consider a market where mergers from triopoly (and duopoly) to monopoly are profitable. No merger occurs in equilibrium if the gain from becoming an insider is negative, that is* $(I_{32} + I_{21}/2)/2 < 0$.

This holdup mechanism is present in area A' in Figure 2. There are two reasons for triopoly not being transformed into monopoly, even though $I_{31} > 0$. First, the merger from triopoly to duopoly is unprofitable ($I_{32} < 0$).[11] Second, the insiders' share of the surplus from the subsequent, and profitable ($I_{21} > 0$), merger from duopoly to monopoly is too small. Together, the insiders only receive half the surplus of the second merger.

Expressed differently, a sequence of mergers from triopoly to monopoly does not occur because the outsider would capture too a large share of the surplus, $I_{31} = [\pi(1) - 3\pi(3)]/r$. There are two reasons why the outsider captures such a large share. First, the merger from triopoly to duopoly may have a positive externality on the outsider, that is $\pi(2^-) > \pi(3)$. Such a positive externality strengthens the outsider's bargaining position (his so-called inside option) in the subsequent merger for monopoly. Second, the outsider free-rides, also in the sense of reaping a positive share (namely half) of the surplus in the merger from duopoly to monopoly, that is $I_{21}/2$. From the industry's point of view, there is a commitment problem. If the outsider could commit not to demand such a large share of the surplus in the negotiations over the merger to monopoly, this holdup mechanism would be mitigated.

The causes behind the holdup mechanism in Propositions 1 and 2 and the one in Proposition 3 are different. The first mechanism is due to the firms' conflicts over the allocation of roles. In the second case, an exogenous allocation of roles does not avoid holdup (there are no asymmetric equilibria in region A'). The problem is the firms' conflict over the split of the surplus.

[11] One may question how a merger can be unprofitable. Cannot the merged firm at least replicate the pre-merger strategy? Not necessarily. Mergers motivated by market power may be unprofitable because competitors expand their output in response to such mergers (Szidarovszky and Yakowitz, 1982; Salant, Switzer, and Reynolds, 1983).

Kamien and Zang (1993) study sequential mergers in a multi-period extension of their previous model. Holdup also occurs in that model because of conflicts over the surplus. In their model, the split of surplus is not determinate, since there are multiple equilibria. Selecting the equilibrium favoring the insiders the most, they show that holdup exists only in parts of our region A'. In particular, giving the outsider only $\pi(2^-)/r$ in the merger from duopoly to monopoly, there is holdup only if $\pi(1) < \pi(2^-) + 2\pi(3)$. Thus, their holdup mechanism is only due to the positive externality from the merger to duopoly. In our model, the split of the surplus is determined in equilibrium. Since the outsider captures a share of the surplus in the merger from duopoly to monopoly, the holdup mechanism is strengthened.

Actually, in our model, there may be holdup even in the case of negative externalities (area A' extends into the area where $\pi(2^-) < \pi(3)$). Since mergers with negative externalities are typically pro-competitive, this observation raises the concern that the market may fail to induce mergers beneficial to both firms and consumers. Holdup may thus hinder socially desirable mergers.

It might be suspected that the holdup mechanisms would disappear (or at least be mitigated) if firms were allowed to bid for both of their competitors at the same time. Fridolfsson (1998) disproves that conjecture; the argument being the same as in Kamien and Zang (1993). Complete monopolization through a sequence of two-firm mergers is preferred to one three-firm merger. (Hence, no merger or a delayed two-firm merger is preferred to a three-firm merger.) Essentially, in a sequential monopolization, the first target must be compensated for the loss of its triopoly value, that is $W(3)$, and the second for the loss of its duopoly value, that is $W(2^-)$. In a three-firm merger, both targets must be paid the duopoly value. Moreover, $W(2^-)$ is larger than $W(3)$ in the relevant cases.

4 Divestiture as Remedy

Propositions 1 and 2 show that the strong positive externality from anti-competitive mergers creates an obstacle for firms attempting to monopolize a market. It also shows that merger control may nevertheless be valuable, since the merger is only delayed. In this section, we show that when designing a merger policy, the holdup mechanism should be taken into account.

In the past, problematic mergers were often challenged in their entirety. In the US, most cases are today resolved by consent decree where the deal is allowed to close so long as a package of assets sufficiently large to address competitive concern is set aside for divestiture (Baer, 1996). According to Article 8(2) of the EU merger regulation, a merger may be approved provided that the merging firms divest part of their assets. For example, the merger in 1992 between Nestlé and Perrier involved the divestiture of Perrier's subsidiary Volvic to the competitor BSN. In this case, it was the merging firms that proposed the divestiture. However, there is little doubt that the parties to the merger thought that without the divestiture, the European Commission was likely to oppose the takeover (Compte, Jenny and Rey, 1996).

In this section, we investigate the consequences of such divestiture requirements on the merger process and the holdup mechanism. In particular, we are interested in the effect of requiring the merging firms to divest assets to competitors, as in the Nestlé-Perrier merger case. This issue can be analyzed in the context of our model, by changing the rules of the acquisition phase. For simplicity, we assume mergers to monopoly to be blocked by the competition authority ($I_{21}^{\star} = 0$). As before, the buyer offers b to the seller. If the seller accepts the offer, the competition authority intervenes and requires some assets to be divested to the outsider. Then, the buyer proposes a price for the assets to be divested. Finally, the outsider either accepts or rejects the offer. If accepted, a duopoly with profit flows $\tilde{\pi}(2^{+})$ and $\tilde{\pi}(2^{-})$ is realized (the tilde symbol indicates the profit flows in the duopoly after divestiture). In case the outsider rejects, the triopoly remains for another period. A symmetric Markov perfect equilibrium is characterized by the quintuple (p, b, a, β, α), where β indicates the price at which the buyer proposes the outsider to buy the asset to be divested and α indicates the highest price the outsider will accept. The firms' values at the time of the merger are given by:

$$\begin{aligned}
V^{buy} &= W\left(2^{+}\right) - b + \beta, && \text{(16a)}\\
V^{sell} &= b, && \text{(16b)}\\
V^{out} &= W\left(2^{-}\right) - \beta, && \text{(16c)}
\end{aligned}$$

where $W\left(2^{i}\right) = \tilde{\pi}\left(2^{i}\right)/r$. All other equations from section 2 remain unchanged. To complete the model, we only need to add two equilibrium conditions. If the outsider rejects offer β, the triopoly remains. Hence, by subgame perfection in the acquisition phase, the highest price accepted by the outsider is given by the external effect, that is

$$\alpha = W\left(2^{-}\right) - W\left(3\right). \tag{17}$$

Moreover, the bidder's profit is maximized if

$$\beta = W\left(2^{-}\right) - W\left(3\right). \tag{18}$$

As it turns out, an immediate merger equilibrium exists (as $\Delta \rightarrow 0$) if, and only if, the aggregate profit in the duopoly is larger than the aggregate profit in the triopoly, that is $\widetilde{\pi}\left(2^{+}\right) + \widetilde{\pi}\left(2^{-}\right) \geq 3\pi\left(3\right)$. A no merger equilibrium exists if, and only if, $\widetilde{\pi}\left(2^{+}\right) + \widetilde{\pi}\left(2^{-}\right) \leq 3\pi\left(3\right)$. Thus, the holdup friction has vanished.

Proposition 4 *Assume that mergers to monopoly are illegal. A policy approving mergers to duopoly, conditional on the buyer divesting assets to the outsider, hastens merger to duopoly, compared to the policy approving mergers to duopoly without conditions.*

The intuition for this result is that the competition authority introduces a channel for transfer of wealth from the outsider to the merging firms. In particular, the outsider is willing to pay a high price for the divested assets, since the alternative is that the merger is blocked. Hereby, the insiders can extract the positive externality from the outsider, and participating in a merger becomes more profitable than standing outside. As a consequence, the free rider friction disappears.

If competition authorities are well-informed, the divestiture policy increases social welfare. Indeed, if a merger to the "best duopoly" increases social welfare relative to the triopoly, then the merger (with divestiture) is carried out, and it is carried out immediately. If, on the other hand, the "best duopoly" decreases social welfare relative to the triopoly, the authority need only forbid it. There is only one restriction, the competition authority must order a divestiture satisfying $\widetilde{\pi}\left(2^{+}\right) + \widetilde{\pi}\left(2^{-}\right) \geq 3\pi\left(3\right)$.

In reality, however, competition authorities do not have detailed knowledge about the welfare effects of mergers. Instead, they rely on threshold concentration levels (in terms of market shares or the Herfindahl index) for approving mergers. Obviously, such policies may block welfare increasing mergers and approve welfare decreasing ones. In such a context, Proposition 4 points at a potential problem. Divestiture of assets from the larger merged entity to the smaller outsider reduces concentration. In some markets, a merger with divestiture keeps concentration below the threshold, while the same merger without divestiture violates the threshold. In such markets, divestiture hastens mergers whether they improve welfare or not.

5 Merger Control and Intertemporal Links

The incentives for mergers in less concentrated markets are affected by the expected merger activities in more concentrated markets. Such intertemporal links have additional implications for merger policy.

5.1 Concentration Based Policies

Consider a merger policy formulated in terms of a threshold concentration level. Since the welfare maximizing level of concentration differs between different markets, such threshold levels imply that some markets will become more concentrated and some less, than the socially optimal level. To be concrete, the policy forbidding monopoly but not duopoly is too strict for markets with very strong scale economies, but too lax for markets with milder economies of scale. However, there is also a less obvious cost of concentration based policies, due to the intertemporal links in merger formation.

An implication of Lemma 1 is that mergers from triopoly to duopoly may be hastened or delayed by the expectation of a subsequent merger to monopoly, due to two opposing effects. First, the net gain to insiders of the first merger is larger than otherwise, since $\partial I/\partial I_{21}^{*} > 0$, which tends to increase Θ and hasten a merger. Second, the net gain for the outsiders in the first merger is also larger than otherwise, since $\partial E/\partial I_{21}^{*} > 0$, which tends to decrease Θ and to delay a merger. The next proposition identifies the conditions under which the latter effect dominates the former.

Proposition 5 *Assume all mergers to be profitable [$I_{32} > 0$, $I_{21} > 0$, and $I_{31} > 0$]. If competition authorities block mergers to monopoly but not to duopoly, then the expected delay for a merger from triopoly to duopoly is lower than under a laisser faire regime, if $\pi(2^{+}) - \pi(2^{-}) \geq \pi(3)$.*

In an industry where social welfare is higher the less concentrated is the market, forbidding mergers to monopoly is expected to be better than not controlling mergers at all. However, Proposition 5 shows that this need not be the case. On the one hand, forbidding merger to monopoly decreases the concentration in the final market structure (duopoly rather than monopoly) which is a welfare gain. On the other hand, the triopoly remains for a shorter period of time when mergers to monopoly are forbidden, which is a welfare cost.

5.2 The Case-by-Case Policy

Consider the policy to allow a proposed merger if, and only if, it is welfare increasing. This case-by-case policy is optimal if each merger is analyzed in isolation and has also been the focus of all earlier welfare analyses of mergers, since those studies have been based on the exogenous merger approach (Williamson, 1968; Farrell and Shapiro, 1990; Barros and Cabral, 1994). In an endogenous merger framework, however, the case-by-case policy need not be optimal.

To illustrate the non-optimality of the case-by-case policy, we use an example of a market where mergers to duopoly generate cost savings. In particular, it is assumed that a merger from triopoly to duopoly reduces marginal costs due the adoption of a superior technology. The knowledge of the new technology fully spills over to the outsider at zero cost.[12] Merged firms are assumed to be more complex which materializes into higher fixed costs. The example is formalized in Appendix B.

In this market, a merger from triopoly to duopoly increases social welfare and would be accepted. The reason is that the efficiency gains in the form of reduced marginal costs dominate both the dead weight loss associated with increased concentration and the increase in fixed costs. For the same reason, monopoly dominates triopoly in welfare terms. In contrast, a merger from duopoly to monopoly reduces social welfare and hence, would not be accepted. There is only increased market power, without any additional cost savings. Thus, from a social welfare point of view:

$$\text{duopoly} \succ \text{monopoly} \succ \text{triopoly}. \tag{19}$$

In this market, a merger from triopoly to duopoly is unprofitable for two reasons; the merged firm has higher fixed costs, and the outsider expands its

[12] We think of the cost reduction as the result of R&D in duopoly. The incentives for R&D are larger in duopoly (and monopoly) than in triopoly for two reasons. The spillover effect is less of a problem when fewer firms free-ride, and less of the cost savings are passed on to consumers via a lower price in a concentrated market.

output. The two beneficial effects (increased market power and reduced costs) are dominated by the negative ones. A merger from duopoly to monopoly is profitable due to increased market power and, as a result, the firms do not merge to duopoly, if the merger to monopoly is blocked. However, there would be delayed mergers to monopoly under a laisser faire regime (area B' in Figure 2).

In this market, a laisser faire regime leads to monopoly, while the case-by-case policy results in triopoly. Hence:

Proposition 6 *Assume the welfare ranking between the different market structures to be given by (19). Assume that mergers to duopoly are unprofitable, but that mergers from triopoly to monopoly via duopoly occur absent merger control. The policy to allow mergers if, and only if, they are welfare increasing, in effect, also blocks mergers from triopoly to duopoly, and hence is inferior to a laisser faire regime.*

The decision not to allow the merger from duopoly to monopoly is motivated by a comparison between the monopoly and the duopoly. However, if the firms understand the policy and can predict the future behavior of competition authorities, the relevant alternative to monopoly is triopoly.

Unfortunately, taking the intertemporal link between different mergers into account is difficult for at least two reasons. First, when a merger (from duopoly to monopoly) is proposed, the competition authority must look back in time and assess which mergers (that have already taken place) would not have occurred if the proposed merger were to be blocked. Such a policy obviously requires that competition authorities have access to a very large amount of information. In particular, more information is needed than for implementing the case-by-case policy. Second, once the socially beneficial merger has taken place, it is actually better to block the merger to monopoly. Hence, in order to implement the optimal policy, the competition authorities must be able to credibly commit not to use the case-by-case policy.

6 Concluding Remarks

Anti-competitive mergers benefit competitors more than the merging firms. We demonstrate that such externalities reduce firms' incentives to merge. Firms delay merger proposals, thereby foregoing valuable profits and hoping other firms will merge instead - a war of attrition. The final result, however, is an overly concentrated market. We also demonstrate how merger incentives may be reduced by the prospect of participating in additional, future, profitable mergers.

These results are derived in a model of endogenous mergers. In particular, we construct a so-called game of timing for describing the bargaining process.[13] 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 or reject it. In the latter case, the recipient can make a counterproposal in the future. As a consequence, firms endogenously decide whether and when to merge, and how to split the surplus, while keeping other possible mergers in mind.[14]

Since the holdup mechanism only creates temporary frictions to monopolization, merger control may play an important part for preserving competitive markets. Even reasonable policies may, however, be worse than not controlling mergers at all.

[13] Games of timing have previously been used for analyzing both "wars of attrition" and thier opposite, preemption. 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).

[14] 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 because the order of proposals is endogenous.

References

Baer William J.: Report from the Bureau of Competition: Looking Back and Going Forward, Prepared Remarks of William J. Baer, Director, Bureau of Competition, Federal Trade Commission, before the 44th Annual Antitrust Spring Meeting , Federal Trade Commission Committee, Washington, D.C., March 28, 1996.

Barros, Pedro P.; Cabral, Luis M. B.: Merger Policy in Open Economies, *European Economic Review*; 38(5), May 1994, pages 1041-55.

Chatterjee, K.; Dutta, B.; Ray, D.; and Senegupta, K.: A Theory of Noncooperative Coalitional Bargaining, *Review of Economic Studies* 60, 1993, pages 463-477.

Compte, Olivier ; Jenny, Frédéric; Rey, Patrick: Capacity Constraints, Mergers and Collusion, mimeo. IDEI, University of Toulouse, 1996.

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).

The Economist: How Mergers Go Wrong, *The Economist*, July 22nd, 2000, 17.

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

Fridolfsson, Sven-Olof: Endogenous 3-firm Mergers, mimeo. Department of Economics, Stockholm University, October 1998.

Fridolfsson, Sven-Olof; Stennek, Johan: Why Mergers Reduce Profits, and Raise Share Prices: A Theory of Preemptive Mergers, Discussion Paper 2357, Center for Economic Policy Research, 2000.

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.

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

Harsanyi, John C.: Games with Randomly Disturbed Payoffs: A New Rationale for Mixed-Strategy Equilibrium Points, *International Journal of Game Theory*; 2, 1973, pages 1-23.

Horn, Henrik; Persson, Lars: Endogenous Mergers in Concentrated Markets, Forthcoming in *International Journal of Industrial Organization*, 2000a.

Horn, Henrik; Persson, Lars: The Equilibrium Ownership of an International Oligopoly, Forthcoming in *Journal of International Economics*, 2000b.

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: 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.

Mackay, Robert J.: Mergers for Monopoly: Problems of Expectations and Commitments, Bureau of Economics, Federal Trade Commission, Working Paper No. 112, July 1984.

Maskin, Eric; Tirole, Jean: Markov Perfect Equilibrium I: Observable Actions, mimeo. Harvard University, November 6. 1995.

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, pages219-27.

Pitofsky, Robert: Staples and Boeing: What They Say About Merger Enforcement at the FTC, Prepared Remarks of Robert Pitofsky, Chairman, Federal Trade Commission, Business Development Associates, The Madison Hotel, Washington, D.C., September 23, 1997.

Ray, Debraj; Vohra, Rajiv: Binding Agreements and Coalitional Bargaining, mimeo. Boston University, July 1995.

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

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.

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

Szidarovszky, F.; Yakowitz, S.: Contributions to Cournot Oligopoly Theory, *Journal of Economic Theory* 28, 1982, 51-70.

US Department of Justice; Federal Trade Commission: *1992 Horizontal Merger Guidelines*, Washington: US Department of Justice, April 1997.

A Proofs

A.1 Preliminaries

Lemma 3 *Let $m \sim Bin\,(n-1,(n-1)\,p)$. When $p>0$,*

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

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

Proof: 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 4 *Let*

$$\xi(p) \equiv \frac{1}{6} \frac{\Pr\{m=0\} - E\left\{\frac{1}{m+1}\right\}}{\frac{1}{3}\Pr\{m=0\} + E\left\{\frac{1}{m+1}\right\}}. \tag{20}$$

Then, since $n = 3$,

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

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

A.2 Proof of Lemma 1

We only provide a proof of Lemma 1 for the case when $I_{21}^* = 0$. When $I_{21}^* > 0$, the proof is similar and therefore omitted. There is one additional complication, however, namely that Θ is a function of Δ.

We start the proof by rewriting the definitions of $W(2^i)$, $W(3)$, $EV(b)$ and $EV(nb)$. Since $I_{21}^* = 0$, equation (2) simplifies to

$$W(2^i) = \pi(2^i)/r \tag{21}$$

for $i \in \{+, -\}$. Moreover, let $d = e^{-r\Delta}/\left(1 - e^{-r\Delta}\right)$, substitute (3a)-(3c) into (4) and rearrange:

$$W(3) - \frac{1}{r}\pi(3) = 2qd\left[W(2^+) + W(2^-) - 3W(3)\right]. \tag{22}$$

Furthermore, by lemma 3, when $p > 0$ and $n = 3$,

$$E\left\{\frac{1}{m+1}\right\} = \frac{1-(1-2p)^3}{6p}. \tag{23}$$

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

$$EV(b) = V^{buy} E\left\{\frac{1}{m+1}\right\} + \left[1 - E\left\{\frac{1}{m+1}\right\}\right]\left[V^{sell} + V^{out}\right]\left(\frac{1}{2}\right). \tag{24}$$

$$EV(nb) = W(3)\Pr\{m=0\} + \left[1 - \Pr\{m=0\}\right]\left[V^{out} + V^{sell}\right]\left(\frac{1}{2}\right). \tag{25}$$

An **immediate-merger** equilibrium is characterized by $p = 1/2$. By equation (5), we have $q = 1/6$. By equation (22), we have $W(3) = \left[W(2^+) + W(2^-)\right]/3$ when $\Delta \to 0$ (that is $d \to \infty$), since $W(3)$ is bounded. By equation (23), $E\left\{\frac{1}{m+1}\right\} = 1/3$. By equation (24) and the fact that $V^{sell} = b = W(3)$, we have $EV(b) = \left[W(2^+) + W(2^-)\right]/3$. By equation (25), we have $EV(nb) = W(2^+)/6 + 4W(2^-)/6$ since $\Pr\{m=0\} = 0$. Hence, by equation (21), $EV(b) \geq EV(nb)$ if and only if $\pi(2^+) \geq 2\pi(2^-)$.

A **no-merger** equilibrium is characterized by $p = 0$. By equation (5), we have $q = 0$. By equation (22), we have $W(3) = \pi(3)/r$. By Lemma 3, $E\left\{\frac{1}{m+1}\right\} = 1$. By equation (24), we have $EV(b) = W(2^+) - \pi(3)/r$. By equation (25), we have $EV(nb) = \pi(3)/r$ since $\Pr\{m=0\} = 1$. Hence, by equation (21), $EV(b) \leq EV(nb)$ 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 (24), and the expected value of not bidding, given by equation (25), and rearranging, we have that

$$W(3) = \frac{W(2^+)}{2} - 2\xi(p)\left[\frac{W(2^+)}{2} - W(2^-)\right] \tag{26}$$

where ξ is defined in Lemma 4 above.

Consider first, the interesting case, characterized by $\pi(3)/r \neq \left[W(2^+) + W(2^-)\right]/3$. By (22), it follows that $W(3) \neq \left[W(2^+) + W(2^-)\right]/3$. To prove this, assume the opposite. Then, the right-hand side of equation (22) is zero. Hence, $W(3) = \pi(3)/r$. In turn, $\pi(3)/r = \left[W(2^+) + W(2^-)\right]/3$ which is a contradiction. Similarly, we can prove that $W(3) \neq \pi(3)/r$. By (26), it follows that $W(2^+)/2 \neq W(2^-)$ for all $p \in (0, 1/2)$, since $\xi(p) \leq 0$. Consequently, by equation (21), $\Theta = 3\frac{\pi(2^+) - 2\pi(3)}{\pi(2^-) - \pi(2^+)/2}$ is finite.

Use (22) to solve for q:

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

Use (26) to eliminate $W(3)$, and (21) 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:

$$q = Q(p, \Delta) \equiv \frac{\Theta + 6\xi(p)}{1 - 6\xi(p)} \frac{1}{6d(\Delta)}. \tag{27}$$

Moreover, according to equation (5):

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

The equilibrium values of p are determined by

$$Q(p) = \widetilde{Q}(p). \tag{28}$$

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 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 $\xi'(p) \leq 0$ (according to Lemma 4) and $Q_p(p, \Delta) = \frac{\xi'(p)}{(1-6\xi)^2}\left[1 + \Theta\right]\frac{1}{d}$ it follows that $Q(p, \Delta)$ is monotonically decreasing. Since

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

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 (27) 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 $p = 0$, contradicting $p \in (0, 1/2)$. 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 $\pi(3)/r = \left[W(2^+) + W(2^-)\right]/3$. By (22), it follows that $W(3) = \left[W(2^+) + W(2^-)\right]/3$ and

$W(3) = \pi(3)/r$ since $1 + 6qd \neq 0$. By (26), it follows that $W(2^+)/2 = W(2^-)$ since $\xi(p) \leq 0$. By equation (21), $W(2^+)/2 = W(2^-)$ if and only if $I_{32}/2 = E_{32}$. Since $W(2^+)/2 = W(2^-)$ it follows by equation (26) 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 (21), is equivalent to $I_{32}/2 = 0$ (hence both the nominator and the denominator of Θ are zero). Hence $EV(b) = EV(nb)$, that is, equation (26) is satisfied, if and only if $I_{32}/2 = E_{32} = 0$. 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 $I_{32}/2 = E_{32} = 0$ characterizes a non-generic parameter configuration, we disregard this possibility. QED.

A.3 Proof of Lemma 2

Again, we only provide a proof for the case when $I_{21}^* = 0$. When $I_{21}^* > 0$, the proof is similar, although Θ being a function of Δ once more implies an additional complication.

By definition

$$G_0(t) = \lim_{\Delta \to 0} [q_0(\Delta)]^{t/\Delta}.$$

Since the logarithm is continuous

$$\ln G_0(t) = t \lim_{\Delta \to 0} \frac{\ln q_0(\Delta)}{\Delta}.$$

Note that $\lim_{\Delta \to 0} q_0(\Delta) = \lim_{\Delta \to 0}(1 - 6q(\Delta)) = 1$. Hence, $\lim_{\Delta \to 0} \frac{\ln q_0(\Delta)}{\Delta} =$ "$\frac{0}{0}$". By l'Hopital's rule: $\lim_{\Delta \to 0} \frac{\ln q_0(\Delta)}{\Delta} = \lim_{\Delta \to 0} \frac{q_0'(\Delta)}{q_0(\Delta)} = \lim_{\Delta \to 0} q_0'(\Delta)$. Hence:

$$\ln G_0(t) = t \lim_{\Delta \to 0} q_0'(\Delta).$$

Use equation (27) and $q_0 = 1 - 6q$ and rearrange to get

$$q_0(\Delta) = \frac{e^{-r\Delta}(1 + \Theta) - (\Theta + 6\xi(p(\Delta)))}{e^{-r\Delta}(1 - 6\xi(p(\Delta)))} \tag{29}$$

Let $\xi^\Delta(\Delta) = \xi'(p(\Delta))\, p'(\Delta)$. If $\lim_{\Delta \to 0} \xi^\Delta(\Delta)$ is finite, then

$$\lim_{\Delta \to 0} q_0'(\Delta) = -r\Theta,$$

hence

$$\ln G_0(t) = -r\Theta t.$$

and consequently $G_0(t) = e^{-r\Theta t}$, as claimed.

It remains to be shown that $\lim_{\Delta\to 0} \xi^{\Delta}(\Delta) = \lim_{\Delta\to 0} \xi'(p(\Delta))\, p'(\Delta)$ is finite. By Lemma 4, $\lim_{\Delta\to 0} \xi'(p(\Delta))$ is finite, and thus it remains to be shown that $\lim_{\Delta\to 0} p'(\Delta)$ is finite. Remember that equilibrium p is determined by equation (28). Hence,

$$\frac{dp}{d\Delta} = \frac{Q_\Delta}{\widetilde{Q}_p - Q_p}. \tag{30}$$

Note that

$$Q_\Delta = \frac{\Theta + 6\xi(p)}{1 - 6\xi(p)} \frac{1}{6} r \left[1 + \frac{1}{d}\right]$$

and hence $\lim_{\Delta\to 0} Q_\Delta = r\Theta/6$, since $p \to 0$ as $\Delta \to 0$. Moreover,

$$Q_p = \frac{18\xi'(p)}{[3 - 18\xi(p)]^2} [1 + \Theta] \frac{1}{2d}$$

and hence $\lim_{\Delta\to 0} Q_p = 0$. Finally, $\widetilde{Q}_p = (1-2p)^2$ and hence $\lim_{\Delta\to 0} \widetilde{Q}_p = 1$. Hence:

$$\lim_{\Delta\to 0} \frac{dp}{d\Delta} = \frac{r\Theta}{6}. \tag{31}$$

QED.

