ESSAYS ON MERGERS AND FINANCIAL MARKETS

Tobias Lindqvist

ESTABLISHED 1939

The Research Institute of Industrial Economics (IUI)

is an independent non-profit institution, founded in 1939 by the Federation of Swedish Industries and the Swedish Employers' Confederation. The research at IUI focuses on economic issues of a long-term structural character. Both empirical and theoretical aspects are considered, but with emphasis on applied economics. Currently the two main research areas at IUI are "Human Capital and Economic Growth" and "Industrial Organization and International Specialization".

Approximately 20 full time researchers are employed at IUI, all holding a doctorate in economics. IUI maintains many formal relations with leading universities and other research institutions around the world and visits by foreign scholars are frequent. IUI also offers doctoral students the opportunity to join the institute while working on their dissertations.

Address
IUI
Box 5501, SE-114 85 Stockholm, Sweden
Telephone +46 8 665 45 00
Telefax +46 8 665 45 99
E-mail info@iui.se
Internet www.iui.se

ESSAYS ON MERGERS AND FINANCIAL MARKETS

Tobias Lindqvist

IUI Dissertation Series No. 59 (1:2003)

Distribution by:
The Research Institute of Industrial Economics (IUI)
Box 5501
SE-114 85 Stockholm
Telephone +46 8 665 45 00
Telefax +46 8 665 45 99
E-mail info@iui.se

ISSN 1404-0700
ISBN 91-7204-699-6
Elanders Gotab, Stockholm 2003

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". This volume consists of four essays on mergers and financial markets. Tobias Lindqvist uses a broad perspective with theoretical, empirical and experimental (two) approaches in his analyses. Implications and consequences of partial ownership when firms merge are considered in the first three chapters. It is shown that initial partial ownership within the industry can motivate a merger that otherwise would not have occurred. The analysis also offers a way for the competition authorities to detect anti-competitive mergers. The last chapter concerns price bubbles in stock markets. The trade is taking place in an experimental double-auction asset market, and tests are made for how inexperienced traders affect prices in these markets.

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 59th dissertation completed at IUI since its foundation in 1939.

Financial support received from the Marianne and Marcus Wallenberg Foundation is gratefully acknowledged.

Stockholm, September 2003

Ulf Jakobsson
Director of IUI

Preface

Back in August 1993, nineteen years old and recently graduated from high school, I went to the US for one year of college studies. This was followed by four years of university studies in Sweden. At that time, after five long years of education at the university level, I had finally finished my academic education, I thought…

Today, I know that another five years were to come. Five years of struggling with the models and mathematical tools I thought I would never see again, five years of contemplating all your friends advancing, exploring and succeeding in the industry, five years of poverty and despise and five years of being a nobody. But of course, also five years of tremendous learning, inspiration, traveling, knowledge, friendship and flexible time constraints.

First of all, I am deeply indebt to my two supervisors Martin Dufwenberg and Johan Stennek at Stockholm University and IUI, respectively. I had the privilege of having two supervisors during my Ph.D. studies since I became affiliated with IUI after the second year but still belonged to the University program. They have taught me basically all I know about doing research. Both engaged in co-authorship with me, dealing with my naivety and ignorance, from which I benefited inestimably. Two professors being so similar when it comes to knowledge and carefulness, yet so different.

Johan, with whom I had daily contact, introduced me to the field of mergers and acquisitions. He had to start by with shaping a lost student from the basics, going through how to structure and approach a research problem. With deep discussions and analyses Johan twisted and turned all problems in all possible manners. Almost every question that can be asked has already been raised by Johan, something that feels invaluably safe when bringing the papers out in public.

Martin, who recently received a full professorship at University of Arizona, got me hooked onto experimental economics when he was excitingly teaching a class in this field. Eventually, we started an experimental research project and writing together with Martin was an experience in itself. I have never met someone committed to the work of writing with such excitement, enjoyment, engagement and passion as you Martin. Even in abstract economic research, I learned that writing is an art of its own.

The main part of my graduate studies has been carried out at IUI. I feel great gratitude for the opportunity of being affiliated with this research institute. Foremost, I would like to thank Ulf Jakobsson and Lars Persson for letting me be based at IUI and creating a stimulating research environment and always encouraging international influences and co-operations. Thanks also to Jörgen Nilsson for excellent data and computer support, Per Skedinger for all comments and all golf invitations, Jonas Björnestedt, Sven-Olof Fridolfsson and Anna Sjögren for all discussions over the fancy second floor group dinners at Östermalm restaurants, María Sáez-Martí and Thomas Tangerås for the international vibes at IUI, Roger Svensson and Lars Oxelheim for all the stock market chatting, Assar Lindbeck and Jörgen Weibull for being such inspiration sources when sharing and spreading their vast knowledge, all the tennis partners and all the assistants and the remaining part of IUI for creating a great environment. In all ways, IUI has meant almost everything in my Ph.D. studies.

I would also like to thank my class mates from the first two years of course work for an enjoyable time and the financial support received from the Marianne and Marcus Wallenberg Foundation.

Finally, I would like to thank my parents for their open minds and for always supporting me and what I do. To them, I dedicate this thesis.

Stockholm, August, 2003 Tobias Lindqvist

Contents

Introduction

At the end of the last millennium, we experienced a boom in merger and acquisition (M&A) deals in the world. The value of all M&As as a share of world GDP rose from 0.3 per cent in 1980 to 8 per cent in 1999 (World Investment Report, 2000). Market economies with removed trade barriers and efficient communication and transportation accelerated the internationalization and the necessary ensuing market restructuring. However, structural changes as M&As may be harmful to consumers and interventions by competition authorities are thus necessary.