A.4 Proof of Proposition 5

Assume that $I_{21} \geq 0$, $I_{31} \geq 0$ and $I_{32} \geq 0$. Note (in Figure 2) that for some parameter configurations, there is an immediate merger to duopoly independent of whether there is a subsequent merger to monopoly. For some other parameter configurations, there is immediate merger to duopoly if there is no subsequent merger to monopoly, otherwise a delayed merger to duopoly. These cases satisfy $\pi(2^+) \geq \pi(3) + \pi(2^-)$.

The more difficult case is when there is delay independent of whether there is a subsequent merger to monopoly. Since $\Theta = 3\frac{\frac{I_{32}}{2}+\frac{I_{21}}{4}}{E_{32}+\frac{I_{21}}{2}-\left(\frac{I_{32}}{2}+\frac{I_{21}}{4}\right)}$ when a subsequent merger to monopoly is allowed, we have

$$\frac{\partial\Theta}{\partial I_{21}} = \frac{1}{3}\Theta^2 \left(\frac{E_{32}+\frac{I_{21}}{2}}{\frac{I_{32}}{2}+\frac{I_{21}}{4}}\right) \left[\frac{1}{4\left(\frac{I_{32}}{2}+\frac{I_{21}}{4}\right)} - \frac{1}{2\left(E_{32}+\frac{I_{21}}{2}\right)}\right].$$

Since $E_{32} + \frac{I_{21}}{2}$ and $\frac{I_{32}}{2} + \frac{I_{21}}{4}$ are both positive when $\Theta > 0$ and $I_{31} \geq 0$, the sign of the partial derivative is determined by the term within brackets. Note that

$$\frac{1}{4\left(\frac{I_{32}}{2}+\frac{I_{21}}{4}\right)} - \frac{1}{2\left(E_{32}+\frac{I_{21}}{2}\right)} \geq 0 \Leftrightarrow \pi\left(2^+\right) \leq \pi(3) + \pi\left(2^-\right).$$

When a subsequent merger to monopoly is not allowed, $\Theta = 3\frac{\frac{I_{32}}{2}}{E_{32}-\frac{I_{32}}{2}}$. Hence, the merger to duopoly is hastened by the expectation of a subsequent merger to monopoly, that is

$$3\frac{\frac{I_{32}}{2}+\frac{I_{21}}{4}}{E_{32}+\frac{I_{21}}{2}-\left(\frac{I_{32}}{2}+\frac{I_{21}}{4}\right)} \geq 3\frac{\frac{I_{32}}{2}}{E_{32}-\frac{I_{32}}{2}},$$

if $\pi\left(2^{+}\right) \leq \pi\left(3\right) + \pi\left(2^{-}\right)$, and delayed otherwise. QED.

B Example

Inverse demand is given by $p = 1 - Q$, where $Q = \sum_i q_i$. Up to a capacity constraint $\overline{q} = 1/3$, each firm in the triopoly has a production cost cq_i where $c < 1$. After a merger to duopoly, the merged entity's marginal cost is reduced to zero (due to the learning of a superior technology) while it also incurs a fixed cost f (since larger firms are more complex to manage). The outsider's marginal cost is also reduced to zero, due to technological spillovers. However, unlike the merged entity, the outsider does not incur an additional fixed cost.

Firms compete à la Cournot. Given that the capacity constraints are non-binding, each firm produces $q_i = (1-c) / (1+n)$ in equilibrium and the gross profit (not including fixed costs) is given by $\pi_i = (1-c)^2 / (1+n)^2$ (set $c = 0$ in case a merger has occurred). The consumers' surplus is given by $Q^2/2$ and social welfare is measured as the sum of consumers' and producers' surpluses. The capacity constraints are never binding (see below). Thus, the triopoly profit is $\pi(3) = (1-c)^2/16$ and the duopoly profits are $\pi(2^+) = 1/9 - f$ and $\pi(2^-) = 1/9$, respectively. In the monopoly, the profit is $1/4 - f$.

If a merger from duopoly to monopoly takes place, the monopoly either shuts down the outsider's plant or the insiders' plants. Keeping both is not optimal, if larger firms induce higher fixed costs. In the former case, the monopoly produces with the merged entity's technology, characterized by the high capacity constraint $2\overline{q}$ and the fixed cost f. The profit is $1/4 - f$. In the latter case, it produces with the outsider's technology, with capacity constraint $\overline{q}$ and zero fixed cost. The profit would be $(1-\overline{q})\,\overline{q} = 2/9$. Thus, the monopoly profit is $\pi(1) = 1/4 - f$ if $f < 1/36$ (C1). The only role of the capacity constraints is to ensure that the monopolist closes down the outsider's plant.

A merger from triopoly to duopoly is not profitable if $f > 1/9 - (1-c)^2/8$ (C2). A merger from duopoly to monopoly is always profitable and a sequence of mergers to monopoly occurs under a laisser faire regime if $f < \left[1 - (1-c)^2\right]/8$ (C3). Finally, social welfare is always higher in duopoly than in monopoly, while social welfare in monopoly is higher than in triopoly if $f < 3/8 - 15(1-c)^2/32$ (C4). Let $c = 0.14$ and $f = 0.02$. Then conditions (C1)-(C4) are all fulfilled.

Essay IV

Anti-Competitive versus Pro-Competitive Mergers[1]

1 Introduction

Today, competitive forces drive a merger wave of historical proportions. The total global value of mergers and acquisitions (M&As) exceeded 3.4 trillion US dollars in 1999 (The Economist, 2000). While many of the M&As in the current wave appear to be motivated by a legitimate response to fast changing business conditions such as global competition, deregulation, and over capacity, a larger share than in the recent past seems to involve direct competitors (Pitofsky, Chairman of the FTC, 1997). As a result, it may legitimately be feared that several of the recent mergers have increased firms' market power and thereby have reduced consumers' welfare.

This concern has been the main motivation for ruling some horizontal mergers illegal. For example, the European Commission recently blocked a merger between the two Swedish truck manufacturers Volvo and Scania on the ground that the merger would nearly eliminate all competition in the Scandinavian market while reducing it significantly in Irland and the United Kingdom (European Commission, 2000a). Interestingly, the prohibition of this merger induced Volvo to acquire Renault Véhicules Industriels (RVI).[2] Unlike the attempted merger between Volvo and Scania, the latter merger was not blocked by the Commission (European Commission, 2000b). According to the Commission, this merger would not increase market concentration significantly in any geographical market and consequently should not hurt the consumers. It may even be hypothesized

[1] This paper has been significantly improved thanks to my discussions with Jonas Björnestedt, Helen Jakobsson, Lars Persson, Giancarlo Spagnolo, Johan Stennek and Andreas Westermark. I am also grateful for comments by participants in workshops at the Stockholm University and at IUI.

[2] Similarly, Volkswagen purchased a large minority stake in Scania. However, this purchase was not investigated by the Commission, since it was not classified as a merger.

that the Volvo-RVI merger might benefit consumers; if a merger does not reduce competition and its only impact is to save on costs, some of the associated benefits should spill over to consumers.

These events raise the concern that mergers that are harmful to consumers, that is anti-competitive mergers, may preempt pro-competitive mergers that are beneficial to this category. The main finding of this paper is that this is a legitimate concern. While the market sometimes selects the most desirable merger from the consumers' point of view, the subsequent analysis highlights several mechanisms leading firms to pursue anti- rather than pro-competitive mergers.

The starting point of this analysis is a robust finding in the theoretical literature on mergers, that the "competitive" nature of mergers is linked to their impact on the profitability of outsiders (competitors). While anti-competitive mergers typically benefit outsiders, the opposite is true for pro-competitive mergers.[3] In turn, the signs and magnitudes of these external effects on outsiders favor anti- rather than pro-competitive mergers.

To be more precise, external effects have a direct influence on the firms' merger decisions which, depending on their sign, materialize into different incentives for potential outsiders. First, consider anti-competitive mergers. Potential outsiders to such mergers refrain from pursuing pro-competitive mergers if the positive external effect from the anti-competitive merger is large enough. This lack of incentives for merging is referred to as the "inducement mechanism." Second, consider pro-competitive mergers with negative external effects. Potential outsiders to such mergers pursue anti-competitive mergers to preempt the pro-competitive merger that would hurt them. This incentive for merging is referred to as the "preemption mechanism."

Furthermore, external effects also have an indirect influence on firms' merger decisions. Since firms' pre-merger values incorporate the risk of becoming an outsider, potential outsiders to anti-competitive mergers with positive external effects have high pre-merger values. As a result, the acquisition of such firms tend to be expensive. Conversely, potential outsiders to pro-competitive mergers tend to be cheap. In turn, other firms, including potential participants in pro-

[3]Intuitively, merging firms in an anti-competitive merger restrict their output relative to their combined pre-merger output in order to increase the equilibrium price. As a result, the external effect of the merger is positive, since the outsider benefits from the higher price without bearing the cost of reducing its own output (Salant, Switzer and Reynolds, 1983; Perry and Porter, 1985; Farrell and Shapiro, 1990). Throughout the paper, I use the sign of the external effects in order to identify whether a merger is anti- or pro-competitive.

competitive mergers, tend to find it profitable to buy potential outsiders to pro-competitive mergers. Thereby, they preempt the pro-competitive merger and instead induce an anti-competitive one. This incentive for buying firms that will lose as outsiders is referred to as the "valuation mechanism."

To illustrate these mechanisms, I extend the model in Essay I to asymmetric firms. Unlike other models of endogenous merger formation, this model predicts how the merging firms split the surplus. In the present context, such a prediction is crucial. Indeed, firms pursue anti- rather than pro-competitive mergers, since the split of the surplus in the former type of merger is more favorable to bidding firms. Thus, I am able to identify the valuation mechanism precisely because the merging firms split the surplus endogenously.

Previous merger analyses, starting with Stigler (1950), have mainly focused on the question of whether the process of merger formation leads to the most desirable level of concentration.[4] In contrast, the present paper asks the question whether the process of merger formation induces the most desirable merger for a given level of concentration. This issue was first addressed in a full-fledged model of endogenous merger formation by Horn and Persson (2000a).[5] They propose a game theoretical cooperative model of endogenous merger formation which captures the inducement and preemption mechanisms. However their model does not endogenously predict the split of the surplus among the merging firms and is therefore not suitable for identifying the valuation mechanism. Moreover, they do not explicitly analyze cases with pro-competitive mergers.

The paper is organized as follows. Section 2 introduces the model. To focus on the competitive nature of mergers, Section 3 considers cases where the profitability of mergers (their internal effects) is small relative to their external effects. As a result, merger incentives are, to a large extent, determined by the external effects of mergers. If one merger is anti-competitive (has a positive external effect) while an alternative merger is pro-competitive (has a negative external effect), the firms tend to pursue the former merger. Furthermore, the market may fail to select the most desirable merger, also when all mergers benefit the consumers (are

[4] More recent contributions along these lines are Kamien and Zang (1990), (1991), (1993), Gowrisankaran and Holmes (2000) and Nocke (2000).

[5] A number of other papers treat related questions. Barros (1998) studies whether the merger formation process eliminates inefficient rather than efficient firms. Persson (1998) formalizes the failing firm defense as an auction and finds that the worst buyer, from the consumers' point of view, often acquires the failing firm. Horn and Persson (2000b) analyze whether firms pursue national rather than cross border mergers.

pro-competitive). Section 4 briefly discusses cases when internal effects are larger than external effects. Section 5 shows that the signs and magnitudes of external effects may be crucial for predicting the likelihood of specific mergers, even though profitability considerations clearly favor specific mergers. Indeed, firms may pursue an unprofitable and anti-competitive merger, even though other mergers are profitable and pro-competitive. The welfare effects may also be perverse; firms may pursue an unprofitable merger reducing both the consumers' and producers' surpluses, even though an alternative and profitable merger increases these surpluses. The Concluding Remarks discuss some prospects for testing the prediction that more anti-competitive mergers preempt less anti-competitive ones as well as policy implications of this finding.

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 nature, with equal probability, selects a firm as the bidder.[6] The selected firm then chooses whether to bid, the identity of the target firm and the size of the bid. A firm receiving a bid can only accept or reject it; if it rejects, it can give a (counter) offer in some future period when selected by nature. No time is assumed to elapse during the acquisition game, although it is described as a sequential game.

I consider an industry which initially consists of three firms: two identical firms, labelled x_1 and x_2, and one other firm, labelled y. Mergers to monopoly are not allowed, that is such mergers are implicitly assumed to be blocked by competition authorities. Consequently, firms can only submit bids for one other firm at a time.

In the second phase, there is a market game. Rather than specifying an explicit oligopoly model, I take the profit levels of each firm in each market structure as exogenous. In the triopoly, a firm x_i earns profit flow $\pi_x(3)$ and firm y earns profit flow $\pi_y(3)$. After the xx-merger, that is the merger between firms x_1 and x_2, the merged firm earns profit flow $\pi_{xx}(2)$, and the outsider (i.e. firm y)

[6]This specification differs from the one in Fridolfsson and Stennek (1999). There, it is assumed that all firms can bid in the same period but that only one bid is transmitted (each with equal probability) if more than one firm bid in the same period. I adopt the specification where a bidder is selected randomly by nature in each period, since it is simpler.

earns $\pi_y(2)$. Similarly, after an xy-merger, that is a merger between say firm x_i and firm y, the merged firm earns profit flow $\pi_{xy}(2)$, and the outsider (i.e. firm x_j) earns $\pi_x(2)$.

A firm's strategy describes the firm's behavior in the acquisition game: whether to bid (if selected by nature), the identity of the target firm, 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. I restrict the attention to Markov strategies and symmetric equilibria. In the present context, symmetry means that firm y treats firms x_1 and x_2 identically, and that firms x_1 and x_2 behave identically. With a slight abuse of notation, let subscripts yx, xx and xy denote the events that firm y submits a bid to firm x_1 or x_2, firm x_i submits a bid to firm x_j and firm x_i submits a bid to firm y. Firm y's strategy consists of the triple (p_{yx}, b_{yx}, a_y), where $p_{yx} \in [0, 1/2]$ denotes the probability that firm y bids for a specific firm x_i in a given period, b_{yx} denotes the size of this bid and a_y denotes the lowest bid that firm y accepts. Firm x_i's strategy consists of the quintuple $(p_{xx}, b_{xx}, p_{xy}, b_{xy}, a_x)$, where $(p_{xx}, p_{xy}) \in \{[0,1]^2 : p_{xx} + p_{xy} \in [0,1]\}$, p_{xx} (p_{xy}) denotes the probability that firm x_i bids for firm x_j (y) in a given period, b_{xx} (b_{xy}) denotes the size of this bid and a_x denotes the lowest bid that firm x_i accepts. For simplicity, I also restrict the attention to sharp bids, that is bids accepted in equilibrium. Formally, it implies that $b_{xy} \geq a_y$ and $b_{xx}, b_{yx} \geq a_x$.[7]

Next, I define the continuation values after a merger, at the date of a merger, and before a merger. After the xy- (xx-) merger has occurred, the values of the merged firm xy (xx) and the outsider x (y) are given by

$$W_i(2) = \frac{\pi_i(2)}{r}, \tag{1}$$

for $i \in \{xy, x, xx, y\}$, where r is the common discount rate, and $\pi_i(2)/r$ is the discounted value of all future profits. At the points in time when firm y buys firm x_i (event yx), firm x_i buys firm x_j (event xx) and firm x_i buys firm y (event xy), the values of the buying and the selling firms are given by

$$V_i^{buy} = W_i(2) - b_i, \tag{2}$$
$$V_i^{sell} = b_i, \tag{3}$$

for $i \in \{yx, xx, xy\}$. Furthermore, at the time of a merger, the value of the

[7]This is assumed without loss of generality, since a firm making a non-sharp bid can achieve the same outcome by not bidding.

outsider is given by

$$V_i^{out} = W_i\left(2\right), \tag{4}$$

for $i \in \{y, x\}$. Finally, firm y's pre-merger value, that is its expected value in the triopoly,is given by

$$\begin{aligned} W_y\left(3\right) = \frac{\pi_y\left(3\right)}{r}\left(1 - e^{-r\Delta}\right) + e^{-r\Delta}\left[\tfrac{2}{3}p_{yx}V_{yx}^{buy} + \tfrac{2}{3}p_{xy}V_{xy}^{sell} + \tfrac{2}{3}p_{xx}V_y^{out}\right. \\ \left. + \left(1 - \tfrac{2}{3}\left(p_{yx} + p_{xy} + p_{xx}\right)\right)W_y\left(3\right)\right]. \end{aligned} \tag{5}$$

The first term is the value generated by firm y in the current period. The second term is the discounted expected value of all future profits, that is the values for firm y of being a buyer, seller, outsider and triopolist in the next period, multiplied by the respective probabilities of becoming a buyer, seller, outsider and triopolist. For example, the probability of firm y being a buyer in the next period is $\frac{2}{3}p_{yx}$, since firm y is selected by nature with probability $\frac{1}{3}$ and then buys each x-firm with probability p_{yx}. Moreover, given the probabilities of firm y being a buyer, a seller and an outsider in the next period, the probability of remaining in the triopoly is $1 - \frac{2}{3}\left(p_{yx} + p_{xy} + p_{xx}\right)$. In particular, note that firm y's pre-merger value incorporates the risk of becoming an outsider in the next period, that is $\frac{2}{3}p_{xx}V_y^{out}$. Similarly, a firm x_i's pre-merger value, that is its expected value in the triopoly, is given by

$$\begin{aligned} W_x\left(3\right) = {} & \frac{\pi_x\left(3\right)}{r}\left(1 - e^{-r\Delta}\right) \\ & + e^{-r\Delta}\left[\tfrac{1}{3}\left(p_{xx}V_{xx}^{buy} + p_{xy}V_{xy}^{buy}\right) + \tfrac{1}{3}\left(p_{xx}V_{xx}^{sell} + p_{yx}V_{yx}^{sell}\right)\right. \\ & \left. + \tfrac{1}{3}\left(p_{xy} + p_{yx}\right)V_x^{out} + \left(1 - \tfrac{2}{3}\left(p_{yx} + p_{xy} + p_{xx}\right)\right)W_x\left(3\right)\right]. \end{aligned} \tag{6}$$

Three types of 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, that is, for $i \in \{x, y\}$,

$$a_i = W_i\left(3\right). \tag{7}$$

Second, for the bidders to maximize their value, it is necessary that

$$\begin{aligned} b_{xy} &= a_y = W_y\left(3\right), \\ b_{xx} &= b_{yx} = a_x = W_x\left(3\right). \end{aligned} \tag{8}$$

The third type of equilibrium condition is that firms, when selected by nature, submit a bid if, and only if, it is profitable. Once firm y is selected by nature, it can either buy an x-firm which is worth V_{yx}^{buy}, or remain in the triopoly which is worth $W_y(3)$. Hence, by subgame perfection it is necessary that

$$\begin{cases} p_{yx} = 0 & \text{only if } \; V_{yx}^{buy} \leq W_y(3), \\ p_{yx} = \frac{1}{2} & \text{only if } \; V_{yx}^{buy} \geq W_y(3), \\ p_{yx} \in \left(0, \frac{1}{2}\right) & \text{only if } \; V_{yx}^{buy} = W_y(3). \end{cases} \tag{9}$$

Similarly, firm x_i can choose between remaining triopolist and buying firm x_j or firm y. Hence, by subgame perfection it is necessary that

$$\begin{cases} (p_{xx}, p_{xy}) = (0,0) & \text{only if } \; V_{xx}^{buy}, V_{xy}^{buy} \leq W_x(3) \\ (p_{xx}, p_{xy}) = (1,0) & \text{only if } \; V_{xx}^{buy} \geq V_{xy}^{buy}, W_x(3) \\ (p_{xx}, p_{xy}) = (0,1) & \text{only if } \; V_{xy}^{buy} \geq V_{xx}^{buy}, W_x(3) \\ (p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} = 1\right\} & \text{only if } \; V_{xx}^{buy} = V_{xy}^{buy} \geq W_x(3) \\ p_{xx} \in (0,1), \, p_{xy} = 0 & \text{only if } \; V_{xx}^{buy} = W_x(3) \geq V_{xy}^{buy} \\ p_{xx} = 0, \, p_{xy} \in (0,1) & \text{only if } \; V_{xy}^{buy} = W_x(3) \geq V_{xx}^{buy} \\ (p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} \in (0,1)\right\} & \text{only if } \; V_{xx}^{buy} = V_{xy}^{buy} = W_x(3). \end{cases} \tag{10}$$

Combining firm y's three types of equilibrium conditions in (9) with the x-firms' seven types of equilibrium conditions in (10) potentially yields 21 types of symmetric Markov perfect equilibria. These different types of equilibria are partitioned into three different categories: no-merger equilibria (NME), immediate-merger equilibria (IME) and delayed-merger equilibria (DME). In a NME, no firm submits bids, that is $p_{yx} = 0$ and $(p_{xx}, p_{xy}) = (0,0)$. In an IME, at least one firm submits a bid with certainty. For example, $p_{yx} = \frac{1}{2}$ and $(p_{xx}, p_{xy}) = (0,1)$ constitute an IME. In total, there are 13 types of IME.[8] In a DME, no firm bids with certainty and at least one firm bids with strictly positive probability. For example, $p_{yx} \in \left(0, \frac{1}{2}\right)$ and $(p_{xx}, p_{xy}) = (0,0)$ constitutes a DME. In total, there are 7 types of DME.

Let the internal effects of the xy- and the xx-merger, that is the profitability of these mergers, be denoted

$$I_{xy} \equiv \frac{1}{r}\left[\pi_{xy}(2) - \pi_x(3) - \pi_y(3)\right], \tag{11a}$$

$$I_{xx} \equiv \frac{1}{r}\left[\pi_{xx}(2) - 2\pi_x(3)\right]. \tag{11b}$$

[8] In some IME, a merger occurs after a few periods. For example, consider the IME where $p_{yx} = 0$ and $(p_{xx}, p_{xy}) = (1,0)$. If firm y is selected as bidder in the first period, then the xx-merger is delayed until firm x_1 or x_2 is selected as bidder. However, the xx-merger occurs almost immediately as the length of the periods become very short and, as $\Delta \to 0$, the delay tends to 0.

Furthermore, let the the external effects of the xy- and the xx-merger, that is the net gain compared to remaining in the triopoly of becoming an outsider to these mergers, be denoted

$$E_{xy} \equiv \frac{1}{r}\left[\pi_x(2) - \pi_x(3)\right], \tag{12a}$$

$$E_{xx} \equiv \frac{1}{r}\left[\pi_y(2) - \pi_y(3)\right]. \tag{12b}$$

Lemma 1 in the Appendix characterizes the conditions under which the different types of equilibria exist as $\Delta \to 0$. In particular, there exists at least one type of equilibrium for all profit configurations. Henceforth, I restrict the attention to equilibria that exist under generic profit configurations.[9] Moreover, if an equilibrium is said to exist, it is meant to exist generically. The following types of equilibria exist:

$$\begin{array}{ll}
NME\text{:} & p_{yx} = 0 \text{ and } (p_{xx}, p_{xy}) = (0,0)\,, \\
IME_{xx}\text{:} & p_{yx} = 0 \text{ and } (p_{xx}, p_{xy}) = (1,0)\,, \\
IME_{xy,yx}\text{:} & p_{yx} = \frac{1}{2} \text{ and } (p_{xx}, p_{xy}) = (0,1)\,, \\
IME_{xx,yx}\text{:} & p_{yx} = \frac{1}{2} \text{ and } (p_{xx}, p_{xy}) = (1,0)\,, \\
IME_{xx,xy,yx}\text{:} & p_{yx} = \frac{1}{2} \text{ and } (p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} = 1\right\}, \\
DME_{xy,yx}\text{:} & p_{yx} \in \left(0, \frac{1}{2}\right) \text{ and } p_{xx} = 0,\ p_{xy} \in (0,1)\,, \\
DME_{xx,xy,yx}\text{:} & p_{yx} \in \left(0, \frac{1}{2}\right) \text{ and } (p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} \in (0,1)\right\}.
\end{array}$$

In the IME_{xx}, the xx-merger occurs with certainty since firm y does not bid while the x-firms bid on each other with certainty. Similarly, in the $IME_{xy,yx}$, an xy-merger occurs with certainty while, in contrast, both types of mergers occur with positive probabilities in the $IME_{xx,yx}$ and the $IME_{xx,xy,yx}$. In the $DME_{xy,yx}$, the xy-merger, even though it is delayed, occurs with certainty as in the $IME_{xy,yx}$. Similarly, the $DME_{xx,xy,yx}$ might be related to the $IME_{xx,xy,yx}$.[10]

In the remainder of the paper, I discuss the properties of the above equilibrium structure. In particular, I am concerned with the impact of external effects on the type of merger that the firms select in equilibrium. For instance, do the firms always select the most profitable merger (with the highest internal effect) or do the external effects of mergers also matter? In fact, the conditions under which a specific merger may occur depend in a subtle way on the signs and magnitudes

[9] Non-generic profit configurations are such that $I_{xx} = 0$, $I_{xx} = E_{xy}$ and so on.

[10] Actually, other equilibria do exist (see Lemma 1 in the Appendix). However, disregarding these (which is done in order to simplify the exposition below), does not affect any result.

of both internal (I_{xx} and I_{yx}) and external (E_{xx} and E_{yx}) effects. To focus on the role of external effects, Section 3 considers cases where these are larger than internal effects. In turn, Section 4 discusses to which extent the insights found in Section 3 carry over to cases where internal effects are larger than external effects. Section 5 considers a case where internal effects clearly favor one type of merger, namely when one type of merger is profitable while the other is unprofitable.

3 Large External Effects

In this section, my focus is on markets where external effects are important for the process of merger formation. To be more precise, I consider profit configurations such that external effects are large in absolute terms relative to internal effects, that is $|E_{xx}|, |E_{xy}| > \max\{I_{xx}, I_{xy}\}$ where $I_{xx}, I_{xy} > 0$.[11] This assumption does not only have the advantage of highlighting the role of external effects on the endogenous formation of mergers, it also has the advantage of putting the impact of mergers on consumers' welfare into focus. Indeed, based on findings in the theoretical literature on mergers, the signs of mergers' external effects can be used to identify whether they are anti- or pro-competitive, that is whether they harm or benefit consumers.[12] Throughout the paper, I assume the following:

Assumption 1 *A merger is anti- [pro-] competitive if its external effect is positive [negative].*

Assumption 1 holds in many oligopoly models. For example, if goods are perfect substitutes and firms compete in quantities, then Assumption 1 holds under standard assumptions about demand and cost functions (Farrell and Shapiro, 1990). Intuitively, merging firms in an anti-competitive merger restrict their output relative to their combined pre-merger output in order to increase the equilibrium price. As a result, the external effect of the merger is positive, since the outsider benefits from the higher price without bearing the cost of reducing its own output. Similarly, Assumption 1 is usually true if goods are differentiated and the firms compete in prices.[13]

[11] The assumption that $I_{xy}, I_{xx} > 0$ implies that the firms have incentives to merge.

[12] A leading example of an anti- (pro-) competitive merger is that it increases (decreases) the prices of final goods. Other examples include mergers reducing (increasing) the variety or the quality of final goods.

[13] To see this, consider an anti-competitive merger. Following such a merger, the merging firms increase their prices. As a result, the outsider is better off, since he responds by increasing

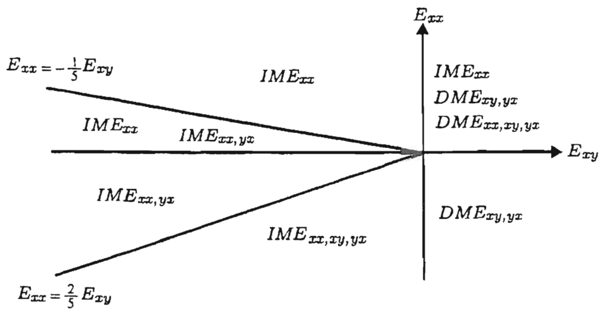

Figure 1: $I_{xx} = I_{xy} = \varepsilon > 0$ where $\varepsilon \to 0$.

3.1 Anti- versus Pro-competitive Mergers

This subsection focuses on profit configurations such that one type of merger has a positive external effect while the other type has a negative one. Note that such a configuration of external effects can be consistent with both types of mergers being profitable. While the type of merger with a positive external effect may be profitable due to fixed cost savings, the other type may also be profitable and have a negative external effect due to marginal cost savings.

Given that Assumption 1 holds, a natural question is whether the firms pursue anti- rather than pro-competitive mergers. In general, no definite answer can be given to this question, but the following analysis highlights several mechanisms inducing firms to act in this way.

The discussion below makes frequent use of Figure 1 which illustrates the conditions under which the different equilibria exist in the case where $I_{xx} = I_{xy} = \varepsilon > 0$ and ε is close to 0 (to focus on the external effects). The horizontal and vertical axes in Figure 1 indicate the external effects of the xy- and the xx-merger, respectively. An IME_{xx} exists in the areas marked with IME_{xx} and so on. Note that there are profit configurations with multiple equilibria.

In the north-west and south-east quadrants of Figure 1, one type of merger is anti-competitive while the other is pro-competitive. These quadrants are characterized by different types of equilibria and are therefore treated sequentially, starting by the north-west quadrant in Figure 1.

his own prices and still gains market shares (Deneckere and Davidson, 1985).

Proposition 1 *Consider profit configurations such that the xx-merger is anti-competitive [$E_{xx} > 0$] while the xy-merger is pro-competitive [$E_{xy} < 0$] and assume mergers to be profitable [$I_{xx}, I_{xy} > 0$]. If external effects are large in absolute terms relative to internal effects [$|E_{xx}|, |E_{xy}| > \max\{I_{xx}, I_{xy}\}$], the IME_{xx} is unique or exists simultaneously with the $IME_{xx,yx}$ so that the anti-competitive xx-merger occurs with a lower bound probability of 2/3.*

All proofs are relegated to the Appendix.

Provided that the IME_{xx} is selected when the $IME_{xx,yx}$ also exists, the anti-competitive xx-merger occurs with certainty in the whole north-west quadrant of Figure 1.[14] Since the xx-merger is profitable, the x-firms have incentives to merge. In turn, the positive external effect E_{xx} ensures that firm y has no incentive to block the xx-merger. Hence, firm y refrains from pursuing the pro-competitive xy-merger in order to induce the anti-competitive xx-merger which is of even further benefit to him. This lack of incentive for merging constitutes an example of the inducement mechanism. Note also that firm y's pre-merger value is high, reflecting that in the IME_{xx}, firm y becomes an outsider with certainty. As a result, the x-firms bid on each other rather than on firm y, since each x-firm is cheaper to buy. This incentive for buying other firms than a potential outsider to an anti-competitive merger constitutes an example of the valuation mechanism.

Unlike the positive external effect E_{xx}, the negative one, E_{xy}, plays no role in sustaining the IME_{xx}. Nevertheless, it plays an important role in ruling out equilibria where the pro-competitive xy-merger occurs with certainty. For example, suppose the $IME_{xy,yx}$ is an equilibrium so that the xy-merger occurs with certainty. In such an equilibrium, each x-firm becomes an outsider with positive probability. In turn, each x-firm's pre-merger value is low (since $E_{xy} < 0$), reflecting the risk of becoming an outsider. As a result, each x-firm is better off buying the other x-firm rather than firm y which contradicts the supposition that the $IME_{xy,yx}$ constitutes an equilibrium. This out of equilibrium incentive for buying a potential outsider to a pro-competitive merger constitutes a second example of the valuation mechanism.

Finally, note that the above discussion illustrates the crucial role of an *endogenous* split of the surplus for the process of merger formation and, more generally,

[14] If the $IME_{xx,yx}$ is instead selected when it exists, the pro-competitive xy-merger occurs with positive probability. Nevertheless, the anti-competitive xx-merger occurs with higher probability in this case, namely with the lower bound probability of 2/3. This lower bound is precisely 2/3, since the firms are exogenously selected as bidders with equal probabilities.

for the process of forming coalitions. In particular, it contrasts with Bloch's (1995, 1996) model of coalition formation where the split of the surplus within a coalition is assumed to be *exogenous.* Proposition 1 shows that such an assumption may be troublesome. Indeed, an exogenous split of the surplus in each merger could easily be constructed such that there exists an equilibrium in which the pro-competitive xy-merger occurs with certainty.

Next, consider the south-east quadrant in Figure 1.

Proposition 2 *Consider profit configurations such that the xy-merger is anti-competitive $[E_{xy} > 0]$, while the xx-merger is pro-competitive $[E_{xx} < 0]$ and assume that $I_{xy} > \frac{I_{xx}}{2} > 0$. If external effects are large in absolute terms relative to internal effects $[|E_{xx}|, |E_{xy}| > \max\{I_{xx}, I_{xy}\}]$, the $DME_{xy,yx}$ is unique so that the anti-competitive xy-merger occurs with certainty in the long run.*

Once more, the negative external effect, in this case E_{xx}, rules out equilibria such as the IME_{xx}, where the pro-competitive xx-merger occurs with certainty. In such an equilibrium, firm y becomes an outsider with certainty which is detrimental to him, since $E_{xx} < 0$. In turn, firm y has an incentive to block the xx-merger by buying one of the x-firms, which contradicts the assumption that the IME_{xx} constitutes an equilibrium. Hence, firm y pursues the anti-competitive xy-merger in order to preempt the pro-competitive xx-merger that would harm him. This out of equilibrium incentive constitutes an example of the preemption mechanism. Note also that the valuation mechanism plays a role in ruling out the IME_{xx}. Indeed, firm y's pre-merger value is low in such an equilibrium, since it becomes an outsider with certainty. As a result, each x-firm is better off buying firm y rather than the other x-firm which again contradicts the assumption that the IME_{xx} constitutes an equilibrium.

At this point, the distinction between the preemption and the valuation mechanisms should be clarified. In the above out of equilibrium example, firm y's motive for merging is to preempt the pro-competitive xx-merger, that is firm y's decision is driven by the preemption mechanism. However, to preempt this merger, firm y cannot choose between different types of mergers, since firm y can only participate in the anti-competitive xy-merger. In contrast, the x-firms can choose between the two different types of mergers. Moreover, these firms pursue the anti-competitive merger precisely because firm y is cheaper to buy, that is, their decision is driven by the valuation mechanism.

While the preemption and valuation mechanisms prevent the pro-competitive merger from occurring, the inducement mechanism *delays* rather than favors the anti-competitive xy-merger. Indeed, the $DME_{xy,yx}$ is unique in the south-east quadrant of Figure 1. In such an equilibrium, the x-firms gain from merging, since $I_{xy} > 0$. However, these firms are even better off as outsiders, since $E_{xy} > I_{xy}$. As a result, the x-firms delay their merger proposals, and consequently forego valuable profits, since they hope other firms will merge instead - much like a war of attrition. Moreover, the larger the positive external effect E_{xy}, the larger the incentives to become an outsider. As a result, the expected delay (until the anti-competitive xy-merger occurs) increases with the positive external effect E_{xy}. Hence, the inducement mechanism creates a holdup problem for the firms in the sense that a profitable merger does not occur immediately (see also Essay III).[15]

Finally, the condition $I_{xy} > \frac{I_{xx}}{2} > 0$ remains to be discussed. In cases where $\frac{I_{xx}}{2} > I_{xy} > 0$ is fulfilled (and external effects are large in absolute terms relative to internal effects), the $DME_{xx,xy,yx}$ is unique if $E_{xy} > 0$ and $E_{xx} < 0$. In such an equilibrium, the xy-merger occurs with strictly positive probability in the long run. However, it also turns out to be impossible to establish a lower bound probability for the anti-competitive xy-merger to occur that is strictly larger than 0 for all pairs of external effects. For this reason, Proposition 2 is stated in terms of the condition $I_{xy} > \frac{I_{xx}}{2} > 0$ only.

3.2 Least versus Most Pro-competitive Mergers

Up to this point, I have only considered cases where one type of merger is anti-competitive and the other pro-competitive. The reason for this is twofold. First, when both types of mergers are anti-competitive (the positive quadrant in Figure 1), there are multiple equilibria. In fact, both the xx- and the xy-merger may occur with certainty depending on which equilibrium is selected. Intuitively, there is a conflict of interests between all firms regarding which merger should form and this conflict materializes into multiple equilibria. Unfortunately, I am not aware

[15] The reason for the ambiguous impact of positive external effects is simple. In the north-west quadrant of Figure 1 (Proposition 1), only firm y gains by becoming an outsider while the x-firms lose as outsiders. As a result, there is no conflict of interests between the firms regarding which merger should form. In contrast, in the south-east quadrant of Figure 1 (Proposition 2), both x-firms are better off as outsiders than as insiders due to the positive external effect E_{xy}. As a result, a conflict of interests appears between firms x_1 and x_2 regarding which xy-merger should form. In turn, by delaying its merger proposal, each x-firm tries to induce the merger in which it does not participate.

of any method of equilibrium selection that can be straightforwardly applied to the present problem, and therefore, I abstain from making any prediction in this region. Second, it is not straightforward to identify which type of merger is the most anti- or pro-competitive when external effects have the same sign. However, the following assumption is motivated in many contexts.

Assumption 2 *If both types of mergers are anti- [pro-] competitive, then the type of merger with the largest positive [negative] external effect is the most anti- [pro-] competitive.*

Assumption 2 has weaker theoretical support than Assumption 1. Nevertheless, it is easy to construct examples by means of simple oligopoly models that validate this assumption. For example, consider an homogeneous good Cournot oligopoly where firms have constant marginal costs, where demand is linear and both types of mergers are pro-competitive due to large marginal cost savings. Then, the merger inducing the largest marginal cost savings is the most pro-competitive, that is benefits the consumers the most. Moreover, this merger has the largest negative external effect, as long as the outsider is not driven out of the market.[16]

Proposition 3 *Consider pro-competitive mergers [$E_{xx}, E_{xy} < 0$] and assume mergers to be profitable [$I_{xx}, I_{xy} > 0$]. If Assumption 2 holds and external effects are large in absolute terms relative to internal effects [$|E_{xx}|, |E_{xy}| > \max\{I_{xx}, I_{xy}\}$], the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is unique and the least pro-competitive merger occurs with a lower bound probability approximately equal to 0,16.*

Proposition 3 focuses on the negative quadrant in Figure 1. In this area, the preemption mechanism provides all the firms with incentives to pursue a merger in order to avoid becoming an outsider. This is not main mechanism, however, for inducing the firms to pursue the least pro-competitive merger. Indeed, firm y has an incentive to pursue the xy-merger irrespective of whether it is the most or the least pro-competitive one. Rather it is the valuation mechanism. To see this, consider the behavior of the x-firms which can choose between the two different

[16]One may construct examples where Assumption 2 does not hold if the negative external effect of one type of merger drives the outsider out of the market. To see this, note that the triopoly profits of the firm becoming an outsider constitutes an upper bound on the negative external effect. Hence, if these profits are small, then the negative external effect must also be small, even though the merger induced marginal cost savings may be large.

types of mergers. Since firms' pre-merger values incorporate the risk of becoming outsiders, these firms tend to buy the firm that is the potential outsider to the most pro-competitive merger with the largest negative external effect. Thereby, they preempt this merger and instead induce the least pro-competitive merger.

To be more precise, consider the simplest case, namely the area in Figure 1 where the $IME_{xx,yx}$ is unique. In this area, the x-firms lose more as outsiders than does firm y (since $E_{xy} < E_{xx} < 0$) and therefore their pre-merger value is low. In turn, the x-firms bid on each other with certainty and therefore, the xx-merger, that is the least pro-competitive merger, occurs with high probability, namely 2/3. In the area where the $IME_{xx,xy,yx}$ is unique, each x-firm bids on both other firms with positive probabilities. However, they bid with the highest probability on the firm that is a potential outsider to the most pro-competitive merger (if $I_{xx} = I_{xy}$). In fact, the x-firms bid on firm y almost with certainty as $E_{xy} \rightarrow 0$. As a result, the preemption and the valuation mechanisms complement each other so that the least pro-competitive merger, in this case the xy-merger, occurs almost with certainty.

4 Large Internal Effects

The present section discusses briefly cases where internal effects may be large relative to external effects, keeping the assumption that mergers are profitable. In connection to the previous analysis, a natural question is whether profitability considerations reinforce the tendency for firms to pursue anti- rather than pro-competitive mergers. The answer to this question is ambiguous, which is not surprising. Assume that one merger is pro-competitive while the other is not, and that the former merger is sufficiently profitable; then the firms tend to pursue the pro-competitive merger. Conversely, if the anti-competitive merger is sufficiently profitable, the firms tend to pursue that merger. While recognizing that firms, in many markets, pursue the most desirable merger, the paper proceeds by identifying further instances in which the opposite is true.

To test the robustness of Propositions 1, 2 and 3 with respect to large internal effects, consider profit configurations such that $I_{xy} > \frac{I_{xx}}{2} > 0$. If external effects are equal to 0, the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is unique. Hence, although some merger occurs with certainty, no specific type of merger occurs with certainty.[17]

[17]Interestingly, this observation implies that firms may fail to pursue the most profitable

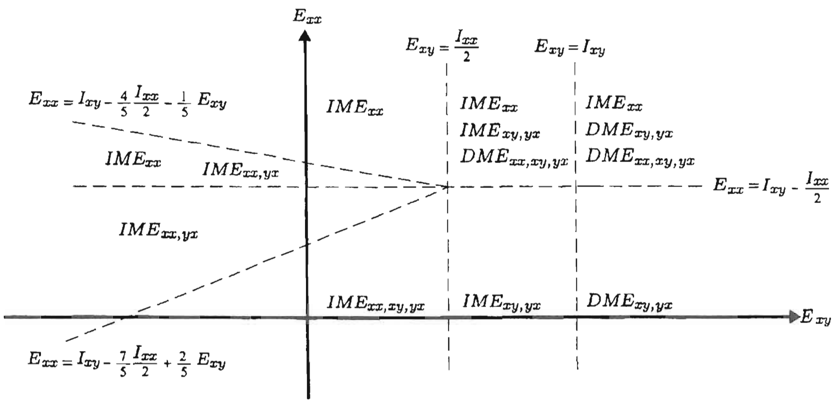

Figure 2: $I_{xy} > \frac{I_{xx}}{2} > 0$.

In this sense, the condition $I_{xy} > \frac{I_{xx}}{2} > 0$ implies that profitability considerations do not favor one type of merger too much over the other. In turn, if external effects differ from 0 and from each other, their impacts on firms' merger decisions are similar to the ones discussed in Section 3.

To be more precise, consider Figure 2 that illustrates in the (E_{xy}, E_{xx})-plane the conditions under which the different equilibria exist when $I_{xy} > \frac{I_{xx}}{2} > 0$. The solid lines represent the horizontal and vertical axes and an equilibrium area is delimited by the dashed lines.[18]

First, consider the north-west and south-east quadrants of Figure 2 where one type of merger is anti-competitive, while the other is pro-competitive. Since the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is unique in these areas if the positive external effect is sufficiently small relative to the internal effect, the anti-competitive type of merger occurs with strictly positive probability in such cases. Furthermore, there are profit configurations in the south-east quadrant of Figure 2 where the $IME_{xy,yx}$ is unique. Unlike the case when internal effects are small, the anti-competitive xy-merger may thus occur, not only with certainty, but also immediately.[19] In these cases, large internal effects thus strengthen Propositions 1 and 2.

merger, even in the absence of external effects.

[18]Note that Figure 1 is obtained by letting the internal effects tend to 0 in Figure 2.

[19]Also, the expected delay associated with the $DME_{xy,yx}$ decreases as I_{xy} increases.

Next, consider the negative quadrant in Figure 2, where both types of mergers are pro-competitive. Since the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is unique in the negative quadrant of Figure 2 also when external effects are small in absolute terms, both types of mergers occur with strictly positive probability in this quadrant. In this sense, Proposition 3 is also robust to large internal effects. Finally, note that equilibria are unique in the positive quadrant of Figure 2 if at least one external effect is sufficiently large relative to the internal effects. Therefore, one may conclude that also more anti-competitive mergers in some cases preempt less anti-competitive ones (in particular, if Assumption 2 holds).

The conclusion of this discussion is thus that external effects being large relative to internal effects is a sufficient, but not a necessary condition, for the results in the previous section to hold.

5 The Preemptive Merger Hypothesis

The present section relaxes the assumption that all mergers are profitable. In particular, I will focus on cases where the xy-merger is unprofitable ($I_{xy} < 0$) while the xx-merger is profitable ($I_{xx} > 0$). Clearly, this assumption favors the xx-merger. Nevertheless, I will show that the signs and magnitudes of the external effects may be crucial in order to determine which merger will occur.

To be more precise, consider Figure 3 which illustrates in the (E_{xy}, E_{xx})-plane the conditions under which the different equilibria exist when, $I_{xx} > 0$ and $\frac{I_{xx}}{2} > I_{xy}$ (actually, Figure 3 is drawn such that $I_{xx} > 0$ and $I_{xy} < 0$). The solid lines represent the horizontal and vertical axes and an equilibrium area is delimited by the dashed lines.

Not surprisingly, the xx-merger occurs with certainty for many profit configurations. More interestingly, however, note that the xx-merger does not occur with certainty if $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$. Hence:

Proposition 4 *Assume that the xx-merger is profitable and pro-competitive [$I_{xx} > 0$ and $E_{xx} < 0$] while the xy-merger is unprofitable and anti-competitive [$I_{xy} < 0$ and $E_{xy} > 0$]. Then, the unprofitable and anti-competitive xy-merger occurs with strictly positive probability if $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$.*[20]

[20] It can be shown that the unprofitable xy-merger may be very likely. For instance, the probability with which the unprofitable xy-merger occurs, tends to 1 as $E_{xy} \to \frac{I_{xx}}{2}$ (given that

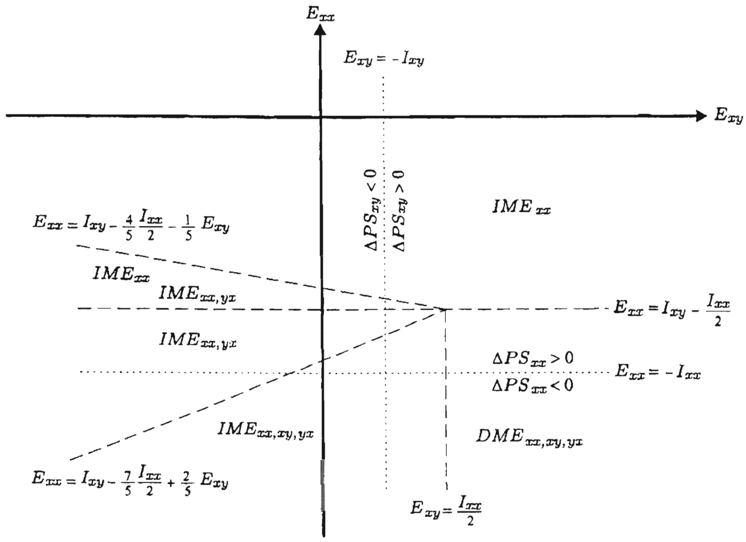

Figure 3: $I_{xx} > 0$ and $\frac{I_{xx}}{2} > I_{xy}$.

The condition $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ guarantees that equilibria such as the IME_{xx} where the profitable xx-merger occurs with certainty, do not exist. In such an equilibrium, the x-firms split the surplus equally. In turn, if firm y buys one of the x-firms (which contradicts that the IME_{xx} is an equilibrium), it must compensate the selling x-firm for its foregone share of the surplus in the xx-merger, that is $\frac{I_{xx}}{2}$. Thereby, firm y loses $I_{xy} - \frac{I_{xx}}{2}$ relative to the status quo. But such a behavior constitutes a best reply if firm y is even worse off as an outsider, that is $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$. Hence, firm y's decision is driven by the preemption mechanism discussed previously. Note also that the valuation mechanism plays a role in ruling out the IME_{xx}, since firm y becomes an outsider with certainty in such an equilibrium. As a result, the x-firms are better off pursuing the unprofitable xy-merger rather than the profitable xx-merger, since firm y's pre-merger value is very low. Finally, note that firm y bears more than the whole cost associated with the xy-merger. Otherwise, it could not be a best-reply for the x-firms to bid on firm y with positive probability, as they do in the $IME_{xx,xy,yx}$ and the

$E_{xx} < I_{xy} - \frac{I_{xx}}{2}$). Note also that there are profit configurations such that an unprofitable and anti-competitive xx-merger occurs with strictly positive probability even though the xy-merger is profitable and pro-competitive.

$DME_{xx,xy,yx}$.[21]

The preemptive motive for unprofitable mergers has already been studied by Fridolfsson and Stennek (1999), that is Essay I. In a setting with three symmetric firms, we show that unprofitable mergers may occur in equilibrium, if being an outsider is even more disadvantageous. The value added of the present paper is thus to extend their analysis to asymmetric firms. Thereby, Proposition 4 shows that the preemptive motive may be so strong that unprofitable mergers occur, even though other mergers are profitable. In addition, the present analysis strengthens their results by showing that some equilibria entailing unprofitable mergers are unique. In Essay I, unprofitable mergers only occur when all mergers are unprofitable (due to symmetry). In that case, a NME exists as well. In contrast, a NME does not exist in Figure 3, since the xx-merger is profitable.[22]

Proposition 4 deserves a few more remarks. First, restricting the attention to *symmetric* Markov perfect equilibria is not crucial for that result. While *asymmetric* equilibria may exist for the profit configurations indicated in Proposition 4, they must entail that the unprofitable merger occurs with positive probability. Indeed, the condition $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ reflects that equilibria such that the profitable xx-merger occurs with certainty, do not exist *even* if the analysis is extended to asymmetric equilibria.

Second, one can easily generate examples by means of simple oligopoly models such that one type of merger is anti-competitive and unprofitable while the other is pro-competitive and profitable. For instance, it is well known that anti-competitive mergers are often unprofitable (Salant, Switzer and Reynolds, 1983; Perry and Porter, 1985). Moreover, substantial average cost savings are necessary for a merger to reduce the equilibrium price (Farrell and Shapiro, 1990) and, thereby, pro-competitive mergers tend to be profitable.

Third, preemptive mergers may be relevant for vertical mergers aiming at raising 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

[21] Hence, assuming an exogenous split of the surplus could, once more, be troublesome. In particular, if both merging firms in the unprofitable merger were exogneously assigned to bear a share of the cost associated with the merger, then the unprofitable merger would not occur.

[22] Note also in Figure 3 that one merger being anti-competitive while the other is pro-competitive, is not a necessary condition for an unprofitable merger to occur with positive probability. Indeed, the $IME_{xx,yx}$ and the $IME_{xx,xy,yx}$ also exist (and are unique) if $E_{xx}, E_{xy} < 0$ (that is, both mergers are pro-competitive), $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $I_{xx} > 0$.

externality on the competitor. The present analysis suggests 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. Hence, by allowing for bidding-competition, this work extends and strengthens the previous analysis of foreclosure.

Fourth, the welfare effects of mergers may be quite perverse. To see this, note that the change in the producers' surplus relative to the initial market structure is given by $\Delta PS_{xx} \equiv I_{xx} + E_{xx}$ and $\Delta PS_{xy} \equiv I_{xy} + E_{xy}$ for the xx- and the xy-merger, respectively. The two dotted lines in Figure 3 separate the areas where $\Delta PS_{xx} > 0$ ($\Delta PS_{xy} > 0$) and $\Delta PS_{xx} < 0$ ($\Delta PS_{xy} < 0$). In particular, consider the area to the left of the vertical dotted line (so that $\Delta PS_{xy} < 0$) and above the horizontal dotted line (so that $\Delta PS_{xx} > 0$). In this area, there are profit configurations such that the xx-merger is profitable ($I_{xx} > 0$) and pro-competitive ($E_{xx} < 0$) while the xy-merger is unprofitable ($I_{xy} < 0$) and anti-competitive ($E_{xy} > 0$). Hence, in this area, the profitable xx-merger increases both the producers' and the consumers' surpluses relative to the initial market structure. In contrast, the unprofitable xy-merger reduces both these surpluses. Nevertheless, the xy-merger occurs with strictly positive probability if $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$.[23]

6 Concluding Remarks

In a framework where mergers are mutually excluding, I find that firms pursue an anti-competitive merger when alternative mergers are pro-competitive. This result is driven by three distinct mechanisms related to the signs and magnitudes of mergers' external effects.

Some indirect evidence, such as the challenged Volvo-Scania merger discussed in the Introduction, indicates that the issue addressed in this paper is not merely a theoretical concern.[24] Unfortunately, it is difficult to find direct evidence, since preempted mergers, by definition, are not observed. However, some further em-

[23]In such cases, the profitable and pro-competitive xx-merger occurs with the highest probability. Nevertheless, the unprofitable and anti-competitive xy-merger occurs with a lower bound probability of $\frac{1}{3}$.

[24]Further indirect evidence indicating that preemption is an important motive behind many mergers is discussed in Essay I.

pirical investigations could be pursued. Most obviously, further indirect evidence could be collected by investigating more systematically whether the prohibition of horizontal mergers have triggered other mergers. Less obviously, the event-study methodology might be used to identify whether preemption is an important motive behind mergers. If the stock market is efficient, in the sense of share prices reflecting firms' true values, then share prices should reflect not only the possibility of becoming an insider, but also the risk of becoming an outsider. Expressed differently, share prices may, prior to the merger, incorporate information on different mergers, including information related to mergers that never occur. This is precisely the case in $IME_{xx,yx}$ and $IME_{xx,xy,yx}$, where all firms may become insiders and outsiders. In such equilibria, the testable prediction is that the combined stock market value of the merging firms increases when a merger is announced, while the share prices of the outsider decrease at that time.