In many cases, it is difficult to measure if and how much consumers will suffer from a certain merger between two firms. One way of measuring the effects on the consumer surplus is to look at rival firms. If rival firms gain from a merger in the industry, consumers can be concluded to lose and vice verse. Naturally, it is also difficult to measure whether rival firms gain from a merger, but there is one way of implicitly observing this. If one firm uses an acquisition strategy, where gains from rivals are necessary, this may be a signal of a harmful merger for consumers. Essay I formalizes this in a theoretical framework and Essay II empirically tests different hypotheses for the theoretical conclusions. In Essay III, an experiment is carried out testing whether profitable mergers do not occur in certain market constellations.

The last chapter, Essay IV, concerns price bubbles in stock markets. Bubble phenomena have many examples in history. Two famous ones are the Dutch "tulipmania" of the 1630s and, more recently, the development of the NASDAQ share index up until March 2000, and the subsequent dramatic loss of value in that market. People have always tried to understand and explain price bubbles but it is problematic in real markets since knowing the fundamental value of a certain asset is essential if a bubble is to be measured. In this essay, the trade is brought to a fictive stock market, i.e. an experimental double-

auction asset market, to overcome this problem and tests are made for how inexperienced traders affect prices in these markets.

Essay I: Mergers by Partial Acquisition

It has been shown in economic theory that there exists an important obstacle to anti-competitive mergers in oligopolies: being an outsider to an anti-competitive merger is often more profitable than participating, since outsiders benefit from a price increase, but need not reduce output themselves. This was first pointed out by Stigler (1950), is consistent with a simple Cournot or Bertrand model and referred to as the insiders' dilemma.

In the endogenous merger literature, Stigler's point is central. A pioneering work within this field by Kamien and Zang (1990) proves the existence of a no-merger equilibrium, despite a merger being profitable. This is due to the positive externality on the outsider firms not participating in the merger. In the light of this result, further work has discussed implications for competition policy and also how results from event studies can be reinterpreted (see e.g. Fridolfsson and Stennek, 2000b).

Models within industrial organization often treat firms as one indivisible unit. In contrast, the finance literature often divides a firm into many shares with corresponding stockholders but treats the takeover exogenously, only looking at the two merging firms or possibly many firms in a bidding competition for a target. In the finance literature it has long been argued that before the acquisition, it is profitable to buy a small share of the target firm.[1] This is referred to as a toehold. Firms with a toehold have an advantage in a bidding contest when the remaining firm will be sold out. A potential acquirer needs to

[1] See e.g. Bulow, Huang and Klemperer (1999) for a theoretical work and Bradley, Desai and Kim (1988) for an empirical study.

pay a premium for fewer shares or, if losing the bid, gain from selling out the toehold at a profit.

Some arguments against controlling mergers have been raised due to the insiders' dilemma. However, this paper suggests a theoretical solution to Stigler's point. The insiders' dilemma is likely to be less prominent when cross ownership exists since the merged firm holds shares in rival firms, i.e. outsider-toeholds, benefiting from the price increase following the merger. Hence, buying outsider-toeholds before an acquisition can solve this puzzle.

The purposes of this paper is to study under which circumstances outsider-toeholds increase incentives for mergers and under which circumstances a competition authority can use outsider-toeholds as a signal of anti-competitive mergers. In a broader view this paper tries to link the modeling of the finance and endogenous merger literature to explain merger strategies and market outcomes.

The analysis is split into firms with single owners and firms with multiple owners, i.e. firms listed in the stock market. In the single owner case there exist multiple monopoly equilibria, since the size of the outsider-toehold can vary independently of the buyer's profit. When firms have multiple owners it is only necessary to buy an outsider-toehold when the insiders' dilemma exists.

There is a policy implication of this result. The insiders' dilemma arises from the assumption of a positive externality on the outsider firm and acquiring an outsider-toehold is thus a signal of an anti-competitive merger. Furthermore, the theoretical results indicate that the target receives the large portion of the merger surplus, which is consistent with the empirical findings. In some countries (e.g. Sweden and France) stocks for one firm are divided into two different categories on the stock market; stocks with strong and weak voting power. It has been argued that this split of the stocks thwart takeovers since a small capital share may be enough for controlling the firm if the capital is invested in the strong

voting power stocks. This conclusion is contrary to the result in this paper. The only reason for buying an outsider-toehold is to extract profit from the corresponding firm and not to have voting power. In fact, the less voting power for a buyer, the larger an outsider-toehold can be without taking over the firm (acquiring it). Hence, weak voting power stocks mitigate acquisitions.

Finally, a word of caution. Theoretically, it has been proved that profitable mergers may not occur since outsider firms may gain more than merging firms. One solution to this theoretical problem is to write contingent contracts between all firms in the industry making a market concentration possible. However, this is not legal. Furthermore it may be questioned if the insiders' dilemma is also relevant in the real world. Nevertheless, this paper offers a legal way of solving this theoretical problem created in the merger literature.

Essay II: Acquisition Strategies: Empirical Evidence of Outsider-Toeholds

This is an empirical paper testing the theories formalized in Essay I. To simplify the model, only two periods are used; first the buyer purchases a small share of one firm, i.e. an outsider-toehold and second, the buyer makes an acquisition of another firm. Event-studies are used to estimate the gains of buyers, outsider firms and competitors in the two periods.

Cross ownership among firms is common and may have many reasons. However, this paper focuses on cross ownership, i.e. outsider-toeholds, within the own industry. Firms buy a share of a rival firm to extract positive externalities from a market concentration. In fact, there is a strong bias towards buying shares in rival firms, i.e. firms within the same industry. In the US, as much as 20 percent of all these investments can be referred to the own industry.

In general, firms holding shares in other firms are not an exceptional feature. The reasons for these cross ownerships may e.g. be investment strategies for diversifying risk or acquisition strategies such as the outsider-toehold theory in this paper or the toehold theory, where a share of the target firm is bought before an acquisition. The investment reason may be motivated, since information about the own industry is superior. In contrast, diversifying risk would imply investments in other industries. Acquisition strategies may thus be stronger reasons for explaining the vast investment results within the same industry.

The main purposes of this paper are to demonstrate the existence of outsider-toeholds, test if acquirers benefit from holding outsider-toeholds and estimate gains for merging parties with and without outsider-toeholds. Looking at US mergers and acquisitions in 1985 to 2000, event studies are used to estimate premiums from stock market reactions and regressions to search for possible variables explaining these premiums. The sample includes 18 buyers, 36 outsider-toehold firms, 97 competitors and 35 buyers without outsider-toeholds.

Two different stages in the acquisition strategy are examined in the event studies; the announcement of buying an outsider-toehold and the announcement of an acquisition. The results exhibit a positive cumulative average abnormal return, CAAR, for the outsider-toehold firm in the first stage. This result may partly be explained in the theory of Grossman and Hart (1980) and Bagnoli and Lipman (1988). They prove that holding a small share of a target firm, i.e. a toehold, before the acquisition of this firm is profitable. Hence, at the time when an outsider-toehold is purchased, the stock market may not be able to distinguish between this and a toehold. The outsider-toehold firm may thus be expected to become a target at a later stage, which may explain the increased CAAR.[2]

[2] Buying toeholds is not rare. In the sample of Bradley et al (1988), 34 percent of the buyers held a toehold in the target when an acquisition was announced. Jennings and Mazzeo (1993) and Jarrell and Poulsen

Further and more interestingly, CAARs are also significantly positive for outsider-toehold firms in the second stage, at the announcement of an acquisition implying a positive external gain for a buyer holding an outsider-toehold. Furthermore, this CAAR is negatively related to the time between outsider-toehold and acquisition announcements, but is not affected by the number of competitors and the size of the outsider-toehold. Hence, when buyers hold a share of another firm they mitigate later acquisitions, due to a positive externality on the rival firm. In fact, buyers also tend to invest outsider-toeholds in firms with a positive and, relative to its rivals, superior CAAR.

According to these result, buyers extract gains from buying an outsider-toehold before making an acquisition. If the choice of holding an outsider-toehold is exogenous, these buyers should experience a larger CAAR as compared to buyers not holding outsider-toeholds. But if the choice of buying an outsider-toehold is endogenous, we may not observe differences in CAARs. As an example, buyers may neither gain nor lose from the acquisition when holding outsider-toeholds, since this strategy is only used when mergers are difficult. In fact, the results show that CAARs are not significantly different from zero at the announcement of an acquisition for buyers with and without outsider-toeholds. This proposes an endogenous choice of whether to buy an outsider-toehold.

In general this paper has focused on clean but few observations and further studies on cross ownership are necessary to explore the implications of these phenomena.

Essay III: The Insiders' Dilemma: An Experiment on Merger Formation

Market power is one of the motives for mergers between competitors. Stigler (1950) points out two important obstacles to such mergers, however. First, even if an anti-

(1989) find toeholds in more than 50 percent of the acquisitions, the former also find most of them to be small (on average 3 percent). In Betton and Eckbo (2000), more than half the buyers held toeholds and the target premium was decreasing in the size of the toehold. Franks and Harris (1989) did not find any differences in target premiums with and without toeholds.

competitive merger increases aggregate industry profits, it may be unprofitable for the firms involved. The reason is that the increased price triggers new entry and induces existing competitors to increase their production, thereby reducing the merging firms' market share. Second, even if the merger is profitable, remaining outside an anti-competitive merger is usually more profitable than participating, since outsiders benefit from an increase in price, but need not reduce output themselves. Firms may thus not have an incentive to participate in anti-competitive mergers, even if these are profitable, a phenomenon that we call the insiders' dilemma.

These obstacles have important implications for competition policy. Anti-competitive mergers are difficult to form, while mergers creating sufficient efficiency gains are not. These considerations suggest that horizontal mergers are primarily formed for other reasons than market power, for instance cost synergies. Allowing competition authorities to control mergers may thwart or delay such gains. Despite its potential importance for merger policy, there does not exist any empirical evidence indicating the strength of the insiders' dilemma, partly due to the difficulty in collecting and interpreting data about mergers that did not occur. Running a laboratory experiment overcomes these difficulties and the purpose of this paper is to test the significance of the insiders' dilemma in such an experiment.[3]

Stigler's first idea has subsequently received partial support in the so-called exogenous merger literature. Horizontal mergers are unprofitable in a Cournot oligopoly with constant marginal costs, unless the merger involves a large proportion of all firms (Szidarovszky and Yakowitz, 1982; Salant, Switzer and Reynolds, 1983). However, if the marginal cost is increasing, or if firms compete in prices, mergers are typically profitable

[3] The previous experimental literature on mergers (Huck, Konrad, Müller and Normann, 2000) has focused on the effects of mergers and not on the actual merger decision.

(Perry and Porter, 1985; Deneckere and Davidson, 1985). The exogenous merger literature also provides some support for Stigler's second point, showing that outsiders in anti-competitive mergers gain more than insiders. A potential drawback of the exogenous merger literature, however, is that it analyzes mergers in isolation and builds on the presumption that mergers occur if, and only if, they are profitable. As a result, these externalities are considered to be irrelevant for the merger decision.

More recently, the endogenous merger literature, using non-cooperative models of the acquisition process, indicates that externalities actually are of importance. This literature has formalized the insiders' dilemma. Kamien and Zang (1990 and 1993) show that a profitable merger from ($n \geq 3$ firm) oligopoly to monopoly may not be an equilibrium. Since each target becomes a duopolist by unilaterally rejecting its bid, they will require too large a premium to make an acquisition profitable for a prospective buyer.[4]

The primary purpose of this paper is to test a particular mechanism, namely Kamien and Zang's formalization of the insiders' dilemma, but it also serves a broader aim. The paper is a first attempt to empirically discriminate between the old exogenous and the new endogenous merger theory. The former only focuses on how the merger changes the insiders' profits in comparison to the outset. The latter, which is an application of the theory of coalition formation, indicates that merger incentives are also affected by externalities.