The finding that the relevant alternative to a merger may be another merger rather than the original market structure, has some policy implications. Current policies mainly evaluate the impact of mergers relative to the original market structure. Propositions 1, 2 and 4 imply that such a policy may underestimate the benefits of blocking anti-competitive mergers. Proposition 3 implies that even blocking pro-competitive mergers may benefit consumers.

An immediate implication of these findings is that competition authorities should try to assess the relevant alternative to a proposed merger. Unfortunately, the implementation of such an ambitious policy is likely to be problematic. Indeed, the authority would not only have to assess the consequences of the proposed merger, but also the impact of mergers that have not been proposed, both as regards profitability and their impact on competitors' as well as on consumers' welfare. Clearly, such a policy requires that antitrust authorities have access to a substantial amount of information. In particular, implementing such a policy requires more information than the implementation of current policies.

It may even be argued that assessing the consequences of proposed mergers is less difficult than assessing the consequences of potential ones. For example, participating firms in potential mergers (that have not been proposed) may be reluctant to reveal relevant information. The last essay in this thesis suggests that, in such cases, delegating to competition authorities a welfare standard with a consumer bias may be optimal.

References

Barros, Pedro: Endogenous Mergers and Size Asymmetry of Merger Participants, *Economic Letters*; 60(1), July 1998, 113-19.

Bloch, Francis: Endogenous Structures of Association in Oligopolies, *RAND Journal of Economics*; Vol 26, 1995, pages 537-56.

Bloch, Francis: Sequential Formation of Coalitions in Games with Externalities and Fixed Payoff Division, *Games and Economic Behavior*; Vol 14, 1996, 90-123.

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

The Economist: How Mergers Go Wrong, *The Economist*, July 22nd, 2000, 17.

EU-Commission: Case No COMP/M.1672 - Volvo/Scania, Regulation (EEC) No 4064/89 Merger Procedure, 2000a.

EU-Commission: Case No COMP/M.1980 - Volvo/Renault V.I., Regulation (EEC) No 4064/89 Merger Procedure, 2000b.

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

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

Gowrisankaran, Gautam; Holmes, Thomas J: Do Mergers Lead To Monopoly in the Long Run? Results from the Dominant Firm Model, University of Minnesota, mimeo, 2000.

Horn, Henrik; Persson, Lars: Endogenous Mergers in Concentrated Markets, Forthcoming in *International Journal of Industrial Organization*, 2000a.

Horn, Henrik; Persson, Lars: The Equilibrium Ownership of an International Oligopoly, Forthcoming in *Journal of International Economics*, 2000b.

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), August 1991, 323-38.

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

Nocke, Volker: Monopolisation and Industry Structure, Nuffield College, Oxford, mimeo, 2000.

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.

Persson, Lars: The Auctioning of a Failing Firm, mimeo, The Research Institute of Industrial Economics, 1999.

Pitofsky, Robert: Staples and Boeing: What They Say About Merger Enforcement at the FTC, Prepared Remarks of Robert Pitofsky, Chairman, Federal Trade Commission, Business Development Associates, The Madison Hotel, Washington, D.C., September 23, 1997.

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.

A Proofs

A.1 Equilibrium Structure

Lemma 1 *Consider the set of symmetric Markov perfect equilibria as $\Delta \to 0$. Such an equilibrium exists for all profit configurations. The following equilibria exist.*

1. *A NME exists if, and only if, $I_{xx} \leq 0$ and $I_{xy} \leq 0$.*
2. *An IME_{xx} exists if, and only if, $I_{xx} \geq 0$ and $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$.*
3. *An $IME_{xy,yx}$ exists if, and only if, $E_{xy} \leq I_{xy}$ and $E_{xy} \geq \frac{I_{xx}}{2}$.*
4. *An $IME_{xx,yx}$ exists if, and only if, $E_{xx} \leq I_{xy} - \frac{I_{xx}}{2} + \frac{1}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$ and $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$.*
5. *An $IME_{xx,xy,yx}$ exists if, and only if, $E_{xy} < \frac{I_{xx}}{2}$ and $E_{xx} < I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$.*
6. *An IME such that $p_{yx} \in \left(0, \frac{1}{2}\right)$ and $(p_{xx}, p_{xy}) = (1,0)$ exists if, and only if, $E_{xx} < I_{xy} - \frac{I_{xx}}{2} + \frac{1}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$ and $E_{xx} > I_{xy} - \frac{I_{xx}}{2}$.*
7. *A $DME_{xy,yx}$ as well as DME such that (i) $p_{yx} \in \left(0, \frac{1}{2}\right)$ and $(p_{xx}, p_{xy}) = (0,0)$, and (ii) $p_{yx} = 0$, $p_{xx} = 0$ and $p_{xy} \in (0,1)$ exist if, and only if, $I_{xy} \geq \frac{I_{xx}}{2}$ and $\Psi_x \equiv \frac{I_{xy}}{E_{xy} - I_{xy}} > 0$.*
8. *A $DME_{xx,xy,yx}$ as well as DME such that (i) $p_{yx} \in \left(0, \frac{1}{2}\right)$, $p_{xx} \in (0,1)$ and $p_{xy} = 0$ and (ii) $p_{yx} = 0$ and $(p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} \in (0,1)\right\}$ exist if, and only if, $\Theta_y \equiv \frac{I_{xy} - \frac{I_{xx}}{2}}{E_{xx} - \left(I_{xy} - \frac{I_{xx}}{2}\right)} > 0$ and $\Theta_x \equiv \frac{\frac{I_{xx}}{2}}{E_{xy} - \frac{I_{xx}}{2}} > 0$.*

All other types of equilibria exist only for non-generic profit configurations.[25]

Proof: The following proof restricts the attention to the type of equilibria that exists generically. Analyzing the equilibria that only exist for non-generic profit configurations is time consuming, but not difficult.

[25] Non-generic parameter configurations are such that $\frac{I_{xx}}{2} = E_{xy}$, $I_{xy} = 0$ and so on.

The proof starts by rewriting the definitions of V_{yx}^{buy}, V_{xx}^{buy}, V_{xy}^{buy}, $W_y(3)$ and $W_x(3)$. By equations (2) and (8), we have:

$$\begin{aligned} V_{yx}^{buy} &= W_{xy}(2) - W_x(3) && \text{(13a)} \\ V_{xx}^{buy} &= W_{xx}(2) - W_x(3) && \text{(13b)} \\ V_{xy}^{buy} &= W_{xy}(2) - W_y(3). && \text{(13c)} \end{aligned}$$

Let $\delta = e^{-r\Delta}$ and rearrange (5) in the following way.

$$\begin{aligned} (1-\delta)\left(W_y(3) - \tfrac{\pi_y(3)}{r}\right) = \tfrac{2\delta}{3}&\left[p_{yx}\left(V_{yx}^{buy} - W_y(3)\right) + p_{xy}\left(V_{xy}^{sell} - W_y(3)\right)\right. \\ &\left. + p_{xx}\left(V_y^{out} - W_y(3)\right)\right]. \end{aligned}$$

By equations (3) and (8), we have $V_{xy}^{sell} = W_y(3)$. Eliminate V_{xy}^{sell}. Use equations (4) and (13a) to eliminate V_y^{out} and V_{yx}^{buy}.

$$\begin{aligned} (1-\delta)\left(W_y(3) - \tfrac{\pi_y(3)}{r}\right) = \tfrac{2\delta}{3}&\left[p_{yx}\left(W_{xy}(2) - W_x(3) - W_y(3)\right)\right. \\ &\left. + p_{xx}\left(W_y(2) - W_y(3)\right)\right]. \end{aligned} \tag{14}$$

Rearrange (6) in a similar way. Use equations (3) and (8) to eliminate V_{xx}^{sell} and V_{yx}^{sell}. Use equations (4), (13b) and (13c) to eliminate V_x^{out}, V_{xx}^{buy} and V_{xy}^{buy}.

$$\begin{aligned} (1-\delta)\left(W_x(3) - \tfrac{\pi_x(3)}{r}\right) = \tfrac{\delta}{3}&\left[p_{xy}\left(W_{xy}(2) - W_y(3) - W_x(3)\right)\right. \\ &+ p_{xx}\left(W_{xx}(2) - 2W_x(3)\right) \\ &\left. + \left(p_{xy} + p_{yx}\right)\left(W_x(2) - W_x(3)\right)\right]. \end{aligned} \tag{15}$$

Next, I derive the conditions under which each type of equilibrium exists. The proof ends by showing that an equilibrium exists for all profit configurations.

Proof of point 1: A NME is characterized by $p_{yx} = 0$ and $(p_{xx}, p_{xy}) = (0, 0)$. By equation (14), we have $W_y(3) = \pi_y(3)/r$. By equation (15), we have $W_x(3) = \pi_x(3)/r$.

First, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) \leq W_y(3) + W_x(3)$. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values. Use (1) to eliminate $W_{xy}(2)$. Rearrange the inequality so as to use definition (11a). Then, it simplifies to $I_{xy} \leq 0$.

Second, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xx}(2) \leq 2W_x(3)$ and $W_{xy}(2) \leq W_y(3) + W_x(3)$. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values. Use (1) to eliminate $W_{xx}(2)$ and $W_{xy}(2)$. Rearrange the inequalities so as to use definitions (11b) and (11a). Then, they simplify to $I_{xx} \leq 0$ and $I_{xy} \leq 0$, respectively.

Proof of point 2: An $IME_{xx,}$ is characterized by $p_{yx} = 0$ and $(p_{xx}, p_{xy}) = (1, 0)$. Use these values to simplify equations (14) and (15). Solve for $W_y(3)$ in (14) and for $W_x(3)$ in (15). Rearrange the solutions in the following way.

$$\begin{aligned} W_y(3) &= \tfrac{\pi_y(3)}{r} + \tfrac{2\delta}{3-\delta}\left[W_y(2) - \tfrac{\pi_y(3)}{r}\right] = \tfrac{\pi_y(3)}{r} + \tfrac{2\delta}{3-\delta}E_{xx}, \\ W_x(3) &= \tfrac{\pi_x(3)}{r} + \tfrac{2\delta}{3-\delta}\tfrac{1}{2}\left[W_{xx}(2) - 2\tfrac{\pi_x(3)}{r}\right] = \tfrac{\pi_x(3)}{r} + \tfrac{2\delta}{3-\delta}\tfrac{I_{xx}}{2}. \end{aligned}$$

The second equality in the solution for $W_y(3)$ [for $W_x(3)$] follows from the definitions in (1) and (12b) [in (1) and (11b)].

First, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) \leq W_y(3) + W_x(3)$. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values as $\delta \to 1$ $(\Delta \to 0)$. Use (1) to eliminate $W_{xy}(2)$. Rearrange the inequality so as to use definition (11a). Then, it simplifies to $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$.

Second, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xx}(2) \geq 2W_x(3)$ and $W_{xx}(2) - W_x(3) \geq W_{xy}(2) - W_y(3)$. Eliminate $W_x(3)$ in the first inequality by using its equilibrium value (where $\delta < 1$). Use (1) to eliminate $W_{xx}(2)$. Rearrange the inequality so as to use definition (11b). Then, it simplifies to $I_{xx} \geq 0$. Next, eliminate $W_y(3)$ and $W_x(3)$ in the second inequality by using their equilibrium values as $\delta \to 1$ $(\Delta \to 0)$. Use (1) to eliminate $W_{xx}(2)$ and $W_{xy}(2)$. Rearrange the inequality so as to use definitions (11a) and (11b). Then, it simplifies to $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$.

Proof of point 3: An $IME_{xy,yx}$ is characterized by $p_{yx} = \frac{1}{2}$ and $(p_{xx}, p_{xy}) = (0, 1)$. Use these values to simplify equations (14) and (15). Then, one gets a system of two equations with two unknowns: $W_y(3)$ and $W_x(3)$. Solve this system. Use (1) to eliminate $W_{xy}(2)$ and $W_x(2)$ in the resulting solutions. Rearrange so as to use definitions (11a) and (12a).

$$\begin{aligned} W_y(3) &= \tfrac{\pi_y(3)}{r} + \tfrac{\delta}{6-5\delta}\left[(2-\delta)I_{xy} - \delta E_{xy}\right], \\ W_x(3) &= \tfrac{\pi_x(3)}{r} + \tfrac{\delta}{6-5\delta}\left[2(1-\delta)I_{xy} + (3-2\delta)E_{xy}\right]. \end{aligned}$$

First, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) \geq W_y(3) + W_x(3)$. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values (where $\delta < 1$). Use (1) to eliminate $W_{xy}(2)$. Rearrange the inequality so as to use definition (11a). Then, it simplifies to $E_{xy} \leq (2-\delta)I_{xy}$. Let $\delta \to 1$ $(\Delta \to 0)$ to get $E_{xy} \leq I_{xy}$.

Second, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xy}(2) \geq W_y(3) + W_x(3)$ and $W_{xy}(2) - W_y(3) \geq$

$W_{xx}(2) - W_x(3)$. We already know that the first inequality simplifies to $E_{xy} \leq I_{xy}$ as $\delta \to 1$. Eliminate $W_y(3)$ and $W_x(3)$ in the second inequality by using their equilibrium values as $\delta \to 1$ $(\Delta \to 0)$. Use (1) to eliminate $W_{xy}(2)$ and $W_{xx}(2)$. Rearrange the inequality so as to use definitions (11a) and (11b). Then, it simplifies to $E_{xy} \geq \frac{I_{xx}}{2}$.

Proof of point 4: An $IME_{xx,yx}$ is characterized by $p_{yx} = \frac{1}{2}$ and $(p_{xx}, p_{xy}) = (1, 0)$. Use these values to simplify (14) and (15). Then, one gets a system of two equations with two unknowns: $W_y(3)$ and $W_x(3)$. Let $\delta \to 1$ $(\Delta \to 0)$ in both equations. The LHS in both equations then equals to 0, since $W_y(3)$ and $W_x(3)$ are bounded. Solve the resulting system of equations. Use (1) to eliminate $W_{xy}(2)$, $W_{xx}(2)$, $W_x(2)$ and $W_y(2)$. Rearrange so as to use definitions (11a), (11b), (12a) and (12b).

$$
\begin{aligned}
W_y(3) &= \tfrac{\pi_y(3)}{r} + \tfrac{1}{3}\left[I_{xy} - \left(\tfrac{4}{5}\tfrac{I_{xx}}{2} + \tfrac{1}{5}E_{xy}\right)\right] + \tfrac{2}{3}E_{xx}, \\
W_x(3) &= \tfrac{\pi_x(3)}{r} + \tfrac{4}{5}\tfrac{I_{xx}}{2} + \tfrac{1}{5}E_{xy}.
\end{aligned}
$$

First, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) \geq W_y(3) + W_x(3)$. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values. Use (1) to eliminate $W_{xy}(2)$. Rearrange the inequality so as to use definition (11a). Then, it simplifies to $E_{xx} \leq I_{xy} - \frac{I_{xx}}{2} + \frac{1}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$.

Second, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xx}(2) \geq 2W_x(3)$ and $W_{xx}(2) - W_x(3) \geq W_{xy}(2) - W_y(3)$. Eliminate $W_x(3)$ in the first inequality by using its equilibrium value. Use (1) to eliminate $W_{xx}(2)$. Rearrange the inequality so as to use definition (11b). Then, it simplifies to $E_{xy} \leq \frac{I_{xx}}{2}$. Next, eliminate $W_y(3)$ and $W_x(3)$ in the second inequality by using their equilibrium values. Use (1) to eliminate $W_{xy}(2)$ and $W_{xx}(2)$. Rearrange the inequality so as to use definitions (11a) and (11b). Then, it simplifies to $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$.

Finally, note that $E_{xy} \leq \frac{I_{xx}}{2}$ is fulfilled if the two other conditions are fulfilled.

Proof of point 5: An $IME_{xx,xy,yx}$ is characterized by $p_{yx} = \frac{1}{2}$ and $(p_{xx}, p_{xy}) \in \left\{(0,1)^2 : p_{xx} + p_{xy} = 1\right\}$. Eliminate p_{yx} in equations (14) and (15) as well as p_{xy}, using the fact that $p_{xy} = 1 - p_{xx}$. Then, one gets a system of two equations with two unknowns: $W_y(3)$ and $W_x(3)$. Let $\delta \to 1$ $(\Delta \to 0)$ in both equations. The LHS in both equations then equals to 0, since $W_y(3)$ and $W_x(3)$ are bounded. Solve the resulting system of equations. Use (1) to eliminate $W_{xy}(2)$, $W_{xx}(2)$, $W_x(2)$ and $W_y(2)$. Rearrange so as to use definitions (11a), (11b), (12a) and

(12b).

$$
\begin{aligned}
W_y(3) &= \tfrac{\pi_y(3)}{r} \\
&\quad + \tfrac{1}{1+4p_{xx}}\left[I_{xy} - E_{xy} + 4p_{xx}E_{xx} + \tfrac{2}{3}p_{xx}\left(I_{xy} - I_{xx} + E_{xy} - E_{xx}\right)\right], \\
W_x(3) &= \tfrac{\pi_x(3)}{r} + \tfrac{I_{xx}}{2} \\
&\quad - \tfrac{1}{1+4p_{xx}}\left[\tfrac{I_{xx}}{2} - E_{xy} - \tfrac{4}{3}p_{xx}\left(1-p_{xx}\right)\left(I_{xy} - I_{xx} + E_{xy} - E_{xx}\right)\right].
\end{aligned}
$$

First, consider the equality $V_{xx}^{buy} = V_{xy}^{buy}$, that is one of the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xx}(2) - W_x(3) = W_{xy}(2) - W_y(3)$. Eliminate $W_x(3)$ and $W_y(3)$ by using their equilibrium values. Use (1) to eliminate $W_{xx}(2)$ and $W_{xy}(2)$. Rearrange the equality so as to use definitions (11a) and (11b). Finally, rearrange in the following way:

$$
f(p_{xx}) \equiv \frac{3(1-2p_{xx})}{p_{xx}(7-2p_{xx})} = \frac{I_{xy} - I_{xx} + E_{xy} - E_{xx}}{\frac{I_{xx}}{2} - E_{xy}}. \qquad (16)
$$

Equation (16) defines p_{xx} implicitly as a function of the exogenous variables in the RHS of (16), since $f'(p_{xx}) < 0 \; \forall p_{xx} \in (0,1)$.

Second, consider the inequality $V_{xy}^{buy} \geq W_x(3)$, that is the x-firms' other equilibrium condition in (10). By equation (13c), we have $W_{xy}(2) \geq W_x(3) + W_y(3)$. Eliminate $W_x(3)$ and $W_y(3)$ by using their equilibrium values. Use (1) to eliminate $W_{xy}(2)$. Rearrange so as to use definition (11a). The inequality then simplifies to

$$
-6\left(\frac{I_{xx}}{2} - E_{xy}\right) \leq (3+2p_{xx})\left(I_{xy} - I_{xx} + E_{xy} - E_{xx}\right).
$$

Assume that $\frac{I_{xx}}{2} > E_{xy}$ and rearrange the inequality in the following way:

$$
-\frac{6}{3+2p_{xx}} \leq \frac{I_{xy} - I_{xx} + E_{xy} - E_{xx}}{\frac{I_{xx}}{2} - E_{xy}}.
$$

By equation (16), the RHS equals $f(p_{xx})$. Simplify to get $3 + 10p_{xx} - 8p_{xx}^2 \geq 0$, which is true $\forall p_{xx} \in (0,1)$. Conversely, the inequality $V_{xy}^{buy} \geq W_x(3)$ simplifies to $3 + 10p_{xx} - 8p_{xx}^2 \leq 0$ if $\frac{I_{xx}}{2} < E_{xy}$, which is not true for any $p_{xx} \in (0,1)$. Hence, if $V_{xx}^{buy} = V_{xy}^{buy}$, then $V_{xy}^{buy} \geq W_x(3)$ if, and only if, $E_{xy} < \frac{I_{xx}}{2}$.

Third, note by (13a), that firm y's equilibrium condition in (9) is equivalent to $W_{xy}(2) \geq W_x(3) + W_y(3)$, that is the inequality treated above.

Finally, note that $\lim_{p_{xx}\to 0} f(p_{xx}) = +\infty$ and $f'(p_{xx}) < 0 \; \forall p_{xx} \in (0,1)$. Since $p_{xx} \in (0,1)$, equation (16) has a unique solution if, and only if,

$$
\frac{I_{xy} - I_{xx} + E_{xy} - E_{xx}}{\frac{I_{xx}}{2} - E_{xy}} > f(1) = -\frac{3}{5}
$$

Since $\frac{I_{xx}}{2} > E_{xy}$, this inequality simplifies to $E_{xx} < I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$.

Proof of point 6: In this equilibrium, $p_{yx} \in \left(0, \frac{1}{2}\right)$ and $(p_{xx}, p_{xy}) = (1, 0)$. Eliminate p_{xx} and p_{xy} in equations (14) and (15). Let $\delta \to 1$ ($\Delta \to 0$) in both equations. Since $W_y(3)$ and $W_x(3)$ are bounded, the two equations simplify to

$$0 = p_{yx}\left[W_{xy}(2) - W_y(3) - W_x(3)\right] + W_y(2) - W_y(3) \qquad (17)$$

$$0 = W_{xx}(2) - 2W_x(3) + p_{yx}\left[W_x(2) - W_x(3)\right] \qquad (18)$$

First, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) = W_y(3) + W_x(3)$. This equation and equation (17) constitute a system of two equations with two unknowns: $W_y(3)$ and $W_x(3)$. Solve this system. Use (1) to eliminate $W_y(2)$ $[W_{xy}(2)]$ in the solution for $W_y(3)$ $[W_x(3)]$. Rearrange so as to use definitions (11a) and (12b). The solutions are then $W_y(3) = \frac{\pi_y(3)}{r} + E_{xx}$ and $W_x(3) = \frac{\pi_x(3)}{r} + I_{xy} - E_{xx}$.

Second, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xx}(2) \geq 2W_x(3)$ and $W_{xx}(2) - W_x(3) \geq W_{xy}(2) - W_y(3)$. Eliminate $W_x(3)$ in the first inequality by using its equilibrium value. Use (1) to eliminate $W_{xx}(2)$. Rearrange so as to use definition (11a). The inequality then simplifies to $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$. Similarly, the second inequality also simplifies to $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$.

Finally, it is required that $p_{yx} \in \left(0, \frac{1}{2}\right)$. To obtain an expression for p_{yx}, insert the equilibrium values of $W_y(3)$ and $W_x(3)$ into (18). Use (1) to eliminate $W_{xx}(2)$ and $W_x(2)$. Rearrange so as to use definitions (11b) and (12a). Solving for p_{yx} yields that $p_{yx} = 2\frac{E_{xx} - (I_{xy} - I_{xx}/2)}{I_{xy} - (E_{xy} + E_{xx})}$. Hence, it is required that $\frac{1}{2} > 2\frac{E_{xx} - (I_{xy} - I_{xx}/2)}{I_{xy} - (E_{xy} + E_{xx})} > 0$. Since $E_{xx} \geq I_{xy} - \frac{I_{xx}}{2}$, these two inequalities imply that $I_{xy} > E_{xy} + E_{xx}$ and $E_{xx} > I_{xy} - \frac{I_{xx}}{2}$ and $E_{xx} < I_{xy} - \frac{I_{xx}}{2} + \frac{1}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$. The two latter inequalities imply that the former one is fulfilled.

Proof of point 7: I only prove the conditions under which a $DME_{xy,yx}$ exists. Following the same steps as below, it is straightforward to prove that the two other DME exist under the same conditions as the $DME_{xy,yx}$.

A $DME_{xy,yx}$ is characterized by $p_{yx} \in \left(0, \frac{1}{2}\right)$ and $p_{xx} = 0$, $p_{xy} \in (0, 1)$.

Consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) = W_y(3) + W_x(3)$. This equation and equation (14) constitute a system of two equations with two unknowns: $W_y(3)$ and $W_x(3)$. Solve this system, using the fact that $p_{xx} = 0$. The solutions are $W_y(3) = \frac{\pi_y(3)}{r}$ and $W_x(3) = W_{xy}(2) - \frac{\pi_y(3)}{r} = \frac{\pi_x(3)}{r} + I_{xy}$ (the second equality follows from definitions (1) and (11a)).

Next, eliminate $W_x(3)$ in the LHS in (15) by using its equilibrium value. The LHS then equals I_{xy}. The RHS in (15) equals $\frac{1}{3}\frac{\delta}{1-\delta}(p_{xy}+p_{yx})(W_x(2)-W_x(3))$, since $p_{xx}=0$ and $W_{xy}(2)=W_y(3)+W_x(3)$. Note that $W_x(2)-W_x(3)=E_{xy}-I_{xy}$ (which follows from the equilibrium value of $W_x(3)$ and the definitions in (1) and (12a)). Hence:

$$p_{xy}+p_{yx}=3\frac{1-\delta}{\delta}\frac{I_{xy}}{E_{xy}-I_{xy}}=3\frac{1-\delta}{\delta}\Psi_x. \tag{19}$$

Since $p_{xy}+p_{yx}>0$, it is necessary that $\Psi_x>0$. As $\delta\to 1$ $(\Delta\to 0)$, the RHS tends to 0 so that there exists probabilities p_{xy} and p_{yx} satisfying the above equality (in fact, there exists a continuum of such probabilities). Thus, the condition $\Psi_x>0$ is also sufficient in order to satisfy the above equality.

Finally, consider the x-firms' equilibrium conditions in (10). By equations (13b) and (13c), we have $W_{xy}(2)=W_y(3)+W_x(3)$ and $W_{xy}(2)-W_y(3)\geq W_{xx}(2)-W_x(3)$. We already know that the equality is fulfilled. Use (1) to eliminate $W_{xy}(2)$ and $W_{xx}(2)$ in the inequality. Eliminate $W_y(3)$ and $W_x(3)$ by using their equilibrium values. Rearrange so as to use definitions (11a) and (11b). The inequality then simplifies to $I_{xy}\geq\frac{I_{xx}}{2}$.

Proof of point 8: I only prove the conditions under which a $DME_{xx,xy,yx}$ exists. Following the same steps as below, it is straightforward to prove that the two other DME exist under the same conditions as the $DME_{xx,xy,yx}$.

A $DME_{xx,xy,yx}$ is characterized by $(p_{xx},p_{xy})\in\left\{(0,1)^2: p_{xx}+p_{xy}\in(0,1)\right\}$ and $p_{yx}\in\left(0,\frac{1}{2}\right)$.

Consider the x-firms' equilibrium condition in (10). By equations (13b) and (13c), we have $W_{xy}(2)=W_y(3)+W_x(3)$ and $W_{xx}(2)-W_x(3)=W_{xy}(2)-W_y(3)$. Use these equations to solve for $W_y(3)$ and $W_x(3)$. The solutions are $W_y(3)=W_{xy}(2)-\frac{W_{xx}(2)}{2}=\frac{\pi_y(3)}{r}+I_{xy}-\frac{I_{xx}}{2}$ and $W_x(3)=\frac{W_{xx}(2)}{2}=\frac{\pi_x(3)}{r}+\frac{I_{xx}}{2}$ (the second equality in the first [second] solution follows from the definitions in (1), (11a) and (11b) [(1) and (11b)]).

Next, eliminate $W_y(3)$ in the LHS in (14) by using its equilibrium value. The LHS then equals $I_{xy}-\frac{I_{xx}}{2}$. The RHS in (14) equals $\frac{2}{3}\frac{\delta}{1-\delta}p_{xx}(W_y(2)-W_y(3))$, since $W_{xy}(2)=W_y(3)+W_x(3)$. Note that $W_y(2)-W_y(3)=E_{xx}-\left(I_{xy}-\frac{I_{xx}}{2}\right)$ (which follows from the equilibrium value of $W_y(3)$ and the definitions in (1) and (12b)). Hence:

$$p_{xx}=\frac{3}{2}\frac{1-\delta}{\delta}\frac{I_{xy}-\frac{I_{xx}}{2}}{E_{xx}-\left(I_{xy}-\frac{I_{xx}}{2}\right)}=3\frac{1-\delta}{\delta}\Theta_y.$$

Since $p_{xx} > 0$, it is necessary that $\Theta_y > 0$. As $\delta \longrightarrow 1$ ($\Delta \longrightarrow 0$), the RHS tends to 0 so that there exists a probability p_{xx} satisfying the above equality. Thus, the condition $\Theta_y > 0$ is also sufficient in order to satisfy the above equality. Similarly, by simplifying equation (15), it is straightforward to show that there exists probabilities p_{xy} and p_{yx} satisfying equation (15) if, and only if, $\Theta_x = \frac{I_{xx}/2}{E_{xy}-I_{xx}/2} > 0$.

Finally, consider firm y's equilibrium condition in (9). By equation (13a), we have $W_{xy}(2) = W_y(3) + W_x(3)$, which we know is fulfilled.

Existence: To complete the proof, it remains to show that at least one type of equilibrium exists for all profit configurations.

Consider the case in Figure 3, that is, profit configurations such that $I_{xx} > 0$ and $\frac{I_{xx}}{2} > I_{xy}$. Next, I show that there exists an equilibrium for all pairs (E_{xx}, E_{xy}), given that the above conditions on I_{xx} and I_{xy} are fulfilled. First, assume that $E_{xx} > I_{xy} - \frac{I_{xx}}{2}$. By point 2, there exists an IME_{xx}, since $I_{xx} > 0$. Second, assume that $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $E_{xy} > \frac{I_{xx}}{2}$. By point 8, there exists a $DME_{xx,xy,yx}$, since $I_{xy} - \frac{I_{xx}}{2} < 0$ and $I_{xx} > 0$. Third, assume that $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $E_{xy} < \frac{I_{xx}}{2}$. By point 5, there exists an $IME_{xx,xy,yx}$ if $E_{xx} < I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$. If instead $E_{xx} > I_{xy} - \frac{I_{xx}}{2} - \frac{2}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$, there exists an $IME_{xx,yx}$. Indeed, this latter inequality constitutes one of the two conditions for an $IME_{xx,yx}$ to exist (see point 4). Moreover, the second condition for such an equilibrium to exist is $E_{xx} < I_{xy} - \frac{I_{xx}}{2} + \frac{1}{5}\left(\frac{I_{xx}}{2} - E_{xy}\right)$. This condition is fulfilled if $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $E_{xy} < \frac{I_{xx}}{2}$.

To check the existence for all possible profit configurations, repeat similar arguments for the following three cases: (i) $I_{xy} > \frac{I_{xx}}{2} > 0$ (that is, the case in Figure 2), (ii) $I_{xy} > 0$ and $I_{xx} < 0$ and (iii) $I_{xx}, I_{xy} < 0$. QED.

A.2 Proofs of Propositions:

All proofs below build upon the equilibrium structure derived in Lemma 1.

A.2.1 Proof of Proposition 1:

By Lemma 1, Figures 2 and 3 illustrate the conditions under which each equilibrium exists when $I_{xy} \geq \frac{I_{xx}}{2} \geq 0$ and $\frac{I_{xx}}{2} \geq I_{xy} \geq 0$, respectively. First, assume that $I_{xy} \geq \frac{I_{xx}}{2} \geq 0$. Then, $E_{xx} > I_{xy} - \frac{I_{xx}}{2}$, since $I_{xy}, I_{xx} > 0$, $E_{xx} > 0$ and $|E_{xx}| > I_{xy}$. Moreover, $E_{xy} < 0 < \frac{I_{xx}}{2}$. By Figure 2, the IME_{xx} is then unique or exists simultaneously with the $IME_{xx,yx}$. Consequently, the xx-merger occurs with probability 1 (in the IME_{xx}) or 2/3 (in the $IME_{xx,yx}$). Second, assume that $\frac{I_{xx}}{2} \geq I_{xy} \geq 0$. Then, $E_{xx} > I_{xy} - \frac{I_{xx}}{2}$, since $E_{xx} > 0 \geq I_{xy} - \frac{I_{xx}}{2}$. The same conclusion as in the first case follows from Figure 3. QED.

A.2.2 Proof of Proposition 2:

By Lemma 1, Figure 2 illustrates the conditions under which each equilibrium exists when $I_{xy} \geq \frac{I_{xx}}{2} \geq 0$. Since $E_{xx} < 0$ and $I_{xy} > \frac{I_{xx}}{2}$, we have that $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$. Moreover, $E_{xy} > I_{xy}$, since $E_{xy} > 0$ and $|E_{xy}| > I_{xy}$. By Figure 2, the $DME_{xy,yx}$ is then unique.

It remains to show that the xy-merger occurs with probability 1 in the long run. Note that there are t/Δ time periods between time 0 and time t. In a $DME_{xy,yx}$, the triopoly remains until time t with probability $\left(1 - \frac{2}{3}\left(p_{yx} + p_{xy}\right)\right)^{t/\Delta} = \left(1 - 2\frac{1-e^{-r\Delta}}{e^{-r\Delta}}\Psi_x\right)^{t/\Delta}$ where the second inequality follows from (19) and the fact that $\delta = e^{-r\Delta}$. Let $q_0\left(\Delta\right) \equiv 1 - 2\frac{1-e^{-r\Delta}}{e^{-r\Delta}}\Psi_x$ and define the cumulative distribution function indicating the probability that a merger has not occurred before time t, as

$$G_0\left(t\right) = \lim_{\Delta \to 0}\left[q_0\left(\Delta\right)\right]^{t/\Delta}.$$

Since the logarithm is continuous

$$\ln G_0\left(t\right) = t \lim_{\Delta \to 0} \frac{\ln q_0\left(\Delta\right)}{\Delta}.$$

Note that $\lim_{\Delta \to 0} q_0\left(\Delta\right) = 1$. Hence, $\lim_{\Delta \to 0} \frac{\ln q_0(\Delta)}{\Delta} = "\frac{0}{0}"$. By l'Hopital's rule: $\lim_{\Delta \to 0} \frac{\ln q_0(\Delta)}{\Delta} = \lim_{\Delta \to 0} \frac{q_0'(\Delta)}{q_0(\Delta)} = \lim_{\Delta \to 0} q_0'\left(\Delta\right)$. Hence:

$$\ln G_0\left(t\right) = t \lim_{\Delta \to 0} q_0'\left(\Delta\right) = -2rt\Psi_x.$$

Thus, $G_0\left(t\right) = e^{-2rt\Psi_x}$. Define the probability of an xy-merger having occurred at time t as $G\left(t\right) \equiv 1 - e^{-2rt\Psi_x}$. $\lim_{t \to \infty} G\left(t\right) = 1$ for all $\Psi_x > 0$. QED.

A.2.3 Proof of Proposition 3:

By Lemma 1, Figures 2 and 3 illustrate the conditions under which each equilibrium exists when $I_{xy} \geq \frac{I_{xx}}{2} \geq 0$ and $\frac{I_{xx}}{2} \geq I_{xy} \geq 0$, respectively. First, assume that $I_{xy} \geq \frac{I_{xx}}{2} \geq 0$. By Figure 2, the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is unique if $E_{xy}, E_{xx} < 0$. Second assume that $\frac{I_{xx}}{2} \geq I_{xy} \geq 0$. Then, $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$, since $I_{xy}, I_{xx} > 0$, $E_{xx} < 0$ and $|E_{xx}| > I_{xx}$. By Figure 3, the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is then unique if $E_{xy}, E_{xx} < 0$.

The lower bound probability remains to be proved . Consider first the simple case when the $IME_{xx,yx}$ is unique. In such an equilibrium, the xy- (xx-) merger occurs with probability 1/3 (2/3). Hence, the least pro-competitive merger must occur with a lower bound probability of 1/3.

Next, consider the more difficult case when the $IME_{xx,xy,yx}$ is unique. In such an equilibrium, the xy-merger occurs with a lower bound probability of 1/3 while the xx-merger may occur with an arbitrarily small probability. It thus remains to determine the lower bound probability for the xx-merger to occur in the cases when it is the least pro-competitive, that is when $0 > E_{xx} > E_{xy}$ (by Assumption 2). This amounts to finding a lower bound for p_{xx}, which is implicitly defined by equation (16). Since $f'(p_{xx}) < 0$ and $\lim_{p_{xx}\to 0} f(p_{xx}) = 0$, the lower bound of p_{xx} is found by solving the following maximization problem.

$$\max_{\{I_{xx},I_{xy},E_{xx},E_{xy}\}} \frac{I_{xy} - I_{xx} + E_{xy} - E_{xx}}{\frac{I_{xx}}{2} - E_{xy}},$$

subject to $E_{xy} - E_{xx} \leq 0$, $I_{xx}, I_{xy} \geq 0$ and $E_{xy}, E_{xx} \leq -\max\{I_{xx}, I_{xy}\}$. By noting that the existence of an $IME_{xx,xy,yx}$ requires that $\frac{I_{xx}}{2} > E_{xy}$, solving the above maximization problem is straightforward. The solutions are given by $\{(I_{xx}, I_{xy}, E_{xx}, E_{xy}) : I_{xx} = 0 \text{ and } E_{xx}, E_{xy} = -I_{xy}\}$. The maximized expression equals 1 at its maximum. Replacing the RHS in (16) by 1 and solving the resulting equation yields that $p_{xx} = \frac{13}{4} - \frac{1}{4}\sqrt{145}$. Moreover, the xx-merger occurs with probability $\frac{2}{3}p_{xx}$. By continuity, it follows that the xx-merger occurs with a lower bound probability of $\frac{2}{3}\left(\frac{13}{4} - \frac{1}{4}\sqrt{145}\right) \simeq 0.16$. QED.

A.2.4 Proof of Proposition 4:

By Lemma 1, Figure 3 illustrates the conditions under which each type of equilibrium exists when $I_{xx} > 0$ and $I_{xy} < 0$. First, consider profit configurations such that $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $E_{xy} < \frac{I_{xx}}{2}$. By Figure 3, either the $IME_{xx,yx}$ or the $IME_{xx,xy,yx}$ is then unique. Hence, the xy-merger then occurs immediately with strictly positive probability. Second, consider profit configurations such that $E_{xx} < I_{xy} - \frac{I_{xx}}{2}$ and $E_{xy} > \frac{I_{xx}}{2}$. By Figure 3, the $DME_{xx,xy,yx}$ is then unique. In the proof of Proposition 2, it was shown that in a $DME_{xy,yx}$, the probability of an xy-merger having occurred at time t is $1 - e^{-2rt\Psi_x}$. Similarly, it can be shown that in a $DME_{xx,xy,yx}$, the probability of some merger having occurred at time t is $1 - e^{-rt(2\Theta_x + \Theta_y)}$. Since $\lim_{t\to\infty} 1 - e^{-rt(2\Theta_x+\Theta_y)} = 1$, it follows that some merger occurs with probability 1 in the long run. Moreover, it is easy to show that, conditional on the event that some merger has occurred, the probability of an xy-merger having occurred is $\frac{2\Theta_x}{2\Theta_x+\Theta_y} > 0$. QED.

Essay V

A Consumers' Surplus Defense in Merger Control[1]

1 Introduction

In many jurisdictions, protecting consumers' interests is an important goal for competition policy. In the US, a merger that increases market concentration might be challenged unless it is expected to deliver such cost-savings that it is also beneficial to consumers (1992 Horizontal Merger Guidelines). Similarly, Article 2 of the EU merger regulation stipulates that the merger task force should be solely concerned with restrictions of competition and that efficiency benefits should only be taken into account as long as consumers are not hurt.[2] A concern for the distribution of wealth, combined with a belief that consumers are, on average, less wealthy than firm owners, is a possible motive for this focus on consumers' interests. This motive has, however, been criticized by economists on at least two grounds (see e.g. Williamson, 1968). First, it has been questioned whether competition policy has important distributional effects. Second, even if it has distributional effects, there are other instruments such as taxes and transfers that are more appropriate for affecting distribution. On these grounds, many economists argue that competition policy ought to promote allocative efficiency only (see e.g. Crampton, 1994 and Jenny, 1997).

The present paper shows that in the context of merger control, the policy objective, the so-called welfare standard, has an impact on which mergers are proposed by firms. As a result, a government that wants to promote an efficient allocation of resources as measured by the total surplus, that is the sum of the consumers' and the producers' surpluses, should strategically delegate a welfare

[1]This paper has been significantly improved thanks to my discussions with Mats Bergman, Jonas Björnestedt, Lars Persson and Johan Stennek. I am also grateful for comments by participants in workshops at the Stockholm University and at IUI.

[2]Whether efficiencies are taken into account in the EU is actually not clear (see Röller, Stennek and Verboven, 2000).

standard with a consumer bias.[3] This result thus indicates that the current practice of protecting the consumers' interests can be motivated on the ground of promoting allocative efficiency.

The main task of merger control is to predict the effects of mergers or transfers of assets from one firm to another and, if necessary, to forbid some of these activities. In some jurisdictions, merger control includes a so-called efficiency defense, that is, competition authorities should trade-off cost-savings induced by mergers against detrimental welfare effects due to increased market power. The exact trade-off differs, however, depending on the welfare standard. Under a total surplus standard, a competition authority would approve a merger irrespective of its distributional effects as long as the merger increases the total surplus. Under a consumers' surplus standard, a merger would have to benefit consumers in addition to enhancing the total surplus.[4]

In the US, the latter standard has been adopted.[5] The present paper argues that such a standard need not be understood as a concern for the distribution of wealth. In terms of the total surplus it may be optimal to block a merger, even though it enhances the total surplus relative to the initial market structure, if the relevant alternative is another merger.[6] To see this, consider the example described in Table 1. For simplicity, there are only three possible market structures, the initial one, M^0, and market structures M^1 and M^2. A change in market structure, for example achieved by means of a merger, induces changes in the producers' (ΔPS), the consumers' (ΔCS) and the total (ΔTS) surpluses. The producers' surplus is largest in market structure M^1, followed by M^2 while it is smallest in the initial market structure. Similarly, Table 1 ranks the different market structures in terms of the other two surpluses.

Assume that any change in market structure is initiated by the firms and that they maximize the producers' surplus. Furthermore, assume that the competition authority can assess the consequences of a proposed change in market structure relative to the initial one, but not the consequences of the alternative

[3] See Fershtman and Judd (1987) for an example of strategic delegation.

[4] The subsequent analysis fits into the framework of an efficiency defense, that is a framework where mergers are evaluated on a case-by-case basis. The finding of this paper could, however, also be relevant for the design of policies based on structural parameters such as the Herfindahl-Hirschman index.

[5] See the 1992 Horizontal Merger Guidelines.

[6] To identify the relevant alternative to a merger, I endogenously determine the equilibrium market structure under different welfare standards. The present paper is thus related to the literature on endogenous mergers (Kamien and Zang, 1990, 1993, and Horn and Persson, 2000).

change in market structure. Delegating a consumers' surplus standard to the competition authority is then, in the example of Table 1, optimal in terms of the total surplus. Indeed, such a welfare standard forbids market structure M^1, since it reduces the consumers' surplus relative to the initial market structure, M^0. Thereby, it instead induces market structure M^2 which maximizes the total surplus. In contrast, the total surplus standard is not optimal, since it induces market structure M^1.

	M^1	M^0	M^2
ΔPS	$++$	0	$+$
ΔCS	$-$	0	$+$
ΔTS	$+$	0	$++$

Table 1.

The crucial assumption underlying the above argument is that the competition authority can perfectly assess the consequences of a *proposed* change in market structure, but not the consequences of *alternative* changes. Clearly, the former assumption overestimates the ability of competition authorities to assess the consequences of a proposed change in market structure. The latter assumption, on the other hand, possibly underestimates the ability of competition authorities to assess the consequences of alternative changes in market structure.[7] For instance, the 1992 US Merger Guidelines prescribe that US competition authorities should assess whether alleged cost savings are specific to the proposed merger. This suggests that at least some competition authorities attempt to evaluate the consequences of alternatives to a proposed merger, possibly other changes in market structure. While the above assumption abstracts from these important issues, it captures the following realistic feature of merger control in the simplest possible way. Assessing the consequences of all possible changes in market structure is clearly much more difficult for a competition authority than assessing the consequences of a proposed one only. For example, it may be possible to perform the latter task while pursuing the former is too costly due to time constraints. Furthermore, it may be easier for a competition authority to require firms to disclose information regarding a proposed change in market structure as opposed to disclose information about some other hypothetical change in market struc-

[7]Note that this latter assumption is implicit in most policy analyses related to merger control (see, for example, Williamson, 1968, Farrell and Shapiro, 1990a, Besanko and Spulber, 1993 and Neven and Röller, 2000).

ture. The present paper may thus be viewed as a first attempt to analyze the implications of the differences in how difficult it is for a competition authority to perform these different tasks.

Due to the above information problem, the competition authority cannot pursue a first-best policy. Furthermore, different welfare standards yield different errors. By applying a total surplus standard, the competition authority may allow a market structure increasing the total surplus, even though the relevant alternative is a market structure increasing the total surplus even further. By applying a consumers' surplus standard, on the other hand, the competition authority may forbid market structures that maximize the total surplus. Due to the first type of error, distorting the competition authority's objective function, that is delegating an operational goal that differs from the total surplus, is actually optimal. In particular, it is optimal to delegate a welfare standard with a consumer bias, which reduces the likelihood of the first type of error. Moreover, reducing this likelihood is shown to be optimal, even though it occurs at the expense of an increase in the likelihood of the second type of error.

This result is derived in a simple three period duopoly model. Two firms are endowed with capital affecting their marginal costs. In the first period, the firms can either propose to merge their assets and thereby form a monopoly, or propose to pursue some alternative transfer of assets that may decrease market concentration. The competition authority either approves or rejects the proposal and, in the third period, the firms compete à la Cournot. The proposed transfer of assets in the first period is viewed as the outcome of an efficient bargaining between the firms, that is, the firms choose a transfer so as to maximize aggregate profits subject to the approval of the competition authority. This set-up has two important features. First, it captures the following basic welfare trade-off in a simple way. Increased concentration may reduce production costs, but at the expense of an increase in market power. Second, the firms may choose between several different market structures.

To my knowledge, there exist two studies that have proposed an argument in favor of a consumers' surplus defense in merger control that is not based on distributional considerations. Besanko and Spulber (1993) argue that competition authorities cannot enforce an ex ante optimal policy due to a lack of commitment ex post. The ex ante optimal policy is a total surplus standard. Delegating a welfare standard with a consumer bias mitigates the commitment problem ex post. Neven and Röller (2000) compare a total surplus standard with a consumers' surplus standard in a political economy model where the firms can influence the decision of the competition authority through perks. Depending on the level of cost savings induced by a merger, either the total surplus or the consumers' surplus standard is optimal. These two studies and the present paper have a common feature: the consumers' surplus standard might be optimal because it affects the firms' merger decisions. The three underlying mechanisms differ, however, and may therefore be viewed as complementary.

2 The Model

Consider a market for a homogeneous good, supplied by two competing firms $i \in \{1,2\}$. Time is divided into three periods. In period 1, the firms bargain over transfers of assets and propose a transfer to a competition authority. In period 2, the competition authority either accepts or rejects the notified transfer. In period 3, the firms compete à la Cournot. A transfer of assets in period 1 will affect the choice of quantities in period 3 by changing the firms' marginal costs. The transaction arising in period 1 is viewed as the outcome of an efficient bargaining between the firms. Therefore, the firms are assumed to choose an allocation of assets in period 1 that maximizes aggregate profits in period 3, subject to the approval of the authority in period 2.[8]

Inverse demand is linear and given by $p(Q) = 1 - Q$, where Q denotes total output. The firms have access to a common technology yielding a short-run cost function $C(q_i, k_i) = \frac{q_i}{k_i}$, where q_i denotes firm i's output and k_i denotes firm i's endowment of an industry-specific capital asset.[9] Firm i's marginal cost, given by $c_i(k_i) \equiv \frac{\partial C(q_i,k_i)}{\partial q_i} = \frac{1}{k_i}$, is constant for a given endowment of capital and decreasing in k_i $(c_i'(k_i) < 0)$. Let $\pi_i \equiv (p - c_i)\, q_i$ denote firm i's profit and define $PS \equiv \pi_1 + \pi_2$ as the producers' surplus. Let $CS \equiv \int_0^Q p(x)\, dx - pQ$ and $TS \equiv \int_0^Q p(x)\, dx - \sum_{i=1}^{2} c_i q_i$ denote the consumers' and the total surplus respectively. Finally, let $WS \equiv \alpha CS + (1-\alpha) PS$ denote a weighted average of

[8]The firms being able to bargain efficiently in period 1, does not imply that they cooperate in period 3 by limiting their joint output. Since agreements to limit joint output are typically prohibited by law, firms cannot write binding contracts to enforce such a behavior. Therefore cooperative outcomes are less likely in this dimension.

[9]This short-run cost function is the dual of the Cobb-Douglas production function $q = kl$, which exhibits long run increasing returns to scale.

the consumers' and producers' surpluses, where $\alpha \in [0, 1]$.

The exogenous parameters of the model are k_1^0 and k_2^0, which describe the initial allocation of the assets. Let $K \equiv k_1^0 + k_2^0$ denote the total amount of the asset which is assumed to be fixed.[10] The initial allocation of assets can thus be described by the pair (k_2^0, K). For a given K, k_2^0 is referred to as the original market structure. To ensure that there exists an original market structure, k_2^0, such that both firms make positive profits, it is assumed that $K > 2$.

In period 1, the firms can propose to transfer any amount of the asset between each other.[11] Hence, a new allocation k_1 and k_2 proposed by the firms must satisfy the condition $k_1 + k_2 = K$.[12] A proposed allocation of assets can thus be described by the vector (k_2, K) where K is an exogenous parameter and k_2 is the firms' period 1 choice variable. For a given K, k_2 is referred to as a market structure. Without loss of generality, I assume that firm 1 is the "large" firm ($c_1 \leq c_2$), both in the original market structure and after a transfer has occured, which implies that $k_2, k_2^0 \in [0, K/2]$. Moreover, a reduction in k_2, that is a transfer of assets from firm 2 to firm 1, then induces a more asymmetric market structure and thereby increases market concentration, as measured by the Herfindahl-Hirschman Index.

This set-up has two important features. First, it captures the following basic welfare trade-off associated with an increase in market concentration in a simple way. On the one hand, increased concentration may reduce production costs,[13] on the other, it also increases market power. Second, the firms may choose between several different market structures.

As discussed in the Introduction, I assume that the competition authority can perfectly assess the consequences of a proposed transfer of assets relative to the original market structure, but not the the consequences of alternative transfers. Therefore, I restrict the attention to the class of policies approving a transfer of assets if, and only if, it increases a weighted average of the consumers' and producers' surpluses, relative to the initial market structure. An element of this class of policies is denoted as a WS-policy and is characterized by the parameter $\alpha \in [0, 1]$, since $WS = \alpha CS + (1 - \alpha) PS$. Moreover, I devote much attention to two specific policies denoted the TS- and the CS-policy which correspond to

[10] Hence, these assets constitute a barrier to entry.

[11] Farrell and Shapiro (1990b) analyze such transfers of assets between two firms in an oligopolistic setting with general demand and cost functions.

[12] Without loss of generality, it is assumed that the firms do not propose allocations such that $k_1 + k_2 < K$.

[13] Note that combining all assets in a single firm yields the lowest marginal cost.

the WS-policies characterized by $\alpha = 1/2$ and $\alpha = 1$ respectively. Finally, the policy is assumed to be common knowledge so that the firms only make proposals approved in equilibrium.

3 Equilibrium Market Structures

In this section, I solve for the equilibrium market structures when the competition authority applies the TS- or the CS-policy. The analysis proceeds by backward induction. First, the period 3 equilibrium outputs are computed for all allocations of assets (k_2, K). Second, the period 1 allocation of assets is determined so as to maximize the period 3 producers' surplus, subject to the approval of the competition authority in period 2.

In period 3, the firms compete à la Cournot. Firm i's profit is given by $\pi_i(q_i, k_i) = p(Q)\, q_i - c_i q_i$ for $i \in \{1, 2\}$.

Consider first allocations of assets such that $c_2 \leq (1 + c_1)/2$. This condition ensures that both firms produce positive quantities and is equivalent to $k_2 \geq \underline{k}_2(K) \equiv \frac{1}{2}\left(K + 3 - \sqrt{(K+9)(K-11) + 108}\right)$.[14] The Cournot equilibrium is then characterized by

$$\frac{\partial \pi_i}{\partial q_i} = p + q_i p' - c_i = 0 \text{ for } i \in \{1, 2\}. \tag{1}$$

Solving for q_1 and q_2 by using the two equations in (1) yields the following equilibrium quantity for firm $i \in \{1, 2\}$:

$$q_i(k_2, K) = \frac{1}{3}(1 - 2c_i + c_j) \text{ if } k_2 \geq \underline{k}_2(K). \tag{2}$$

Note that the equilibrium quantities in (2) are functions of k_2 and K through the firms' marginal costs.