The experiment consists of four treatments. Treatments Sim-T and Sim-M concern the simultaneous acquisition game and treatments Seq-T and Seq-M the sequential acquisition game. In all treatments, the monopoly profit, M=43.5, and the triopoly profit,

[4] Fridolfsson and Stennek (2000) formalize the existence of an insiders' dilemma also in the case of mergers between two firms. In their model of multi-person bargaining, mergers are delayed rather than completely blocked, however. Gomes (2000) shows that the insiders' dilemma may be overcome if firms use contingent

T=11.5, are held constant. Thus, the profitability of a merger to monopoly, that is M-3T>0, is held constant throughout the experiment. We use the duopoly profit D as a control variable. In the test treatments Sim-T and Seq-T, the duopoly profit is sufficiently high for endogenous merger theory to predict that no merger occurs, even though a merger to monopoly is profitable. In the control treatments Sim-M and Seq-M, the duopoly profit is sufficiently low for a merger to monopoly to occur according to endogenous merger theory. We planned to run ten trials of each treatment, where groups of three subjects (one buyer and two sellers) were randomly formed in each trial.

Our first two treatments concern simultaneous acquisitions. Although the profitability of a merger from triopoly to monopoly is the same in both the test treatment and the control treatment, the sellers' outside option is different since the duopoly profit is higher in the test treatment. There are significantly less mergers to monopoly when the duopoly profit (threat point) is high, as suggested by the insiders' dilemma hypothesis.

In the treatments concerning sequential acquisitions, monopoly outcomes were not observed either in the test treatment (with high duopoly profit) or in the control treatment (with low duopoly profit). The failure to monopolize the market in the control treatments indicates that the insiders' dilemma is not an appropriate explanation here.

Essay IV: Bubbles and Experience: An Experiment on Speculation

History contains many colorful examples where speculative trade in some commodity or financial asset generated a phase of rapidly increasing prices, followed by a sudden collapse (see e.g. Chancellor, 1999 or Kindleberger, 2001). One famous case cited by many economists (see Garber 1990, pp. 36-37 for references) is the Dutch

---

bids. Using a cooperative model of the acquisition process, Horn and Persson (2001) argue that firms may be able to overcome the insiders' dilemma.

"tulipmania" of the 1630s. The prices of certain tulip bulbs reached peaks in excess of several times a normal person's yearly income, and then suddenly lost almost all value in February 1637 (see Dash, 1999). In more recent times, we have the development of the NASDAQ share index up till March 2000, and the subsequent dramatic loss of value in that market.

It is hard to describe such developments in other than bubble-crash terms, where the term "bubble" is meant to suggest that prices exceed the traded asset's "fundamental" value. Commentary often invokes terms suggestive of folly or hysteria, like "mania", "panic", or (Alan Greenspan's) "irrational exuberance", as in the titles of Kindleberger's (1994) and Shiller's (2000) books on the topic. However, it is difficult to establish empirically the degree (or nature) of "the madness of the market", because it is hard to pin down what is the fundamental value of an asset. In fact, skeptics have called to question the bubble-crash description, arguing that what at first glance appears like a bubble-crash hype at closer scrutiny becomes explicable with reference to fundamentals.

A strong case against this view, or at least a case for the independent relevance of bubble-crash phenomena, can be articulated with reference to results obtained by experimental economists. In a classic paper, Smith, Suchanek and Williams (1988) report results from several laboratory financial markets. In the settings they consider it is pretty clear what the fundamental value of the assets traded should be. The experimenters control both the (stochastic) dividend process and the time span of the assets, and this information is made public so that valuations can be derived by backward induction. Yet, in the experiments, bubble-crash phenomena are frequent and strong. This suggests drawing an analogy: *bubbles and crashes may be relevant in financial markets since they are relevant in the lab*.

Several subsequent papers have corroborated the Smith *et al* findings. Lei, Noussair and Plott (2001, p. 831) summarize the evidence, and explain how the observed bubble-

crash phenomena seem robust with respect to a variety of manipulations. They do, however, point out that bubbles can be eliminated if the trading subjects are experienced: "The only manipulation that has been shown to reliably eliminate bubbles and crashes is prior participation in at least two sessions in the same type of assets market". This interesting finding does not, however, detract that much from the lab-reality analogy. In most experimental sessions that have been run either none or all subjects were experienced, but in non-laboratory financial markets there is likely to be a *mixture* of experienced and inexperienced traders. Although Smith *et al* (1988) and Peterson (1993) ran a few markets with a mixture of inexperienced and experienced subjects, the issue of heterogeneity of experience levels was not the main focus of these studies and was not systematically explored. It is thus natural to seek deeper insights regarding what happens in the lab if there is a mixture of experienced and inexperienced traders. Does it take many, or only a few, experienced traders for bubble-crash patterns to vanish? Believers in the analogy between laboratory and other financial markets may be curious. Such curiosity has inspired this study!

We examine laboratory financial markets with a mixture of experienced and inexperienced traders. We consider two treatments with different proportions of experienced traders. The setup is as follows: Six subjects trade in three successive market rounds and gain experience in an experimental double-auction asset market. In a fourth round, depending on the treatment, *two or four experienced subjects are replaced by inexperienced subjects.*

We consider these two treatments because if bubbles and crashes occur or vanish in an environment with a mixture of experienced and inexperienced traders, then it is interesting to learn something about how many experienced or inexperienced traders this takes. The issue is related to the literature on "noise-trading" in financial markets (see *e.g.* Palomino 1996 and Abreu and Brunnermeier 2002). How many irrational noise-traders

does a market need to work very differently from a market without noise trading? Our lab markets may be viewed as one particular test-bed for this issue, given that one adopts the view that the inexperienced subjects of the design may be regarded as noise-traders.

The results from the two treatments show that in either of these mixed-experience markets bubble-crash pricing patterns were not common. This does not mean that mixed markets function just as markets where all traders are experienced. The number of trades increased when inexperienced subjects entered the market, and even though the market prices stay pretty much in line with fundamentals there is a difference in the earnings of the different subject categories. The experienced subjects fare better than the inexperienced ones.