Consider next allocations of assets such that $c_2 > (1 + c_1)/2$, that is $k_2 < \underline{k}_2(K)$. In this case, firm 1 is a monopolist. Standard computations yield the following equilibrium quantity for firm 1:

$$q_1(k_2, K) = \frac{1}{2}(1 - c_1) \text{ if } k_2 < \underline{k}_2(K). \tag{3}$$

Before proceeding to period 1, note that the different surpluses are easily computed as functions of k_2 and K by using the equilibrium quantities derived

[14] To obtain the expression for $\underline{k}_2(K)$, solve for k_2 in the equation $c_2 = (1 + c_1)/2$, using the facts that $c_i = 1/k_i$, $k_1 = K - k_2$ and $k_2 \in [0, K/2]$. The solution is $\underline{k}_2(K)$.

in (2) and (3). These functions are denoted $CS(k_2, K)$, $PS(k_2, K)$, $TS(k_2, K)$ and $WS(k_2, K)$. Note already now that panels a, b and c in Figure 1 illustrate $CS(k_2, K)$, $PS(k_2, K)$ and $TS(k_2, K)$ in terms of the firms' period 1 choice variable k_2, in a case where the exogenous parameter K is large.

In period 1, the firms are assumed to allocate the assets so as to maximize the aggregate profits in period 3, subject to the approval of the competition authority in period 2. The assumption that the firms maximize aggregate profits is viewed as the outcome of an efficient bargaining.[15] Hence, the firms solve the following maximization problem:

$$\max_{k_2 \in [0, K/2]} PS(k_2, K) \text{ subject to } WS(k_2, K) \geq WS(k_2^0, K). \tag{4}$$

Depending on the policy $\alpha \in \left\{\frac{1}{2}, 1\right\}$ and the exogenous parameters $K > 2$ and $k_2^0 \in [\underline{k}_2(K), K/2]$, problem (4) turns out to have one of the three following solutions: the monopoly ($k_2 = 0$), the original market structure ($k_2 = k_2^0$) or the symmetric duopoly ($k_2 = K/2$). Note already at this stage that the monopoly always maximizes the producers' surplus. Hence, absent antitrust intervention, the firms would always propose that market structure. Under the TS- and the CS-policy, however, the monopoly is not always allowed. Below, I show that the relevant alternative to the monopoly need not be the original market structure. Rather, the firms may propose the symmetric duopoly if the monopoly is forbidden, that is a market structure reducing market concentration.

Proposition 1 *Assume that the competition authority applies the TS-policy [$\alpha = 1/2$]. There exists a function $k_2^t(K) : [K^t, +\infty) \to \mathbb{R}^+$ where $K^t \simeq 13,28$ such that $\underline{k}_2(K) < k_2^t(K) < K/2$ for all $K > K^t$. The unique equilibrium market structure is*

1. *the monopoly [$k_2 = 0$] if, and only if, (i) $K \in [2, K^t]$ or (ii) $K > K^t$ and $k_2^0 \in [\underline{k}_2(K), k_2^t(K)]$,*

2. *the symmetric duopoly [$k_2 = K/2$] if, and only if, $K > K^t$ and $k_2^0 \in (k_2^t(K), K/2]$.*

The proofs of all Propositions are relegated to Appendix B.

[15] Binmore (1987) shows in a non-cooperative bargaining model where the two players can choose the size of the cake to be divided, that they choose to divide the largest cake.

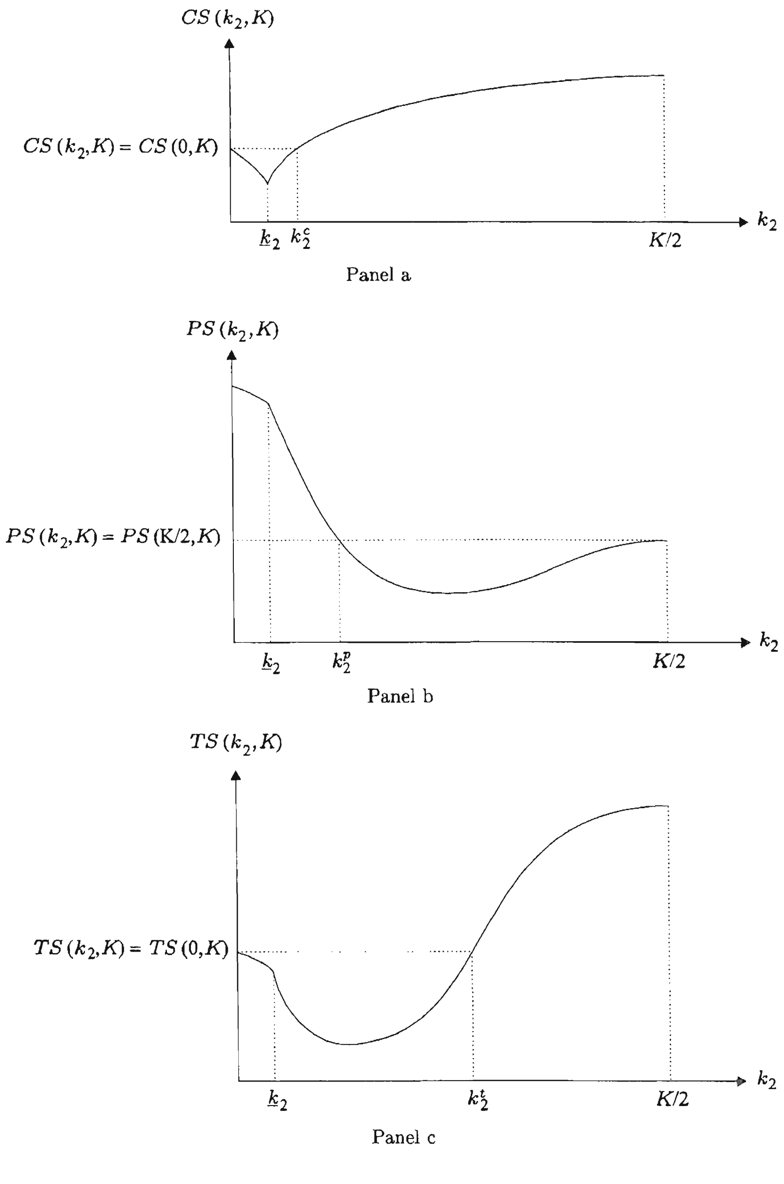
$CS\,(k_2,K)$
$CS\,(k_2,K) = CS\,(0,K)$
$\underline{k}_2$ k_2^c
$K/2$
k_2
Panel a
$PS\,(k_2,K)$
$PS\,(k_2,K) = PS\,(K/2,K)$
$\underline{k}_2$ k_2^p
$K/2$
k_2
Panel b
$TS\,(k_2,K)$
$TS\,(k_2,K) = TS\,(0,K)$
$\underline{k}_2$ k_2^t
$K/2$
k_2
Panel c

Figure 1: $K > K^t$.

To understand Proposition 1, and in particular the threshold values K^t and $k_2^t(K)$, it is necessary to study how the producers' and the total surpluses depend on k_2. However, I will first partly explain Proposition 1 by using Figure 1.

Consider first the simple case which is not illustrated in Figure 1, namely when $K \leq K^t$. In this case, it turns out that the monopoly maximizes the total surplus. Therefore, the TS-policy allows the monopoly for all original market structures $k_2^0 \in [\underline{k}_2(K), K/2]$ and consequently, the firms propose that market structure, since it maximizes the producers' surplus. Next, consider the more complicated case illustrated in Figure 1 where $K > K^t$. In this case, the symmetric duopoly maximizes the total surplus so that private and social incentives are not aligned. If $k_2^0 \leq k_2^t(K)$, the TS-policy allows the monopoly, since the monopoly increases the total surplus relative to the original market structure (see panel c in Figure 1). Consequently, the firms propose that market structure. If instead $k_2^0 > k_2^t(K)$, the TS-policy does not allow the monopoly and the firms propose their second best solution, namely the symmetric duopoly which increases the producers' surplus (see panel b in Figure 1). Finally, note that for a large set of initial allocations of assets (k_2^0, K), the TS-policy induces the monopoly while the symmetric duopoly maximizes the total surplus. Therefore, the TS-policy need not be optimal in terms of the total surplus.

Next, I explain how the producers' and the total surpluses depend on k_2. Consider first the simple case when firm 1 is a monopolist, that is when $k_2 < \underline{k}_2(K)$. It is well known that increasing the marginal cost of a monopolist makes both consumers and the monopolist worse off. As an immediate consequence, the producers' and the total surpluses decrease with k_2 for all $k_2 \in [0, \underline{k}_2(K))$. This is illustrated in panels b and c of Figure 1, where $PS(k_2, K)$ and $TS(k_2, K)$ are decreasing in k_2 when $k_2 \in [0, \underline{k}_2(K))$.

Consider next the more complicated case when both firms produce positive quantities, that is when $k_2 \geq \underline{k}_2(K)$. First, I analyze the impact of a transfer of assets from firm 1 to firm 2 ($dk_2 > 0$) on the firms' equilibrium quantities given by equation (2). Differentiate q_i with respect to k_1 and k_2 and use the fact that $dk_1 = -dk_2$.

$$\frac{dq_1}{dk_2} = \frac{\partial q_1}{\partial k_2} - \frac{\partial q_1}{\partial k_1} = \frac{1}{3}(c_2' + 2c_1') < 0, \tag{5a}$$

$$\frac{dq_2}{dk_2} = \frac{\partial q_2}{\partial k_2} - \frac{\partial q_2}{\partial k_1} = -\frac{1}{3}(2c_2' + c_1') > 0. \tag{5b}$$

These inequalities simply reflect that transferring capital from firm 1 to firm 2 increases firm 1's and decreases firm 2's marginal cost. Consequently, firm 1 reduces and firm 2 increases its equilibrium output. The impact on total output is given by:

$$\frac{dQ}{dk_2} = \frac{dq_2}{dk_2} + \frac{dq_1}{dk_2} = \frac{1}{3}(c_1' - c_2') > 0. \tag{6}$$

Total output thus increases as market concentration decreases ($dk_2 > 0$). The reason is that the impact of such a transfer of assets is larger on firm 2's than on firm 1's marginal cost (i.e. $|c_2'| > |c_1'|$) and that total output only depends on the sum of the firms' marginal costs.

Next, I turn to the impact of a transfer of assets from firm 1 to firm 2 ($dk_2 > 0$) on the producers' surplus. Recall by (1) that $\frac{\partial \pi_i}{\partial q_i} = 0$. As a result, differentiating $PS = \pi_1 + \pi_2 = (p - c_1) q_1 + (p - c_2) q_2$ with respect to q_1, q_2, c_1 and c_2 yields:

$$dPS = q_2 p' dq_1 + q_1 p' dq_2 - q_1 dc_1 - q_2 dc_2.$$

The two last terms on the RHS can be written as $(c_1' q_1 - c_2' q_2) dk_2$, since $dc_2 = c_2' dk_2$ and $dc_1 = -c_1' dk_2$. The two first terms can be written as $p' q_1 dQ + p'(q_2 - q_1) dq_1$, since $dq_2 = dQ - dq_1$. Furthermore, recall by (1) that $q_i p' = -(p - c_i)$. As a result, $p' q_1 = p'(Q - q_2) = p'Q + p - c_2$ and $p'(q_2 - q_1) = (c_2 - c_1)$ Hence:

$$\frac{dPS}{dk_2} = \underbrace{(p'Q + p)\frac{dQ}{dk_2}}_{\text{change in total revenues}} \underbrace{\overbrace{-c_2\frac{dQ}{dk_2}}^{\text{output cost effect}} + \overbrace{(c_2 - c_1)\frac{dq_1}{dk_2}}^{\text{business stealing effect}} + \overbrace{c_1' q_1 - c_2' q_2}^{\text{direct cost effect}}}_{\text{change in total costs}}. \tag{7}$$

The first term reflects the change in total revenues as total output increases after the transfer, dk_2. The remaining terms reflect the change in total costs. Note that $p'Q + p - c_2$ is negative, since the marginal revenue is lower than the firms' marginal costs when firms compete à la Cournot. As a result, the sum of the two first terms is negative. The term $(c_2 - c_1)\frac{dq_1}{dk_2}$ is negative and reflects the increase in total costs as firm 2 steals business from firm 1. The two last terms constitute the direct cost effect of dk_2 keeping the firms' output at the level prior to the transfer dk_2. While firms 1's direct cost effect is negative ($c_1' q_1 < 0$), it is positive for firm 2 ($-c_2' q_2 > 0$).

Lemma 1 in Appendix A signs $\frac{dPS}{dk_2}$ for all $k_2 \in [\underline{k}_2(K), K/2]$. It shows that firm 2's direct cost effect, that is $-c_2' q_2$, need not always be dominated by the other terms in (7). If $K > 11$, the producers' surplus decreases with k_2 for sufficiently asymmetric market structures. However, for more symmetric market structures, the producers' surplus increases as illustrated in panel b of Figure 1. Hence, decreasing market concentration ($dk_2 > 0$) may increase the producers' surplus despite the reduction in price. This observation is crucial for the main result in this paper. Its implication is simple: forbidding increases in market concentration need not imply that the original market structure will remain. Rather, as in Proposition 1, the firms may propose a transfer of assets inducing the symmetric duopoly.[16] Actually, if increases in market concentration are forbidden and if $K > 11$, then the firms have an incentive to propose the symmetric duopoly if $k_2 > k_2^p(K)$ (see panel b in Figure 1) where the function $k_2^p(K)$ is defined implicitly as the solution in k_2 to the equation $PS(k_2, K) = PS(K/2, K)$.[17] Finally, note that firm 2's direct cost effect is dominated by the other terms in (7) if $K \leq 11$. In this case, $PS(k_2, K)$ thus decreases with k_2 for all $k_2 \in [\underline{k}_2(K), K/2]$.

Finally, consider the impact of a transfer of assets from firm 1 to firm 2 ($dk_2 > 0$) on the total surplus. By differentiating $TS = \int_0^Q p(x)\,dx - \sum_{i=1}^2 c_i q_i$ with respect to q_1, q_2, c_1 and c_2 and by using the facts that $dc_2 = c_2' dk_2$ and $dc_1 = -c_1' dk_2$, it is easy to show the following:

$$\frac{dTS}{dk_2} = \underbrace{(p - c_2)\frac{dQ}{dk_2}}_{\text{reduced dead-weight loss}} + \underbrace{(c_2 - c_1)\frac{dq_1}{dk_2}}_{\text{business stealing effect}} + \underbrace{c_1' q_1 - c_2' q_2}_{\text{direct cost effect}}. \tag{8}$$

Note that $\frac{dTS}{dk_2}$ differs from $\frac{dPS}{dk_2}$ by its first term. In contrast to the two first terms in (7), the term $(p - c_2)\frac{dQ}{dk_2}$ in (8) is positive, which reflects the reduced dead-weight loss as the firms expand total output above the level prior to the transfer dk_2.

Lemma 2 in Appendix A signs $\frac{dTS}{dk_2}$ for all $k_2 \in [\underline{k}_2(K), K/2]$. If $K \leq 13/2$, $TS(k_2, K)$ decreases with k_2 for all $k_2 \in [\underline{k}_2(K), K/2]$. In this case, the negative terms in (8), namely the business stealing effect and firm 1's direct cost effect,

[16] A legitimate question is whether $\frac{dPS}{dk_2}$ is positive due to the cost-function that exhibits strong long run increasing returns to scale. To address this question, consider the short-run cost function $C(q, k) = \frac{q^2}{k^a}$, while keeping the assumption of linear demand. This cost function is the dual of the Cobb-Douglas production function $q = k^{\frac{a}{2}} l^{\frac{1}{2}}$ which exhibits increasing returns to scale if, and only if, $a > 1$. Although it is difficult to sign $\frac{dPS}{dk_2}$ for all allocations of assets (k_2, K), it is possible to show for $a > 1$ that $\frac{dPS}{dk_2}$ is positive for almost symmetric market structures (provided that K is sufficiently large). Thus, $\frac{dPS}{dk_2}$ may be positive also for cost functions exhibiting moderate degrees of increasing returns to scale.

[17] This equation has a (unique) solution if, and only if, $K > 11$, that is when $PS(k_2, K)$ increases with k_2 for sufficiently symmetric market structures as in panel b of Figure 1.

thus dominate the positive terms, that is the reduced dead weight loss and firm 2's direct cost effect. In the present model, this observation constitutes the rationale for applying an efficiency defense. If $K > 13/2$, $TS\left(k_2, K\right)$ still decreases with k_2 for sufficiently asymmetric market structures. However, for more symmetric market structures, $TS\left(k_2, K\right)$ increases with k_2 as illustrated in panel c of Figure 1.[18] In particular, note that Figure 1 depicts a case where $K > K^t \simeq 13.28$, that is when the symmetric duopoly maximizes the total surplus.[19] In such cases, the firms' incentives differ from social incentives, since the monopoly always maximizes the producers' surplus. Finally, note that the function $k_2^t(K)$ is defined implicitly as the solution in k_2 to the equation $TS\left(k_2, K\right) = TS\left(0, K\right)$.[20]

Having derived the equilibrium market structures under the TS-policy, I turn to the CS-policy.

Proposition 2 *Assume that the competition authority applies the CS-policy [$\alpha = 1$]. There exists a function $k_2^c(K) : [5, +\infty) \to \mathbb{R}^+$ and a function $k_2^p(K) : [11, +\infty) \to \mathbb{R}^+$ such that $\underline{k}_2(K) < k_2^c(K) < K/2$ for all $K > 5$ and $k_2^c(K) < k_2^p(K) < K/2$ for all $K > 11$. The unique equilibrium market structure is*

1. *the monopoly [$k_2 = 0$] if, and only if, (i) $K \in [2, 5]$ or (ii) $K > 5$ and $k_2^0 \in [\underline{k}_2(K), k_2^c(K)]$,*
2. *the original market structure [$k_2 = k_2^0$] if, and only if, (i) $K \in (5, 11]$ and $k_2^0 \in [k_2^c(K), K/2]$ or (ii) $K > 11$ and $k_2^0 \in [k_2^c(K), k_2^p(K)]$,*
3. *the symmetric duopoly [$k_2 = K/2$] if, and only if, $K > 11$ and $k_2^0 \in (k_2^p(K), K/2]$.*

Before explaining Proposition 2 in terms of Figure 1, I analyze how the consumers' surplus depends on k_2. Consider first the case when firm 1 is a monopolist, that is, when $k_2 < \underline{k}_2(K)$. As noted previously, consumers are worse off when the marginal cost of a monopolist increases. Consequently, $CS\left(k_2, K\right)$ decreases

[18] Note that $TS\left(k_2, K\right)$ may both increase and decrease with k_2, also with the cost function $C\left(q, k\right) = \frac{q^2}{k^a}$, where $a > 1$. Hence, the assumed cost-function that exhibits strong increasing returns to scale is not crucial in this respect either.

[19] It is not surprising that the symmetric duopoly maximizes the total surplus when K is large. Indeed, the difference between the marginal costs of the firms in the symmetric duopoly and the marginal cost of the monopolist is smaller the larger K.

[20] This equation has a (unique) solution if, and only if, $K \geq K^t$, that is when the symmetric duopoly maximizes the total surplus as in panel c of Figure 1.

with k_2 for all $k_2 \in [0, \underline{k}_2(K))$ as illustrated in panel a of Figure 1. Consider next the case when both firms produce positive quantities, that is, when $k_2 \geq \underline{k}_2(K)$. By equation (6), total output increases as market concentration decreases ($dk_2 > 0$). Consequently, $CS(k_2, K)$ increases with k_2 for all $k_2 \in [\underline{k}_2(K), K/2]$ as illustrated in panel a of Figure 1. Finally, note that the function $k_2^c(K)$ defined as the solution in k_2 to the equation $CS(k_2, K) = CS(0, K)$.[21]

Let us now explain Proposition 2. Whenever the monopoly increases the consumers' surplus relative to the original market structure, the CS-policy induces that market structure, since the monopoly always maximizes the producers' surplus. When the monopoly instead reduces the consumers' surplus relative to the original market structure, there are two possible outcomes: the original market structure or the symmetric duopoly. For example, consider Figure 1 and original market structures such that the monopoly reduces the consumers' surplus, that is $k_2^0 > k_2^c(K)$. In this case, the CS-policy only allows less concentrated market structures than the original one, that is $k_2 \in [k_2^0, K/2]$ (see panel a in Figure 1). The firms, however, may lose from less concentrated market structures, which is the case if $k_2^0 < k_2^p(K)$ (see panel b in Figure 1). Consequently, the original market structure remains if $k_2^0 \in [k_2^c(K), k_2^p(K)]$. If instead $k_2^0 > k_2^p(K)$, the symmetric duopoly maximizes the producers' surplus among all the market structures the CS-policy allows. In this case, the CS-policy thus induces the symmetric duopoly. This latter observation is actually crucial for the results in the next section.

4 A Consumers' Surplus Defense

The present section argues that competition authorities should assign a larger weight to the consumers' than to the producers' surplus. At the heart of the argument lies the observation that for some initial allocations of assets, the TS-policy does not induce the transfer of assets that maximizes the total surplus while the CS-policy does. To see this, recall that the symmetric duopoly maximizes the total surplus if $K > K^t$. By Proposition 1, the TS-policy then induces the monopoly for all original market structures such that $k_2^0 \leq k_2^t(K)$. By Proposition 2, the CS-policy then induces the symmetric duopoly for all original market

[21]This equation has a (unique) solution if, and only if, $K \geq 5$, that is when the symmetric duopoly maximizes the consumers' surplus as in panel a of Figure 1.

structures such that $k_2^0 > k_2^p(K)$. Moreover, note in Figure 1 that $k_2^p(K) < k_2^t(K)$. Hence:

Proposition 3 *Assume that the objective of merger control is to maximize the total surplus. If $K > K^t$, then $k_2^p(K) < k_2^t(K)$ and the CS-policy outperforms the TS-policy if $k_2^0 \in (k_2^p(K), k_2^t(K)]$.*

The intuition behind this result is straightforward. By forbidding a transfer of assets that increases the total surplus, one may expect an alternative transfer to be proposed in equilibrium, that is, a transfer that would further increase the total surplus relative to the transfer proposed initially. The CS-policy performs exactly this task for the parameter configurations indicated in Proposition 3. First, it restricts the set of allowed transfers, so that more asymmetric market structures, relative to the original one, are excluded. Thereby, the CS-policy induces the firms to propose, from their point of view, the best transfer of assets that is allowed, namely the one leading to the symmetric duopoly. In turn, the symmetric duopoly maximizes the total surplus (since $K > K^t$). Furthermore, it is not surprising that the CS-policy in particular may outperform the TS-policy in terms of the total surplus. Indeed, the initiative to transfers of assets is taken by the firms and their objective is to maximize the producers' surplus. The total surplus, however, also includes the consumers' surplus. Giving a larger weight to the consumers' than to the producers' surplus (in this case, giving no weight to the producers' surplus), corrects for the firms' lack of incentives to internalize the effect of a transfer on the consumers' surplus. The larger weight on the consumers' surplus can also be seen as a mean of compensating for consumers' inability to take collective actions by proposing transfers of assets.

Although the CS-policy outperforms the TS-policy in terms of the total surplus for some initial allocations of assets as shown in Proposition 3, there are other such allocations where the opposite is true. Figure 2 indicates when each policy is optimal in terms of the exogenous parameters k_2^0 and K. The horizontal and vertical axes indicate k_2^0 and K respectively. To ensure that firm 2 produces a positive quantity in the original market structure, we must have that $k_2^0 \geq \underline{k}_2(K)$. Furthermore, $k_2^0 \leq K/2$, since firm 2 is assumed to be the small firm. Hence, the parameters of interest are given by the area below the line $K/2$ and above the curve $\underline{k}_2(K)$. The symmetric duopoly maximizes the total surplus to the right of the vertical line where $K = K^t$. The area above the curve $k_2^t(K)$ indicates the parameter configurations where the TS-policy forbids the monopoly.

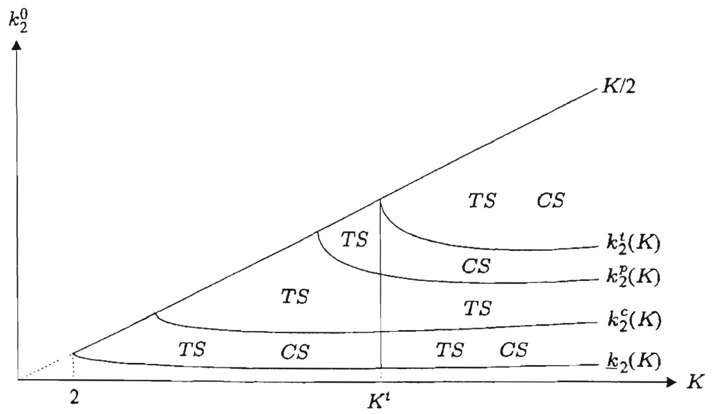

Figure 2: CS- versus TS-policy.

Similarly, the areas above the curve $k_2^c(K)$ indicate the parameter configurations where the CS-policy forbids the monopoly. Finally, the areas above the curve $k_2^p(K)$ indicate the parameter configurations where the firms have an incentive to propose the symmetric duopoly if the monopoly is forbidden.

The TS- and the CS-policies are optimal in all areas marked with TS and CS respectively. The parameter configurations indicated in Proposition 3 are given by the area marked with CS only. Similarly, the three areas marked with TS only, correspond to the parameter configurations where the TS- but not the CS-policy is optimal. In the two areas marked with TS only and where $K < K^t$, the CS-policy is suboptimal, since it forbids the monopoly even though the monopoly maximizes the total surplus. In the area marked with TS only and where $K > K^t$, the CS-policy is also suboptimal, since it forbids the monopoly that increases the total surplus relative to the original market structure in a situation where the firms have no incentive to propose the symmetric duopoly.

Clearly, neither the CS- nor the TS-policy is optimal for all initial allocations of assets. A natural extension is therefore to consider other WS-policies than the TS- and the CS-policy. Not surprisingly, it is possible to show that assigning a lower weight to the consumers' than to the producers' surplus (i.e. $\alpha < 1/2$) is suboptimal. In fact, any such WS-policy is outperformed by the TS-policy for all pairs (k_2^0, K). Intuitively, such a WS-policy is suboptimal, since it allows the monopoly even though the monopoly might reduce the total surplus relative to the original market structure.

While any WS-policy such that $\alpha < 1/2$ is outperformed by the TS-policy for all initial allocations of assets, it is not possible to find a WS-policy with a consumer bias ($\alpha > 1/2$) that outperforms the TS-policy in terms of the total surplus for all initial allocations of assets. For instance, any such WS-policy performs better than the TS-policy for some pairs (k_2^0, K) while the opposite is true for other pairs (k_2^0, K). This observation implies that, in general, it is not possible to rule out that the TS-policy might be optimal. Indeed, consider a world where different industries are described by different initial allocations of assets (k_2^0, K). If no industry is characterized by a pair (k_2^0, K) belonging to the area marked with CS only in Figure 2, then the TS-policy is clearly optimal. Nevertheless, Proposition 4 below shows that under mild conditions, the TS-policy is suboptimal in expectational terms. Let the density function $f(k_2^0, K)$ describe the distribution of initial allocations of assets (k_2^0, K).