Our finding may induce some shift of the burden of proof between those who believe in "the madness of the market" and the "market fundamentalists". Our results provide arguments in favor of the latter rather than the former position.

References

Abreu, Dilip and Markus K. Brunnermeier (2002), "Bubbles and Crashes," forthcoming in *Econometrica.*

Bagnoli, Mark, and Barton L. Lipman (1988), "Successful Takeovers without Exclusion," *Review of Financial Studies*, 1(1), 89-110.

Betton, Sandra, and B. Espen Eckbo (2000), "Toeholds, Bid Jumps, and Expected Payoffs in Takeovers," *Review of Financial Studies*, 13(4), 841-82.

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

Bulow, Jeremy, Ming Huang and Paul Klemperer (1999), "Toeholds and Takeovers," *Journal of Political Economy*, 107(3), 427-54.

Chancellor, Edward (1999), *Devil Take the Hindmost: A History of Financial Speculation*, New York: Farrar, Straus & Giraux.

Dash, Mike (1999), *Tulipomania: The Story of the World's Most Coveted Flower and the Extraordinary Passions it Aroused*, Crown Publishers.

Deneckere, R., and C. Davidson (1985), "Incentives to Form Coalitions with Bertrand Competition," *Rand Journal of Economics*, Winter, 16(4), 473-86.

Franks, Julian R. and Robert S. Harris (1989) "Shareholder Wealth Effects of Corporate Takeovers: The U.K. Experience 1955-1985," *Journal of Financial Economics*, 23(2), 225-49.

Fridolfsson, S-O., and J. Stennek (2000), "Should We Control Mergers?," Discussion Paper 2705, Center for Economic Policy Research.

Fridolfsson, Sven-Olof and Johan Stennek (2000b), "Why Event Studies Do Not Detect Anti-Competitive Mergers," Working Paper 542, The Research Institute of Industrial Economics.

Garber, Peter (1990), "Famous First Bubbles," *Journal of Economic Perspectives*, 4(2), 35-54.

Grossman, Sanford J. and Oliver D. Hart (1980), "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation," *The Bell Journal of Economics*, 11, 42-64.

Horn, H., and L. Persson (2001), "Endogenous Mergers in Concentrated Markets," *International Journal of Industrial Organization*, September, 19(8), 1213-44.

Huck, S., K. A. Konrad, W. Müller, and H. T. Normann (2001), "Mergers and the Perception of Market Power: An Experimental Study," mimeo. Royal Holloway.

Jarrell, Gregg A. and Annette B. Poulsen (1989), "Stock Trading before the Announcement of Tender Offers: Insider Trading or Market Anticipation?," *Journal of Law, Economics and Organization*, 5(2), 225-48.

Jennings, Robert H. and Michael A. Mazzeo (1993), "Competing Bids, Target Management Resistance, and the Structure of Takeover Bids," *Review of Financial Studies*, 6(4), 883-909.

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

Kamien, M. I., and I. Zang (1993), "Monopolization by Sequential Acquisition," *The Journal of Law, Economics, & Organization*, October, 9(2), 205-29.

Kindleberger, Charles (2001), *Manias, Panics & Crashes: A History of Financial Crisis*, fourth edition, Wiley.

Lei, Vivian, Charles N. Noussair and Charles R. Plott (2001), "Nonspeculative Bubbles in Experimental Asset Markets: Lack of Common Knowledge of Rationality vs. Actual Irrationality, " *Econometrica*, 69(4), 831-59.

Palomino, Frédéric (1996), "Noise Trading in Small Markets", *Journal of Finance*, 51(4) 1537-50.

Perry, M. K., and R. H. Porter (1985), "Oligopoly and the Incentive for Horizontal Merger," *American Economic Review*, March, 75(1), 219-27.

Peterson, Steven (1993), "Forecasting Dynamics and Convergence to Market Fundamentals: Evidence from Experimental Asset Markets," *Journal of Economic Behavior and Organization*, 22, 269-84.

Salant, S. W., S. Switzer, and R. J. Reynolds (1983), "Losses from Horizontal Merger The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium," *Quarterly Journal of Economics*, May, 98(2), 185-99.

Shiller, Robert J. (2000), *Irrational Exuberance*, Princeton University Press.

Smith, Vernon L., Gerry L. Suchanek and Arlington W. Williams (1988), "Bubbles Crashes and Endogenous Expectations in Experimental Spot Asset Markets," *Econometrica*, 56(5), 1119-51.

Stigler, George J. (1950), "Monopoly and Oligopoly by Merger," *American Economic Review*, 40, 23-34.

Szidarovszky, F., and S. Yakowitz (1982), "Contributions to Cournot Oligopoly Theory," *Journal of Economic Theory*, 28, 51-70.

United Nations (2000), *World Investment Report 2000 - Cross-border Mergers and Acquisitions and Development*, New York and Geneva.

Essay I

Mergers by Partial Acquisition*

Tobias Lindqvist
IUI and Stockholm University

Abstract

This paper evaluates partial acquisition strategies. The model allows for buying a share of a firm before the actual acquisition takes place. Holding a share in a competing firm before the acquisition of another firm, outsider-toehold, eliminates the insiders' dilemma, i.e. profitable mergers do not occur. This strategy may thus be more profitable for a buyer than acquiring entire firms at once. Furthermore, the insiders' dilemma arises from the assumption of a positive externality on the outsider firm and acquiring an outsider-toehold is thus a signal of an anti-competitive merger.

Keywords: acquisition, antitrust, insiders' dilemma, mergers, toeholds

JEL classification: G34, L12, L13, L41

*Thanks to Sylvain Bourjade, Martin Dufwenberg, Matias Eklöf, Sven-Olof Fridolfsson and Johan Stennek and participants at EARIE'02 in Madrid, ENTER'03 in Tilburg, NORIO'03 in Copenhagen, EEA'03 in Stockholm and EARIE'03 in Helsinki and a seminar at Stockholm University for comments and Marianne och Marcus Wallenbergs Stiftelse for financial support. Email: TobiasL@iui.se, Postal address: The Research Institute of Industrial Economics (IUI), P.O. Box 5501, SE-114 85 Stockhom, Sweden.

1 Introduction

Some markets are characterized by cross ownership with firms holding share in rival firms. These markets have essential implications for merger pattern and merger policy.

It has been shown in economic theory that there exists an important obstacle to anti-competitive mergers in oligopolies: being an outsider to an anti-competitive merger is often more profitable than participating, since outsiders benefit from a price increase, but need not reduce output themselves. This was first pointed out by Stigler (1950) and is consistent with a simple Cournot or Bertrand model and referred to as the *insiders' dilemma*.

In the endogenous merger literature, Stigler's point is central. Kamien and Zang (1990), a pioneering work in this field, studied a non-cooperative endogenous merger model where firms simultaneously offer bids for the other firms and an asking price for the own firm, showing that the acquisition process may fail and the market structure will remain, despite monopoly being profitable. Consider, for example, a three firm industry where one firm tries to acquire the other two. By unilaterally rejecting the offer and becoming an outsider, a target will profit from a duopoly. Hence, in equilibrium both firms require a duopoly profit to accept the offer. A buyer may not afford this high bid and the triopoly remains. This result arises from the assumption of a positive externality on the outsider.[2]

This simultaneous merger game was later developed by Kamien and Zang (1993). They then introduced sequential acquisitions where a buyer in the first period only has to pay a triopoly profit for the first firm but in the

[1] For cooperative endogenous merger models see e.g. Horn and Persson (2001).

[2] Models studied by Szidarovszky and Yakowitz (1982), Salant, Switzer and Reynolds (1983), Perry and Porter (1985) and Deneckere and Davidson (1985) show that outsider profits may be positive or negative depending on the situation.

second period, it still needs to pay a duopoly profit. Although this mitigates the insiders' dilemma, it still is considerable. Lindqvist and Stennek (2001) also demonstrate the existence of this dilemma in a laboratory.

Models within industrial organization often treat firms as one indivisible unit. In contrast, the finance literature often divides a firm into many shares with corresponding stockholders but treats the takeover exogenously, only looking at the two merging firms or possibly many firms in a bidding competition for a target. In the finance literature, it has long been argued that before the acquisition, it is profitable to buy a small share of the target firm.[3] This is referred to as a *toehold*. Firms with a toehold have an advantage in a bidding contest when the remaining firm will be sold out. A potential acquirer needs to pay a premium for fewer shares or, if losing the bid, gains from selling out the toehold at a profit. Grossman and Hart (1980) show that this kind of takeovers may have some complications since the buyer must pay at least the worth of the remaining stocks if the bid succeeds, which may not be profitable for the buyer. This work was later developed by Bagnoli and Lipman (1988), arguing that the seller in the target firm must be pivotal for an equilibrium to exist.

Some arguments against controlling mergers have been raised due to the insiders' dilemma.[4] However, this paper suggests a theoretical solution to Stigler's point. The insiders' dilemma is likely to be less prominent when cross ownership exists since the merged firm holds shares in rival firms, i.e. *outsider-toeholds*, benefiting from the price increase following the merger.

[3]See e.g. Malueg and Schwartz (1991), Bulow, Huang and Klemperer (1999), Ravid and Spiegel (1999) and Högfeldt and Högholm (2000) for theoretical work and Bradley, Desai and Kim (1988), Franks and Harris (1989), Jarrell and Poulsen (1989), Stulz Walkling and Song (1990), Van Hulle, Vermaelen and Wouters (1991), Jennings and Mazzeo (1993) and Betton and Eckbo (2000) for empirical studies. See Lindqvist (2003) for an extended literature description and results.

[4]See e.g. Fridolfsson and Stennek (2000) for arguments against merger control.

Hence, buying outsider-toeholds before an acquisition can solve this puzzle.

There is also a policy implication from this result. The insiders' dilemma arises from the assumption of a positive externality on the outsider firm and acquiring an outsider-toehold is thus a signal of an anti-competitive merger. This result can also imply another interpretation of toeholds theoretically and empirically studied in the finance literature.

The purposes of this paper are to study under which circumstances outside toeholds increase incentives for mergers and under which circumstances a competition authority can use outsider-toeholds as a signal of anti-competitive mergers. In a broader view, this paper tries to link the modelling of the finance and endogenous merger literature to explain merger strategies and market outcomes.

The paper is structured as follows. Section 2 describes the model for two cases; single owner firms and firms listed on a stock market, i.e. firms with multiple owners, section 3 provides some empirical validity and policy implications and section 4 concludes.

2 Model

Initially the industry consists of three firms; one buyer (firm a) and two sellers (firms b and c). Due to cash limits, cross-border constraints etc., firm a may be the only valid acquirer and this market situation may thus arise. The model starts with an acquisition game before the firm(s) enter(s) the market. The acquisition game consists of three periods, k. In each period, the buyer can choose not to bid or offer one bid to a seller. If a buyer ceases to bid, the acquisition game closes and the firm(s) enter(s) the market. The buyer offers one bid, (p_i^k, b_i^k), by stating the target firm, $i \in (b, c)$, the size of

the bid (transaction price), $b_i \in \mathbb{R}$, and the claiming share, $p_i \in [0,1]$. This bid can only be rejected or accepted by the corresponding seller. A selling firm vanishes from the market if and only if the entire firm is acquired, i.e. $\sum_{k=1}^{3} p_i^k = 1$, where $p_i^k = 0$ for a rejecting bid or a closed period.