Proposition 4 *Assume that the objective of Merger Control is to maximize the total surplus. Then, there exists a WS-policy assigning a larger weight to the consumers' than to the producers' surplus [$\alpha \in \left(\frac{1}{2}, 1\right)$] that outperforms the TS-policy in expectational terms, if the density function f has full support.*

Proposition 4 reflects the following two facts. The loss of applying an appropriately chosen WS-policy relative to the TS-policy is *small* in situations where only the TS-policy is optimal. In contrast, the loss of applying the TS-policy relative to the appropriately chosen WS-policy is *large* in situations where only the WS-policy is optimal. To be more precise, consider a WS-policy assigning a slightly larger weight to the consumers' than to the producers' surplus, that is, α is strictly larger than but close to $1/2$.[22] For such a WS-policy, it is possible to find pairs (k_2^0, K) such that the TS-policy outperforms this WS-policy, as well as other pairs (k_2^0, K) such that the opposite is true. This is illustrated in Figure 3 which compares the TS-policy with the WS-policy. As in Figure 2, we have that $K/2 \geq k_2^0 \geq \underline{k}_2(K)$. The only new feature in Figure 3 is the curve $k_2^w(K, \alpha)$. The areas above this curve indicate the parameter configurations where the WS-policy forbids the monopoly. In the area marked with TS, only the TS-policy

[22] In fact, Proposition 4 is proved by evaluating, at the point where $\alpha = \frac{1}{2}$, the partial derivative with respect to α of the expected total surplus of applying a WS-policy. The conditions indicated in Proposition 4 are shown to be sufficient for this partial derivative to be strictly positive.

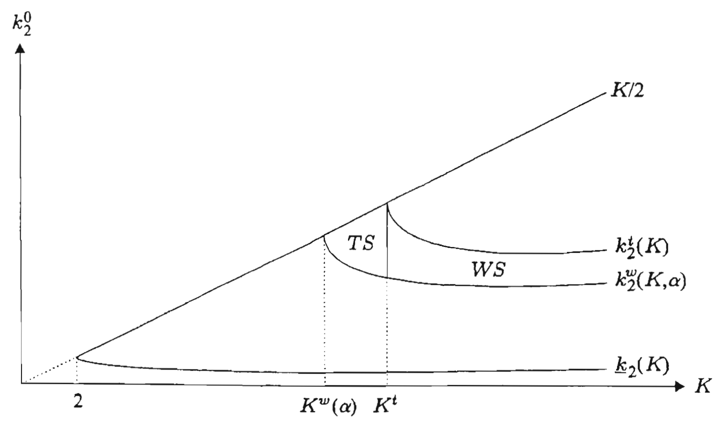

Figure 3: WS- versus TS-policy, where $\alpha > 1/2$.

is optimal. Conversely, only the WS-policy is optimal in the area marked with WS. In all other areas, the two policies perform equally well.

Consider first the area in Figure 3 marked with TS. In this area, the WS-policy is suboptimal because it does not allow the monopoly maximizing the total surplus. The loss of not allowing the monopoly is small, however, if α is close to $1/2$. Otherwise the monopoly would be allowed, since the weighted surplus is a good approximation of the total surplus if α is close to $1/2$. In fact, this loss tends to 0 as α tends to $1/2$. Hence, the loss of applying such a WS-policy is negligible.

Consider next the area in Figure 3 marked with WS. In this area, the TS-policy is suboptimal because it allows the monopoly in situations where the firms have an incentive to propose the symmetric duopoly (that maximizes the total surplus) if the monopoly is forbidden. In this case, however, the loss from not forbidding the monopoly is far from negligible. For example, consider pairs (k_2^0, K) in the area marked WS where K is very large. In such cases, the loss of applying the TS- rather than the WS-policy can be approximated by the difference in total surplus between the monopoly with a marginal cost equal to zero, and the symmetric duopoly where the firms also have zero marginal cost.

The above discussion suggests that the TS-policy is unlikely to be a good approximation of the optimal WS-policy if the initial allocations of assets (k_2^0, K) are evenly distributed. Indeed, for the TS-policy to outperform the WS-policy considered in Figure 3, it is not sufficient that an initial allocation of assets (k_2^0, K), picked at random, equally likely belongs to the areas marked with TS and WS. Rather, it must be much more likely to belong to the area marked with TS, since the WS-policy performs almost as well as the TS-policy in that area while the TS-policy performs significantly worse than the WS-policy in the area marked with WS.

While Proposition 4 does not characterize the optimal WS-policy in expectational terms, an immediate consequence of Proposition 4 (and the fact that the TS-policy outperforms any WS-policy such that $\alpha < 1/2$) is that an optimal WS-policy must have a consumer bias. It should, however, be emphasized that the CS-policy cannot be optimal. In fact, there exists a WS-policy assigning a lower but strictly positive weight to the producers' than to the consumers' surplus $[\alpha \in (\frac{1}{2}, 1)]$, and that weakly outperforms the CS-policy for all initial allocations of assets (k_2^0, K). To see this, note that (i) the monopoly is approved under the WS-policy whenever it is approved under the CS-policy and (ii) the WS-policy approves the monopoly for some pairs (k_2^0, K) when the CS-policy does not. Second, approving the monopoly for a larger set of initial allocations of assets than does the CS-policy, unambiguously improves upon the CS-policy if, and only if, the monopoly is still forbidden for all pairs (k_2^0, K) where the CS-policy optimally induces the symmetric duopoly. An appropriately chosen WS-policy performs this task, since the consumers' surplus, for all the parameter configurations indicated in Proposition 3, is strictly larger in the original market structure k_2^0 than in the monopoly. Consequently, if the weight on the producers' surplus is sufficiently low (i.e. α is sufficiently close to 1), then the weighted surplus is strictly larger in k_2^0 than in the monopoly.

5 Concluding Remarks

This paper provides an argument for a consumers' surplus defense in merger control that is not based on distributional considerations. A government wanting to promote an efficient allocation of resources as measured by the total surplus, should strategically delegate a welfare standard with a consumer bias to its competition authority. A consumer bias means that some welfare increasing mergers will be blocked. This is optimal, if the relevant alternative to the merger is another change in market structure that will increase the total surplus even more.

Furthermore, a consumer bias is shown to be optimal even though it increases the likelihood of forbidding mergers maximizing the total surplus.

This result is derived in a simple duopoly model where the two firms can transfer assets between each other. The advantage of this model is that determining the equilibrium market structure is fairly easy. In particular, it is unproblematic to assume that the firms choose the market structure so as to maximize aggregate profits. In an oligopolistic setting where many different mergers are possible, motivating such an assumption is more difficult.[23] However, in Essay V, I show that anti-competitive mergers may preempt pro-competitive ones. This finding suggests that a consumers' surplus standard may be optimal, also in an oligopolistic setting.

[23] Horn and Persson (2000) find some evidence of efficient outcomes from the firms' point of view in a game theoretical cooperative model of merger formation. In contrast, Kamien and Zhang (1990 and 1993) show in a non-cooperative model that monopolization cannot be an equilibrium outcome even though the monopoly maximizes the producers' surplus. Moreover, Fridolfsson and Stennek (1999), that is Essay I, we show that unprofitable mergers may occur in equilibrium if they harm competitors.

References

Besanko, David; Spulber, Daniel F.: Contested Mergers and Equilibrium Antitrust Policy, *The Journal of Law, Economics & Organization*; V9 N1, April 1993, 1-29.

Binmore, K.: Perfect equilibrium in bargaining models, in K. Binmore P. Dasgupta (eds), The Economics of Bargaining, Basil Blackwell, chapter 5, 1987, 77–105.

Crampton, P.: Alternative Approaches to Competition Law: Consumers' surplus, Total Surplus, Total Welfare and Non-Efficiency Goals, *World Competition* 17, 1994, 55-86.

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

Farrell, Joseph; Shapiro, Carl: Asset Ownership and allocation of assets Structure in Oligopoly, *Rand Journal of Economics*; 21(2), Summer 1990b, 275-292.

Fershtman, Chaim; Judd Kenneth L.: Equilibrium Incentives in Oligopoly, *American Economic Review*; 77(5), December 1987, 927-40.

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

Horn, Henrik; Persson, Lars: Endogenous Mergers in Concentrated Markets, Forthcoming in *International Journal of Industrial Organization*, 2000.

Jenny, Frederic: Antitrust in a Global Economy, in B. Hawk (ed.) Fordham Corporate Law Institute, 1997.

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

Neven, Damien J.; Röller, Lars-Hendrik: Consumer Surplus versus Welfare Standard in a Political Economy Model of Merger Control, Wissenschaftszentrum Berlin Für Sozialforschung, Discussion Paper FS IV 00 - 15, October 2000.

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

Röller, Lars-Hendrik; Stennek, Johan; Verboven, Frank: Efficiency Gains from Mergers, Wissenschaftszentrum Berlin Für Sozialforschung, Discussion Paper FS IV 00 - 09, August 2000.

US Department of Justice; Federal Trade Commission: *1992 Horizontal Merger Guidelines*, Washington: US Department of Justice, April 1997.

Williamson, Oliver E.: Economies as an Antitrust Defense: The Welfare Tradeoffs, *American Economic Review*; 58, 1968, 18-36.

A Preliminaries

Lemma 1 *Let* $\widetilde{k}_2 \equiv \frac{K}{2}\left(1-\sqrt{\frac{K-11}{K+9}}\right)$. *$PS(k_2, K)$ is decreasing in k_2 if (i) $K \in (2, 11]$ or (ii) $K > 11$ and $k_2 \in \left[\underline{k}_2(K), \widetilde{k}_2\right)$. $PS(k_2, K)$ is increasing in k_2 if $K > 11$ and $k_2 \in \left[\widetilde{k}_2, K/2\right]$.*

Proof: Note first that $PS(k_2, K)$ is continuous in k_2, in particular at the point where $k_2 = \underline{k}_2(K)$.

Next, consider market structures such that $k_2 \in [0, \underline{k}_2(K))$. In this case, firm 1 is a monopolist and consequently $PS(k_2, K)$ decreases with k_2, since the profits of a monopolist decreases when its marginal cost increases.

Finally, consider the more complicated case when both firms produce positive quantities, that is when $k_2 \in [\underline{k}_2(K), K/2]$. Use equations (2), (5a) and (6) to eliminate q_i, $\frac{dq_1}{dk_2}$ and $\frac{dQ}{dk_2}$ in (7).

$$\begin{aligned}\tfrac{dPS}{dk_2} = {} & \tfrac{p'}{9}(1-2c_1+c_2)(c_1'-c_2') + \tfrac{1}{3}(c_2-c_1)(c_2'+2c_1') \\ & + \tfrac{1}{3}(1-2c_1+c_2)c_1' - \tfrac{1}{3}(1-2c_2+c_1)c_2'.\end{aligned}$$

Use the facts that $p' = -1$, $c_i = \frac{1}{k_i}$, $c_i' = -\frac{1}{k_i^2}$ and $k_1 = K - k_2$ to express $\frac{dPS}{dk_2}$ in terms of K and k_2 only.

$$\begin{aligned}\tfrac{dPS}{dk_2} = {} & \tfrac{1}{9}\left(1-\tfrac{2}{K-k_2}+\tfrac{1}{k_2}\right)\left(\tfrac{1}{(K-k_2)^2}-\tfrac{1}{k_2^2}\right) - \tfrac{1}{3}\left(\tfrac{1}{k_2}-\tfrac{1}{K-k_2}\right)\left(\tfrac{1}{k_2^2}+\tfrac{2}{(K-k_2)^2}\right) \\ & -\tfrac{1}{3(K-k_2)^2}\left(1-\tfrac{2}{K-k_2}+\tfrac{1}{k_2}\right)+\tfrac{1}{3k_2^2}\left(1-\tfrac{2}{k_2}+\tfrac{1}{K-k_2}\right).\end{aligned}$$

Rearrange the RHS in the following way.

$$\frac{dPS}{dk_2} = \frac{2g(k_2)}{9k_2^3(K-k_2)^3},$$

where $g(k_2) \equiv 2(9+K)k_2^3 - 3K(9+K)k_2^2 + K^2(19+K)k_2 - 5K^3$. First, note that $sign\left\{\frac{dPS}{dk_2}\right\} = sign\{g(k_2)\}$. Second, $g(k_2)$ is a polynomial of third degree with three roots: $\frac{K}{2}$, $\widetilde{k}_2$ and $\widetilde{k}_2' \equiv \frac{K}{2}\left(1+\sqrt{\frac{K-11}{K+9}}\right)$. But $\frac{K-11}{K+9} \gtreqless 0$ if, and only if, $K \gtreqless 11$, since $K > 2$. Hence, the polynomial $g(k_2)$ has a unique root $(\frac{K}{2})$ if, and only if, $K \in (2, 11]$ and three roots ($\frac{K}{2}$, $\widetilde{k}_2$ and $\widetilde{k}_2'$) if, and only if, $K > 11$.

The remainder of the proof signs $\frac{dPS}{dk_2}$. Assume first that $K \in (2, 11]$. Then $g(k_2)$ has a unique root: $\frac{K}{2}$. Hence, $g(k_2) > 0$ or $g(k_2) < 0$ for all $k_2 < \frac{K}{2}$. But $g(0) = -5K^3 < 0$. Hence, $g(k_2) < 0$ for all $k_2 < \frac{K}{2}$ so that $\frac{dPS}{dk_2} < 0$ for all $k_2 \in \left[\underline{k}_2(K), \frac{K}{2}\right)$.

Next, assume that $K > 11$. Then $g(k_2)$ has three roots: $\frac{K}{2}$, $\widetilde{k}_2$ and $\widetilde{k}_2'$. Note that $\widetilde{k}_2' > \frac{K}{2} > \widetilde{k}_2$. Hence, to sign $g(k_2)$ when $k_2 < \frac{K}{2}$, we are left with two non-trivial cases.

Case 1: $k_2 \in \left(\widetilde{k}_2, \frac{K}{2}\right)$. Then $g(k_2) > 0$ or $g(k_2) < 0$ for all $k_2 \in \left(\widetilde{k}_2, \frac{K}{2}\right)$. But $g'\left(\frac{K}{2}\right) = \frac{K^2}{2}(11 - K) < 0$. By continuity, $g(k_2) > g\left(\frac{K}{2}\right)$ if k_2 is smaller than but sufficiently close to $\frac{K}{2}$. But $g\left(\frac{K}{2}\right) = 0$. Hence, $g(k_2) > 0$ for all $k_2 \in \left(\widetilde{k}_2, \frac{K}{2}\right)$ so that $\frac{dPS}{dk_2} > 0$ for all $k_2 \in \left(\widetilde{k}_2, \frac{K}{2}\right)$.

Case 2: $k_2 < \widetilde{k}_2$. Recall that $q_2 = 0$ if $k_2 = \underline{k}_2(K)$. Therefore, $\frac{dPS}{dk_2}_{|k_2=\underline{k}_2(K)} < 0$, since the only positive term on the RHS in (7), namely $-c_2'q_2$, then equals 0. Consequently, $g(\underline{k}_2(K)) < 0$, since $sign\{g(k_2)\} = sign\left\{\frac{dPS}{dk_2}\right\}$. As an immediate consequence, $\underline{k}_2(K) \notin \left(\widetilde{k}_2, \frac{K}{2}\right)$, since $g(k_2) > 0$ for all $k_2 \in \left(\widetilde{k}_2, \frac{K}{2}\right)$. In fact, $\underline{k}_2(K) < \widetilde{k}_2$, since $\underline{k}_2(K) < \frac{K}{2}$. Thus, we have found that $g(\underline{k}_2(K)) < 0$ and that $\underline{k}_2(K) < \widetilde{k}_2$. Since $g(k_2)$ has no root smaller than $\widetilde{k}_2$, it follows that $g(k_2) < 0$ for all $k_2 \in \left[\underline{k}_2(K), \widetilde{k}_2\right)$ so that $\frac{dPS}{dk_2} < 0$ for all $\left[\underline{k}_2(K), \widetilde{k}_2\right)$. QED.

Lemma 2 *Let* $\widehat{k}_2 \equiv \frac{K}{2}\left(1 - \sqrt{\frac{2K-13}{2K+9}}\right)$. $TS(k_2, K)$ *is decreasing in* k_2 *if (i)* $K \in (2, 13/2]$ *or (ii)* $K > 13/2$ *and* $k_2 \in \left[\underline{k}_2(K), \widehat{k}_2\right)$. $TS(k_2, K)$ *is increasing in* k_2 *if* $K > 11$ *and* $k_2 \in \left[\widetilde{k}_2, K/2\right]$.

Proof: Note first that $TS(k_2, K)$ is continuous in k_2, in particular at the point where $k_2 = \underline{k}_2(K)$.

Next, consider market structures such that $k_2 \in [0, \underline{k}_2(K))$. In this case, firm 1 is a monopolist and consequently $TS(k_2, K)$ decreases with k_2, since both consumers and the monopolist are worse off when the marginal cost of the monopolist increases.

Finally, consider the more complicated case when both firms produce positive quantities, that is when $k_2 \in [\underline{k}_2(K), K/2]$. Use equations (2), (5a) and (6) to eliminate q_i, $\frac{dq_1}{dk_2}$ and $\frac{dQ}{dk_2}$ in (8).

$$\begin{aligned}\frac{dTS}{dk_2} = & \tfrac{1}{3}(p - c_2)(c_1' - c_2') + \tfrac{1}{3}(c_2 - c_1)(c_2' + 2c_1') \\ & + \tfrac{1}{3}(1 - 2c_1 + c_2)c_1' - \tfrac{1}{3}(1 - 2c_2 + c_1)c_2'.\end{aligned}$$

Recall by (1) that $p - c_2 = -p'q_2$ and by (2) that $q_2 = \frac{1}{3}(1 - 2c_2 + c_1)$. Use these facts as well as the facts that $p' = -1$, $c_i = \frac{1}{k_i}$, $c_i' = -\frac{1}{k_i^2}$ and $k_1 = K - k_2$ to express $\frac{dTS}{dk_2}$ in terms of K and k_2 only.

$$\frac{dTS}{dk_2} = \frac{1}{9}\left(1-\frac{2}{k_2}+\frac{1}{K-k_2}\right)\left(\frac{1}{k_2^2}-\frac{1}{(K-k_2)^2}\right)-\frac{1}{3}\left(\frac{1}{k_2}-\frac{1}{K-k_2}\right)\left(\frac{1}{k_2^2}+\frac{2}{(K-k_2)^2}\right)$$
$$-\frac{1}{3(K-k_2)^2}\left(1-\frac{2}{K-k_2}+\frac{1}{k_2}\right)+\frac{1}{3k_2^2}\left(1-\frac{2}{k_2}+\frac{1}{K-k_2}\right).$$

Rearrange the RHS in the following way.

$$\frac{dTS}{dk_2} = \frac{h(k_2)}{9k_2^3(K-k_2)^3}, \tag{9}$$

where $h(k_2) \equiv 4(9+2K)k_2^3 - 6K(9+2K)k_2^2 + 4K^2(K+10)k_2 - 11K^3$. First, note that $sign\left\{\frac{dTS}{dk_2}\right\} = sign\{h(k_2)\}$. Second, $h(k_2)$ is a polynomial of third degree with three roots: $\frac{K}{2}$, $\widehat{k}_2$ and $\widehat{k}_2' \equiv \frac{K}{2}\left(1+\sqrt{\frac{2K-13}{2K+9}}\right)$. But $\frac{2K-13}{2K+9} \gtreqless 0$ if, and only if, $K \gtreqless \frac{13}{2}$, since $K > 2$. Hence, the polynomial $h(k_2)$ has a unique root $(\frac{K}{2})$, if, and only if, $K \in \left(2, \frac{13}{2}\right]$ and three roots ($\frac{K}{2}$, $\widehat{k}_2$ and $\widehat{k}_2'$) if, and only if, $K > \frac{13}{2}$.

The remainder of the proof signs $\frac{dTS}{dk_2}$. Assume first that $K \in \left(2, \frac{13}{2}\right]$. Then $h(k_2)$ has a unique root: $\frac{K}{2}$. Hence, $h(k_2) > 0$ or $h(k_2) < 0$ for all $k_2 < \frac{K}{2}$. But $h(0) = -11K^3 < 0$. Hence, $h(k_2) < 0$ for all $k_2 < \frac{K}{2}$ so that $\frac{dTS}{dk_2} < 0$ for all $k_2 \in \left[\underline{k}_2(K), \frac{K}{2}\right)$.

Next, assume that $K > \frac{13}{2}$. Then $h(k_2)$ has three roots: $\frac{K}{2}$, $\widehat{k}_2$ and $\widehat{k}_2'$. Note that $\widehat{k}_2' > \frac{K}{2} > \widehat{k}_2$. Hence, to sign $h(k_2)$ when $k_2 < \frac{K}{2}$, we are left with two non-trivial cases.

Case 1: $k_2 \in \left(\widehat{k}_2, \frac{K}{2}\right)$. Then $h(k_2) > 0$ or $h(k_2) < 0$ for all $k_2 \in \left(\widehat{k}_2, \frac{K}{2}\right)$. But $h'\left(\frac{K}{2}\right) = K^2(13-2K) < 0$. By continuity, $h(k_2) > h\left(\frac{K}{2}\right)$ for k_2 smaller than but sufficiently close to $\frac{K}{2}$. But $h\left(\frac{K}{2}\right) = 0$. Hence, $h(k_2) > 0$ for all $k_2 \in \left(\widehat{k}_2, \frac{K}{2}\right)$ so that $\frac{dTS}{dk_2} > 0$ for all $k_2 \in \left(\widehat{k}_2, \frac{K}{2}\right)$.

Case 2: $k_2 < \widehat{k}_2$. Recall that $q_2 = 0$ if $k_2 = \underline{k}_2(K)$. Therefore $\frac{dTS}{dk_2}_{|k_2=\underline{k}_2(K)} < 0$, since the only positive terms on the RHS in (8), namely $(p-c_2)\frac{dQ}{dk_2}$ and $-c_2'q_2$, then equals 0 (the first of these terms then equals 0, since $p - c_2 = -p'q_2$ by (1)). Consequently, $h(\underline{k}_2(K)) < 0$, since $sign\{h(k_2)\} = sign\left\{\frac{dTS}{dk_2}\right\}$. As an immediate consequence, $\underline{k}_2(K) \notin \left(\widehat{k}_2, \frac{K}{2}\right)$, since $h(k_2) > 0$ for all $k_2 \in \left(\widehat{k}_2, \frac{K}{2}\right)$. In fact, $\underline{k}_2(K) < \widehat{k}_2$, since $\underline{k}_2(K) < \frac{K}{2}$. Thus, we have found that $h(\underline{k}_2(K)) < 0$ and that $\underline{k}_2(K) < \widehat{k}_2$. Since $h(k_2)$ has no root smaller than $\widehat{k}_2$, it follows that $h(k_2) < 0$ for all $k_2 \in \left[\underline{k}_2(K), \widehat{k}_2\right)$ so that $\frac{dTS}{dk_2} < 0$ for all $\left[\underline{k}_2(K), \widehat{k}_2\right)$. QED.

Lemma 3 *$CS(k_2, K)$ is decreasing in k_2 if $k_2 \in [0, \underline{k}_2(K))$. $CS(k_2, K)$ is increasing in k_2 if $k_2 \in [\underline{k}_2(K), K/2]$.*

Proof: Note first that $CS(k_2, K)$ is continuous in k_2, in particular at the point where $k_2 = \underline{k}_2(K)$. Next, consider market structures such that $k_2 \in [0, \underline{k}_2(K))$. In this case, firm 1 is a monopolist and consequently $CS(k_2, K)$ decreases with k_2, since the consumers are worse off when the marginal cost of the monopolist increases. Finally, consider the case when both firms produce positive quantities that is when $k_2 \in [\underline{k}_2(K), K/2]$. By (6), total output then increases with k_2 and consequently $CS(k_2, K)$ increases with k_2. QED.

Lemma 4 *If $k_2 \geq \underline{k}_2(K)$, then*

$$\begin{aligned} CS(k_2, K) &= \tfrac{1}{18}\left(2 - \tfrac{1}{K-k_2} - \tfrac{1}{k_2}\right)^2, \\ PS(k_2, K) &= \tfrac{1}{9}\left(2 - \tfrac{2}{K-k_2} - \tfrac{2}{k_2} - \tfrac{8}{(K-k_2)k_2} + \tfrac{5}{(K-k_2)^2} + \tfrac{5}{k_2^2}\right), \\ TS(k_2, K) &= \tfrac{1}{18}\left(8 - \tfrac{8}{K-k_2} - \tfrac{8}{k_2} - \tfrac{14}{(K-k_2)k_2} + \tfrac{11}{(K-k_2)^2} + \tfrac{11}{k_2^2}\right). \end{aligned}$$

In particular, $CS\left(\frac{K}{2}, K\right) = PS\left(\frac{K}{2}, K\right) = \frac{2}{9}\left(1 - \frac{2}{K}\right)^2$ and $TS\left(\frac{K}{2}, K\right) = \frac{4}{9}\left(1 - \frac{2}{K}\right)^2$.

Proof: Insert the quantities given by (2) into the definitions of the different surpluses to get expressions in terms of c_1 and c_2. Replace c_i by $\frac{1}{k_i}$ and k_1 by $K - k_2$. Replace k_2 by $\frac{K}{2}$ to get the three last expressions. QED.

Lemma 5 *$CS(0, K) = \frac{1}{8}\left(1 - \frac{1}{K}\right)^2$, $PS(0, K) = \frac{1}{4}\left(1 - \frac{1}{K}\right)^2$ and $TS(0, K) = \frac{3}{8}\left(1 - \frac{1}{K}\right)^2$.*

Proof: Insert the quantity given by (3) into the definitions of the different surpluses to get expressions in terms of c_1. Replace c_1 by $\frac{1}{K}$. QED.

B Proofs of Propositions

All proofs below build upon the Lemmas in Appendix A.

B.1 Proof of Proposition 1

By Lemma 2, $TS(k_2, K)$ is U-shaped in k_2 if $K \geq K^t$. In Claim 1 below, I show that $k_2 = K/2$ maximizes $TS(k_2, K)$ if, and only if, $K \geq K^t$. Consequently, there exists a function $k_2^t(K) : [K^t, +\infty) \to \mathbb{R}^+$ implicitly defined as the solution in k_2 to $TS(k_2, K) = TS(0, K)$.

Before deriving the equilibrium market structure, I establish four Claims.

Claim 1: $k_2 = 0$ ($k_2 = K/2$) maximizes $TS(k_2, K)$ if, and only if, $K \leq K^t$ ($K \geq K^t$).

Proof: By Lemma 2, either $k_2 = 0$ or $k_2 = K/2$ maximizes $TS(k_2, K)$. By Lemmas 4 and 5, $TS\left(\frac{K}{2}, K\right) \gtreqless TS(0, K)$ if, and only if, $\frac{4}{9}\left(1 - \frac{2}{K}\right)^2 \gtreqless \frac{3}{8}\left(1 - \frac{1}{K}\right)^2 \Leftrightarrow 5K^2 - 74K + 101 \gtreqless 0$. Moreover, if $K > 2$, $5K^2 - 74K + 101 \gtreqless 0$ if, and only if, $K \gtreqless K^t \equiv \frac{37}{5} + \frac{12}{5}\sqrt{6} \simeq 13,28$.