After the acquisition game the firm(s) enter(s) the market. The market can be treated as one period with three different profit levels for one firm. If the market consists of three firms, there is a triopoly where each firm profits $\pi(3)$, two firms each profit $\pi(2)$ in a duopoly and a monopoly firm profits $\pi(1)$, where $\pi'(n) < 0$, $\forall n \in (1,2,3)$.[5] The profit structure is based on the assumption that a single manager of each firm only acts in the interest of its own firm, trying to maximize the profit of that firm. This implies that the profit structure becomes symmetric, since the owner structure is not considered by the manager. However, the owner(s) take(s) all decisions about the owner structure, i.e. if buying a share or making a full acquisition of another firm.[6]

The solution concept is a subgame perfect Nash equilibrium. To find the market outcomes, the analysis is divided into two parts depending on the number of owners for each firm. We start with the single owner case.

[5] Another way of defining profits is to use the Cournot model, where each firm optimizes its profit given the current ownership structure. Furthermore, a discounting factor can be introduced allowing for infinite number of periods. In fact, these assumptions were considered in an earlier version of this paper but were, for simplicity, changed to a fixed profit since the main results still hold.

[6] Note that the profit structure is assumed to be symmetric even after a merger, i.e. two merging firms will have the same profit as the non merging firm. Another assumption is to assume that the two merging firms have a profit twice that of the non merging firm. In a real market the truth may be somewhere between these two extremes which implies that the insiders' dilemma is still prominent (but decreases when approaching the latter extreme case).

2.1 Single owners

In this section, the firm has one owner. Let us start with a benchmark strategy when the buyer monopolizes the market without partial acquisitions, i.e. $p_i^k = 1, \forall i$. Note that this requires the buyer to acquire one firm in each period 1 and 2, respectively.

1. a acquires b
2. a acquires c
3. No bid

In the last period, the buyer cannot offer any bid since there exist no other firms in the market. It must pay a duopoly profit in the second period. In the first period, seller b accepts a bid of a triopoly profit in equilibrium, if it is unprofitable for a buyer to form a duopoly, i.e. $\pi(2) < 2\pi(3)$, which is illustrated as to the left of line 2 in Figure 1.[7]

In the market the buyer profits from a monopoly, $\pi(1)$, after the two acquisitions. The value of the firm, v_a, must exceed the initial triopoly profit, $\pi(3)$, for the buyer to monopolize the market in equilibrium, i.e.

$$v_a = \pi(1) - \pi(2) - \pi(3) \geq \pi(3), \tag{1}$$

which is illustrated in Figure 1 at or above line 4. In addition, subgame perfection of the equilibrium requires that the buyer has no incentive to deviate from the current strategy. In particular, upon reaching the second period, the buyer should still have an incentive to buy the remaining firm i.e.

$$\pi(1) - \pi(2) \geq \pi(2), \tag{2}$$

[7] Assume that the buyer strategy is to bid for firm b also in the second period, if firm c rejects the first period offer. In equilibrium firm b does not increase its payoff if rejecting in the first period, and accepting already in period one is thus a Nash equilibrium.

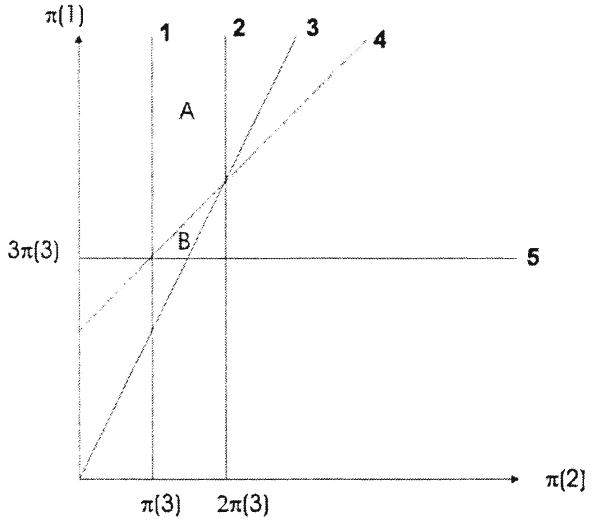


Figure 1: The Insiders' Dilemma

which holds at or above line 3 in Figure 1. Since a duopoly profit is larger than a triopoly profit (to the right of line 1), the monopoly equilibrium is illustrated as area A in the figure. However, the area of interest in Figure 1 is area B. Despite a monopolization being profitable, i.e. $\pi(1) > 3\pi(3)$ and $\pi(1) > 2\pi(2)$ represented as above line 5 and 3 respectively, the triopoly remains, due to the positive externality on the outsider, firm c. After the first acquisition, the market is concentrated and the rival (firm c) now becomes a duopolist with its corresponding profit. The buyer must now pay a duopoly profit to buy firm c since this is c's alternative cost. In area B, this is not profitable for a buyer. This mechanism is referred to as the insiders' dilemma and is thus illustrated as area B.

Now, let us see if this monopolization failure can be dissolved if a buyer uses partial acquisitions. Since there is a positive externality on the outsider, it may be more profitable for the buyer to purchase a share of the

future outsider before making a full acquisition of the other firm. This share, $p_i \in (0,1)$, is referred to as an outsider-toehold. Having an outsider-toehold implies a corresponding share of the profit in this firm. We start with the case where the buyer monopolizes the market according to the following:

1. a buys p_c of c
2. a acquires b
3. a acquires $(1-p_c)$ of c

Working backwards and starting with the third period in equilibrium, firm c requires a bid, b_c^3, of at least the share of the duopoly profit still held by c, which is

$$b_c^3 \geq (1-p_c)\pi(2). \tag{3}$$

Since the buyer offers the bids, and thus has all the bargaining power, this bid (and all other bids in this section) holds with equality. In the second period, firm b requires

$$b_b^2 \geq \pi(3), \tag{4}$$

since the market still consists of three firms. In the first period, firm c is considering the future bid in the third period in an equilibrium and the following must hold

$$b_c^1 + b_c^3 \geq \pi(3) \Leftrightarrow b_c^1 \geq \pi(3) - b_c^3. \tag{5}$$

For the first bid to firm c, b_c^1, and the bid to firm b, b_b^2, to be accepted, it must be unprofitable for the buyer to form a duopoly (to the left of line 2 in Figure 1). The value, $\widehat{v}_a$, of the buyer after a monopolization must exceed the initial triopoly profit in equilibrium, i.e.