Claim 2: $k_2^t(K) < K/2$ if $K > K^t$.

Proof: By Lemma 2, $TS(k_2, K)$ is U-shaped in k_2 if $K \geq K^t$. By Claim 1, $TS\left(\frac{K}{2}, K\right) > TS(0, K)$ if $K > K^t$. By definition, $TS(k_2^t(K), K) = TS(0, K)$. Consequently, $k_2^t(K) < K/2$ if $K > K^t$.

Claim 3: There exists a function $k_2^p(K) : [11, +\infty) \to \mathbb{R}^+$ implicitly defined as the solution in k_2 to $PS(k_2, K) = PS\left(\frac{K}{2}, K\right)$ such that $k_2^p(K) < k_2^t(K)$ if $K > K^t$.

Proof: The proof proceeds in two steps. Step 1 finds the analytical form of $k_2^p(K)$. Step 2 uses the definitions of $k_2^p(K)$ and $k_2^t(K)$ to complete the proof.

Step 1: By definition, $PS(k_2^p(K), K) = PS\left(\frac{K}{2}, K\right)$. Equate the expressions for $PS(k_2, K)$ and $PS\left(\frac{K}{2}, K\right)$ in Lemma 4 and rearrange to get $8(K-1)k_2^4 - 16K(K-1)k_2^3 + 10K^2(K+1)k_2^2 - 2K^3(K+9)k_2 + 5K^4 = 0$. Apart from its trivial solution ($k_2 = \frac{K}{2}$), this equation has two other solutions if, and only if, $K > 11$, namely $k_2 = \frac{K}{2}\left(1 \pm \sqrt{\frac{K-11}{K-1}}\right)$. Hence, $k_2^p(K)$ exists if, and only if, $K \geq 11$. Moreover, $k_2^p(K) = \frac{K}{2}\left(1 - \sqrt{\frac{K-11}{K-1}}\right)$, since $\frac{K}{2}\left(1 + \sqrt{\frac{K-11}{K-1}}\right) > \frac{K}{2}$.

Step 2: By Claim 2, $k_2^t(K) < K/2$ if $K > K^t$. By Lemma 2, $TS(k_2, K)$ is U-shaped in k_2 if $K \geq K^t$. Consequently, $\frac{dTS}{dk_2} > 0$ for all $k_2 \in \left[k_2^t(K), \frac{K}{2}\right)$ if $K > K^t$. In turn, if $K > K^t$, then $k_2^p(K) < k_2^t(K)$ if $TS(k_2^p(K), K) < TS(k_2^t(K), K)$. The proof ends by showing that this inequality is true. First, note that $TS\left(k_2^p(K), K\right) = PS\left(\frac{K}{2}, K\right) + CS\left(k_2^p(K), K\right)$, since, by definition, $PS\left(k_2^p(K), K\right) = PS\left(\frac{K}{2}, K\right)$. Second, $TS\left(k_2^t(K), K\right) = TS(0, K)$ by definition. Consequently, $TS\left(k_2^p(K), K\right) < TS\left(k_2^t(K), K\right)$ if, and only if, $CS\left(k_2^p(K), K\right) < TS(0, K) - PS\left(\frac{K}{2}, K\right)$. Use Lemmas 4 and 5 to rearrange the inequality in the following way:

$$4\left(2K - \frac{K}{K - k_2^p(K)} - \frac{K}{k_2^p(K)}\right)^2 < 11K^2 - 10K - 37.$$

Replace $k_2^p(K)$ by $\frac{K}{2}\left(1 - \sqrt{\frac{K-11}{K-1}}\right)$. The LHS then simplifies to $\frac{16}{25}(4K+1)^2$. Finally, rearrange the inequality to get $19K^2 + 122K - 941 > 0$. This inequality is true for all $K > K^t$.

Claim 4: $\underline{k}_2(K) < k_2^t(K)$ if $K > K^t$.

Proof: The proof of Lemma 2 establishes that $\frac{dTS}{dk_2}_{|k_2=\underline{k}_2(K)} < 0$. The proof of Claim 3 establishes that $\frac{dTS}{dk_2}_{|k_2=k_2^t(K)} > 0$. By Lemma 2, $TS(k_2, K)$ is U-shaped in k_2 if $K \geq K^t$. Consequently, $\underline{k}_2(K) < k_2^t(K)$ if $K > K^t$.

Proof of point 1 (i): Whenever $k_2 = 0$ maximizes $TS(k_2, K)$, the TS-policy induces $k_2 = 0$, since $k_2 = 0$ maximizes $PS(k_2, K)$. The proof follows by Claim 1.

Proof of point 1 (ii): Whenever $TS(0, K) \geq TS(k_2^0, K)$, the TS-policy allows $k_2 = 0$ and consequently induces $k_2 = 0$, since $k_2 = 0$ maximizes $PS(k_2, K)$. By Lemma 2, $TS(k_2, K)$ is U-shaped if $K > K^t$. By definition, $TS\left(k_2^t(K), K\right) = TS(0, K)$. By Claim 4, $\underline{k}_2(K) < k_2^t(K)$ if $K > K^t$. Consequently, $TS(0, K) \geq TS(k_2^0, K)$ if $k_2^0 \in [\underline{k}_2(K), k_2^t(K)]$.

Proof of point 2: By Lemma 2, $TS(k_2, K)$ is U-shaped if $K > K^t$. By definition, $TS\left(k_2^t(K), K\right) = TS(0, K)$. By Claim 2, $k_2^t(K) < K/2$ if $K > K^t$. Consequently, if $K > K^t$, the TS-policy only allows market structures such that $k_2 \in [k_2^0, K/2]$ if $k_2^0 \in (k_2^t(K), K/2]$. It remains to show that $k_2 = K/2$ maximizes $PS(k_2, K)$ if $k_2 \in \left[k_2^0, \frac{K}{2}\right]$ where $k_2^0 \in (k_2^t(K), K/2]$. By Lemma 1, $PS(k_2, K)$ is U-shaped if $K > K^t$. By definition, $PS\left(k_2^p(K), K\right) = PS(K/2, K)$. Consequently, $PS(K/2, K) > PS(k_2, K)$ for all $k_2 \in \left(k_2^p(K), \frac{K}{2}\right)$. Finally, note by Claim 3 that $k_2^0 \in \left(k_2^p(K), \frac{K}{2}\right)$ if $k_2^0 \in (k_2^t(K), K/2]$. QED.

B.2 Proof of Proposition 2

By Lemma 3, $CS(k_2, K)$ is U-shaped in k_2. In Claim 5 below, I show that $k_2 = K/2$ maximizes $CS(k_2, K)$ if, and only if, $K \geq 5$. Consequently, there exists a function $k_2^c(K) : [5, +\infty) \to \mathbb{R}^+$ implicitly defined as the solution in k_2 to $CS(k_2, K) = CS(0, K)$. Furthermore, by Claim 3 in the proof of Proposition 1, the function $k_2^p(K) : [11, +\infty) \to \mathbb{R}^+$ exists.

Before deriving the equilibrium market structure, I establish five Claims.

Claim 5: $k_2 = 0$ ($k_2 = K/2$) maximizes $CS(k_2, K)$ if, and only if, $K \leq 5$ ($K \geq 5$).

Proof: By Lemma 3, either $k_2 = 0$ or $k_2 = K/2$ maximizes $CS(k_2, K)$. By Lemmas 4 and 5, $CS\left(\frac{K}{2}, K\right) \gtreqless CS(0, K)$ if, and only if, $\frac{2}{9}\left(1 - \frac{2}{K}\right)^2 \gtreqless \frac{1}{8}\left(1 - \frac{1}{K}\right)^2 \Leftrightarrow 7K^2 - 46K + 55 \gtreqless 0$. Moreover, if $K > 2$, $7K^2 - 46K + 55 \gtreqless 0$ if, and only if, $K \gtreqless 5$.

Claim 6: $k_2^c(K) < K/2$ if $K > 5$.

Proof: By Lemma 3, $CS(k_2, K)$ is U-shaped in k_2. By Claim 5, $CS\left(\frac{K}{2}, K\right) > CS(0, K)$ if $K > 5$. By definition, $CS(k_2^c(K), K) = CS(0, K)$. Consequently, $k_2^c(K) < K/2$ if $K > 5$.

Claim 7: $\underline{k}_2(K) < k_2^c(K)$ if $K > 5$.

Proof: By Lemma 3, $\frac{dCS}{dk_2} < 0$ for all $k_2 \in [0, \underline{k}_2(K))$. By definition, $CS(0, K) = CS(k_2^c(K), K)$. Consequently, $\underline{k}_2(K) < k_2^c(K)$ if $K > 5$ if $K > 5$.

Claim 8: $k_2^p(K) < K/2$ if $K > 11$.

Proof: By Lemma 3, $PS(k_2, K)$ is U-shaped in k_2 if $K > 11$. By definition, $PS(k_2^p(K), K) = PS\left(\frac{K}{2}, K\right)$.Consequently, $k_2^p(K) < K/2$ if $K > 11$.

Claim 9: $k_2^c(K) < k_2^p(K)$ if $K > 11$.

Proof: By definition, $CS(k_2^c(K), K) = CS(0, K)$. By Lemmas 4 and 5, $CS(k_2, K) = CS(0, K) \Leftrightarrow \left(\frac{1}{3}\left(2 - \frac{1}{K - k_2} - \frac{1}{k_2}\right)\right)^2 = \left(\frac{1}{2}\left(1 - \frac{1}{K}\right)\right)^2$. The terms in the squared brackets are positive. Hence, $CS(k_2, K) = CS(0, K)$ if, and only if, $\frac{1}{2}\left(1 - \frac{1}{K}\right) = \frac{1}{3}\left(2 - \frac{1}{K - k_2} - \frac{1}{k_2}\right)$. This expression is equivalent to $(K + 3)k_2^2 - (3K + K^2)k_2 + 2K^2 = 0$. This equation has two solutions: $k_2 = \frac{K}{2}\left(1 \pm \sqrt{\frac{K-5}{K+3}}\right)$. Moreover, $k_2^c(K) = \frac{K}{2}\left(1 - \sqrt{\frac{K-5}{K+3}}\right)$, since $\frac{K}{2}\left(1 + \sqrt{\frac{K-5}{K+3}}\right) > \frac{K}{2}$. Recall from the proof of Proposition 1 that $k_2^p(K) = \frac{K}{2}\left(1 - \sqrt{\frac{K-11}{K-1}}\right)$. Moreover, $k_2^c(K) < k_2^p(K)$ if, and only if, $2K + 38 > 0$, which is true for all $K > 11$.

Proof of point 1 (i): Whenever $k_2 = 0$ maximizes $CS(k_2, K)$, the CS-policy induces $k_2 = 0$, since $k_2 = 0$ maximizes $PS(k_2, K)$. The proof follows by Claim 3.

Proof of point 1 (ii): Whenever $CS(0, K) \geq CS(k_2^0, K)$, the CS-policy allows $k_2 = 0$ and consequently induces $k_2 = 0$, since $k_2 = 0$ maximizes $PS(k_2, K)$. By

Lemma 3, $CS(k_2, K)$ is U-shaped if $K > 5$. By definition, $CS(k_2^c(K), K) = CS(0, K)$. By Claim 7, $\underline{k}_2(K) < k_2^c(K)$ if $K > 5$. Consequently, $CS(0, K) \geq CS(k_2^0, K)$ if $k_2^0 \in [\underline{k}_2(K), k_2^c(K)]$.
Proof of point 2 (i): By Lemma 3, $CS(k_2, K)$ is U-shaped if $K \in (5, 11]$. By definition, $CS(k_2^c(K), K) = CS(0, K)$. By Claim 6, $k_2^c(K) < K/2$ if $K > 5$. Consequently, if $K \in (5, 11]$, the CS-policy only allows market structures such that $k_2 \in [k_2^0, K/2]$ if $k_2^0 \in (k_2^c(K), K/2]$. It remains to show that $k_2 = k_2^0$ maximizes $PS(k_2, K)$ if $k_2 \in \left[k_2^0, \frac{K}{2}\right]$ and $K \in (5, 11]$. By Lemma 1, $PS(k_2^0, K) > PS(k_2, K)$ for all $k_2 > k_2^0$ if $K \in (5, 11]$.
Proof of point 2 (ii): By Claim 9, $k_2^c(K) < k_2^p(K)$ if $K > 11$. By Lemma 3, $CS(k_2, K)$ is U-shaped if $K > 11$. By definition, $CS(k_2^c(K), K) = CS(0, K)$. Consequently, if $K > 11$, the CS-policy only allows market structures such that $k_2 \geq k_2^0$ if $k_2^0 \in [k_2^c(K), k_2^p(K)]$. It remains to show that $k_2 = k_2^0$ maximizes $PS(k_2, K)$ if $K > 11$ and $k_2 \in \left[k_2^0, \frac{K}{2}\right]$ where $k_2^0 \in [k_2^c(K), k_2^p(K)]$. By Lemma 1, $PS(k_2, K)$ is U-shaped if $K > 11$. By definition, $PS(k_2^p(K), K) = PS\left(\frac{K}{2}, K\right)$. Consequently, $PS(k_2^0, K) > PS(k_2, K)$ for all $\left(k_2^0, \frac{K}{2}\right]$ if $k_2^0 < k_2^p(K)$.
Proof of point 3: By Lemma 3, $CS(k_2, K)$ is U-shaped if $K > 11$. By definition, $CS(k_2^c(K), K) = CS(0, K)$. By Claims 8 and 9, $k_2^c(K) < k_2^p(K) < K/2$ if $K > 11$. Consequently, the CS-policy only allows market structures such that $k_2 \geq k_2^0$ if $k_2^0 \in (k_2^p(K), K/2]$ and $K > 11$. It remains to show that $k_2 = K/2$ maximizes $PS(k_2, K)$ if $k_2 \in \left[k_2^0, \frac{K}{2}\right]$ where $k_2^0 \in (k_2^p(K), K/2]$. By Lemma 1, $PS(k_2, K)$ is U-shaped if $K > 11$. By definition, $PS(k_2^p(K), K) = PS(K/2, K)$. Consequently, $PS(K/2, K) > PS(k_2, K)$ for all $k_2 \in \left(k_2^p(K), \frac{K}{2}\right)$. QED.

B.3 Proof of Proposition 3

By Claim 1 in the proof of Proposition 1, the symmetric duopoly maximizes $TS(k_2, K)$ if $K > K^t$. By Proposition 1, the TS-policy induces the monopoly if $k_2^0 \in [\underline{k}_2(K), k_2^t(K)]$ and $K > K^t$. By Proposition 2, the CS-policy induces the symmetric duopoly if $k_2^0 \in (k_2^p(K), K/2]$ and $K > K^t$. By Claim 3 in the proof of Proposition 1, $k_2^p(K) < k_2^t(K)$ if $K > K^t$. QED.

B.4 Proof of Proposition 4

The proof starts by establishing three claims.
Claim 10: If α is sufficiently close to 1/2, $k_2 = 0$ ($k_2 = K/2$) maximizes

$WS(k_2,K)$ if, and only if, $K \leq K^w(\alpha)$ $(K \geq K^w(\alpha))$ where $K^{w\prime}(\alpha) < 0$ and $K^w(1/2) = K^t$.

Proof: Recall that $WS = \alpha CS + (1-\alpha) PS$. By continuity, it follows by Lemma 2 that either $k_2 = 0$ or $k_2 = K/2$ maximizes the weighted surplus if α is sufficiently close to $1/2$. Note by Lemmas 4 and 5 that $WS\left(\frac{K}{2},K\right) = \frac{2}{9}\left(1-\frac{2}{K}\right)^2$ and $WS(0,K) = \frac{1}{8}(2-\alpha)\left(1-\frac{2}{K}\right)^2$ so that $WS\left(\frac{K}{2},K\right) = WS(0,K)$ if, and only if, $(2-9\alpha)K^2 + (28+18\alpha)K - 46 - 9\alpha = 0$. This equation has two roots for all $\alpha \in [0,1]$, namely $K = \frac{9\alpha+14\pm12\sqrt{2-\alpha}}{9\alpha-2}$. But $\frac{9\alpha+14-12\sqrt{2-\alpha}}{9\alpha-2} < 2$ for all $\alpha \in [0,1]$ and $\frac{9\alpha+14+12\sqrt{2-\alpha}}{9\alpha-2} > 2$ if, and only if, $\alpha \in \left(\frac{2}{9},1\right]$. Hence, $WS\left(\frac{K}{2},K\right) = WS(0,K)$ has a unique (no) solution in K if, and only if, $\alpha \in \left(\frac{2}{9},1\right]$ $\left(\alpha \in \left[0,\frac{2}{9}\right]\right)$: $K^w(\alpha) \equiv \frac{9\alpha+14+12\sqrt{2-\alpha}}{9\alpha-2}$. Moreover, $WS\left(\frac{K}{2},K\right) \gtreqless WS(0,K)$ if, and only if, $K \gtreqless K^w(\alpha)$. Furthermore, note that $K^w(1/2) = K^t$ and that $K^{w\prime}(\alpha) < 0$.

Claim 11: If α is sufficiently close to $1/2$, the solution in k_2 to $WS(k_2,K) = WS(0,K)$ defines implicitly k_2 as a function of K and α if, and only if $K \geq K^w(\alpha)$. This function, denoted $k_2^w(K,\alpha)$, has the properties that $k_2^w(K^w(\alpha),\alpha) = K^w(\alpha)/2$, $k_2^w\left(K,\frac{1}{2}\right) = k_2^t(K)$ and $\frac{\partial k_2^w(K,\alpha)}{\partial\alpha} < 0$.

Proof: By continuity, it follows by Lemma 2 and by Claim 10 that if α is sufficiently close to $1/2$, then $WS(k_2,K) = WS(0,K)$ has a (unique) solution in k_2 if, and only if, $K \geq K^w(\alpha)$. By Claim 10, $k_2^w(K^w(\alpha),\alpha) = K^w(\alpha)/2$ and by definition, $k_2^w\left(K,\frac{1}{2}\right) = k_2^t(K)$. It remains to show that $\frac{\partial k_2^w(K,\alpha)}{\partial\alpha} < 0$ if α is sufficiently close to $1/2$. Differentiate $WS(k_2^w,K) = WS(0,K)$ with respect to k_2 and α. By the implicit function theorem,

$$\frac{\partial k_2^w(K,\alpha)}{\partial\alpha} = \frac{dk_2^w}{d\alpha} = \frac{CS(0,K) - CS(k_2^w,K) - (PS(0,K) - PS(k_2^w,K))}{\alpha\frac{dCS}{dk_2^w} + (1-\alpha)\frac{dPS}{dk_2^w}}.$$

By continuity, the denominator is positive if α is sufficiently close to $1/2$, since $\frac{dTS}{dk_2}_{|k_2=k_2^t(K)} > 0$. The term $PS(0,K) - PS(k_2^w,K)$ is positive, since $k_2 = 0$ maximizes $PS(k_2^w,K)$. Finally, note that $\frac{1-\alpha}{\alpha}(PS(k_2^w,K) - PS(0,K)) = CS(0,K) - CS(k_2^w,K)$, since $WS(k_2^w,K) = WS(0,K)$. Consequently, the term $CS(0,K) - CS(k_2^w,K)$ is negative. Hence, $\frac{\partial k_2^w(K,\alpha)}{\partial\alpha} < 0$.

Claim 12: Assume that the competition authority applies a WS-policy such that α is sufficiently close to $1/2$. The unique equilibrium market structure is the monopoly $[k_2 = 0]$ if, and only if, (i) $K \in [2, K^w(\alpha)]$ or (ii) $K > K^w(\alpha)$ and $k_2^0 \in [\underline{k}_2(K), k_2^w(K,\alpha)]$. The unique equilibrium market structure is the symmetric duopoly $[k_2 = K/2]$ if, and only if, $K > K^w(\alpha)$ and $k_2^0 \in (k_2^w(K,\alpha), K/2]$.

Proof: By Claim 11, $k_2^w\left(K,\frac{1}{2}\right) = k_2^t(K)$. By Claim 2 in the proof of Proposition

1, $k_2^t(K) > k_2^p(K)$ if $K > K^t$. If $K > K^w(\alpha)$, it follows by continuity that $k_2^w(K,\alpha) > k_2^p(K)$ if α is sufficiently close to 1/2. The proof of Claim 12 follows by using the same logic as in the proofs of points 1 (i), 1 (ii) and 2 of Proposition 1.

Having proved Claims 10 to 12, let us now turn to the proof of Proposition 4. Let $W(\alpha)$ denote the expected total surplus of applying a WS-policy parametrized by α, given that k_2^0 and K are distributed according to the density function f. The remainder of the proof derives an expression for $W'\left(\frac{1}{2}\right)$ and finds a sufficient condition for this expression to be strictly positive. Recall that $K > 2$ and $k_2^0 \in \left[\underline{k}_2(K), \frac{K}{2}\right]$. By Claim 12, if α is sufficiently close to $\frac{1}{2}$, we have:

$$\begin{aligned} W(\alpha) = & \int_{2}^{K^w(\alpha)} \int_{\underline{k}_2(K)}^{K/2} TS(0,K) f(k_2^0,K)\, dk_2^0 dK + \\ & \int_{K^w(\alpha)}^{\infty} \int_{\underline{k}_2(K)}^{k_2^w(K,\alpha)} TS(0,K) f(k_2^0,K)\, dk_2^0 dK + \\ & \int_{K^w(\alpha)}^{\infty} \int_{k_2^w(K,\alpha)}^{K/2} TS\left(\tfrac{K}{2},K\right) f(k_2^0,K)\, dk_2^0 dK. \end{aligned}$$

Let $\Delta TS(K) \equiv TS\left(\frac{K}{2},K\right) - TS(0,K)$ and note that $\Delta TS(K)$ is a function of K only. Hence, one may rearrange $W(\alpha)$ as follows:

$$\begin{aligned} & W(\alpha) = \int_{2}^{\infty} TS(0,K) \int_{\underline{k}_2(K)}^{K/2} f(k_2^0,K)\, dk_2^0 dK + A(\alpha), \\ & \text{where } A(\alpha) \equiv \int_{K^w(\alpha)}^{\infty} \Delta TS(K) \int_{k_2^w(K,\alpha)}^{K/2} f(k_2^0,K)\, dk_2^0 dK. \end{aligned}$$

Note that $W'(\alpha) = A'(\alpha)$. Define $F(k_2^0,K)$ such that $\frac{\partial F(k_2^0,K)}{\partial k_2^0} = f(k_2^0,K)$. Then, $\int_{k_2^w(K,\alpha)}^{K/2} f(k_2^0,K)\, dk_2^0 = F\left(\frac{K}{2},K\right) - F\left(k_2^w(K,\alpha),K\right)$. Assume that $\alpha \geq \frac{1}{2}$ so that $K^w(\alpha) \leq K^t$ (by Claim 10) and let $K^t < K^m$. Rearrange $A(\alpha)$ so that $A(\alpha) = B(\alpha) - C(\alpha) - D(\alpha)$, where

$$\begin{aligned} B(\alpha) &\equiv \int_{K^w(\alpha)}^{\infty} \Delta TS(K)\, F\left(\tfrac{K}{2},K\right) dK, \\ C(\alpha) &\equiv \int_{K^m}^{\infty} \Delta TS(K)\, F\left(k_2^w(K,\alpha),K\right) dK, \\ D(\alpha) &\equiv \int_{K^w(\alpha)}^{K^m} \Delta TS(K)\, F\left(k_2^w(K,\alpha),K\right) dK. \end{aligned}$$

Hence:

$$\begin{aligned}
B'(\alpha) &= -\Delta TS\left(K^{w}(\alpha)\right)F\left(\tfrac{K^{w}(\alpha)}{2},K^{w}(\alpha)\right)K^{w\prime}(\alpha),\\
C'(\alpha) &= \int_{K^{m}}^{\infty}\Delta TS(K)\,f\left(k_2^{w}(K,\alpha),K\right)\frac{\partial k_2^{w}(K,\alpha)}{\partial\alpha}dK,\\
D'(\alpha) &= \int_{K^{w}(\alpha)}^{K^{m}}\Delta TS(K)\,f\left(k_2^{w}(K,\alpha),K\right)\frac{\partial k_2^{w}(K,\alpha)}{\partial\alpha}dK\\
&\quad -\Delta TS\left(K^{w}(\alpha)\right)F\left(k_2^{w}\left(K^{w}(\alpha),\alpha\right),K^{w}(\alpha)\right)K^{w\prime}(\alpha).
\end{aligned}$$

By Claims 10 and 11, $K^{w}\left(\frac{1}{2}\right)=K^{t}$ and $k_2^{w}\left(K^{t},\frac{1}{2}\right)=\frac{K^{t}}{2}$. Hence:

$$\begin{aligned}
B'\left(\tfrac{1}{2}\right) &= -\Delta TS\left(K^{t}\right)F\left(\tfrac{K^{t}}{2},K^{t}\right)K^{w\prime}\left(\tfrac{1}{2}\right),\\
C'\left(\tfrac{1}{2}\right) &= \int_{K^{t}}^{\infty}\Delta TS(K)\,f\left(k_2^{w}\left(K,\tfrac{1}{2}\right),K\right)\frac{\partial k_2^{w}\left(K,\frac{1}{2}\right)}{\partial\alpha}dK,\\
D'\left(\tfrac{1}{2}\right) &= \int_{K^{t}}^{K^{m}}\Delta TS(K)\,f\left(k_2^{w}\left(K,\tfrac{1}{2}\right),K\right)\frac{\partial k_2^{w}\left(K,\frac{1}{2}\right)}{\partial\alpha}dK\\
&\quad -\Delta TS\left(K^{t}\right)F\left(\tfrac{K^{t}}{2},K^{t}\right)K^{w\prime}\left(\tfrac{1}{2}\right).
\end{aligned}$$

But $F\left(\frac{K^{t}}{2},K^{t}\right)$ and $K^{w\prime}\left(\frac{1}{2}\right)$ are finite and $\Delta TS(K)=0$, since $TS\left(\frac{K^{t}}{2},K^{t}\right)=TS\left(0,K^{t}\right)$. Hence, $B'\left(\frac{1}{2}\right)$ as well as the second term in $D'\left(\frac{1}{2}\right)$ equal 0. Moreover, $\frac{\partial k_2^{w}\left(K,\frac{1}{2}\right)}{\partial\alpha}<0$ by Claim 11, $\Delta TS(K)>0$ if $K>K^{t}$ and $f\left(k_2^{w}\left(K,\frac{1}{2}\right),K\right)>0$ for all $K>K^{t}$ if f has full support. Hence, $C'\left(\frac{1}{2}\right),D'\left(\frac{1}{2}\right)<0$ if f has full support. Consequently, $W'\left(\frac{1}{2}\right)>0$ if f has full support. QED.

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