$$\widehat{v}_a = \pi(1) - b_c^1 - b_b^2 - b_c^3 \geq \pi(3). \tag{6}$$

Substituting the bids from equations 3, 4 and 5 into equation 6 implies

$$\pi(1) \geq 3\pi(3). \tag{7}$$

This is illustrated in Figure 1 as at or above line 5. By subgame perfection, we also need the following to hold for a monopolization in equilibrium:

$$\pi(1) - (1 - p_c)\pi(2) \geq \pi(2) + p_c\pi(2) \Leftrightarrow \pi(1) \geq 2\pi(2) \tag{8}$$

$$\pi(1) - (1 - p_c)\pi(2) - \pi(3) \geq \pi(3) + p_c\pi(3). \tag{9}$$

Equation 8 ensures a buyer to have an incentive to acquire the rest of firm c in the third period. The buyer will profit from a monopoly but must pay for the rest of firm c, $(1 - p_c)\pi(2)$. The alternative is not to bid and receive a duopoly profit from the own firm and the holding share, p_c, in firm c. This inequality is illustrated as at or above line 3 in Figure 1. Equation 9 must hold for a monopolization to occur, since the buyer must have an incentive to continue after the first period. A monopoly profit minus the bids to firms b and c must exceed the triopoly profit from the own firm and the share of the triopoly profit from firm c. Equation 9 can be rewritten as

$$\pi(1) \geq (1 - p_c)\left[\pi(2) - \pi(3)\right] + 3\pi(3). \tag{10}$$

If the outsider-toehold, p_c, is zero the inequality holds at or above line 4 in Figure 1. This implies that a monopolization occurs in equilibrium in area A, which is exactly the same as in the benchmark case. However, when p_c is increasing, line 4 is rotating clockwise around the intersection with lines 5

and 1 down to line 5 as p_c approaches 1. The insiders' dilemma, area B, is thus decreasing in the outsider-toehold, p_c. Hence, the insiders' dilemma is mitigated for all $p_i > 0$ and disappearing as $p_i \to 1$.

Proposition 1 *Buying an outsider-toehold dissolves the insiders' dilemma and all profitable mergers occur in equilibrium when firms have single owners.*

See proof in the appendix.

In fact, buying an outsider-toehold mitigates acquisitions, even when a monopoly (or other market concentration limits) is not allowed or when there are more than three firms in the industry. However, the insiders' dilemma becomes larger as the number of firms in the market increases. It is only in oligopoly markets that the dilemma is essentially decreasing. However, acquisitions are always mitigated as the outsider-toehold increases.

Proposition 2 *The insiders' dilemma is decreasing in the outsider-toehold.*

See proof in the appendix.

Furthermore, comparing equations 1 and 6, we get

$$\widehat{v}_a = \pi(1) - 2\pi(3) > v_a = \pi(1) - \pi(2) - \pi(3), \tag{11}$$

since $\pi(2) > \pi(3)$.

Proposition 3 *The value of a buyer is independent of the size of the outsider-toehold and buying such a toehold is always more profitable than acquiring entire firms at once.*

In this analysis we have only allowed for three periods in the acquisition game. Relieving this assumption, other partial acquisition strategies can be an equilibrium, such as buying a small portion of firm c, a small portion of

firm b, and so on until a monopolization. Introducing e.g. a fixed cost (or a discounting factor) for the buyer in each acquisition period would eliminate these equilibria.

The analysis in this section builds on a firm with a single owner. An outsider accepts to sell out a share of the firm at a lower price than the actual value. The reason for doing this is the future profit the firm will receive when the rest of the firm is acquired in the last period. However, this is not possible when the firm has multiple owners. Who wants to sell out a share in the first period at this low price, not receiving anything in later periods? Now the buyer must pay the market price in the first period. This feature will be analyzed in the next section.

2.2 Multiple owners

A firm with multiple (atomistic) owners can be treated as a listed firm on a stock market. When using the same acquisition strategy as in the single owner case, the bid for the outsider-toehold in the first period is different in equilibrium. Some owners sell out their share in the firm in the first period and thus require at least a share of a triopoly profit, $\widehat{b}_c^1 = p_c\pi(3)$, for the outsider-toehold since they will not profit from the larger second bid, b_c^3 in equation 3, when the firm is sold in the last period. Hence, owners selling out their share in the first period will gain less than the remaining owners, since they receive a duopoly profit in the last period. In equilibrium, the first sellers must thus be pivotal, i.e. if rejecting, the monopolization collapses. Hence, the size of p_c will be unique in equilibrium and we must look at the buyer constraint to find its value.

The value of a buyer after a monopolization must exceed the triopoly

profit in an equilibrium. i.e.

$$\widehat{v}_a^v = \pi(1) - \widehat{b}_c^1 - b_b^2 - b_c^3 = \pi(1) - (1 - p_c)\left[\pi(2) - \pi(3)\right] - 2\pi(3) \geq \pi(3). \quad (12)$$

This constraint is oscillating with p_c between lines 4 and 5 in Figure 1, just like equations 9 and 10 in the single owner section. The necessary constraints for a subgame perfection are equal to the single owner case, since the acquisition process is the same after the first period.

However, to ensure acceptance when buying the outsider-toehold, sellers must be pivotal. Solving for p_c in equation 12 implies

$$p_c \geq [2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)].$$

This holds with equality if the right hand side is positive, i.e. in area B in figure 1 in a monopolization equilibrium. Otherwise, the size of p_c is as small as possible, i.e. one share, but theoretically it can be treated as zero, which is equal to not buying any outsider-toehold at all.

Proposition 4 *The insiders' dilemma is dissolved through an outsider-toehold in a unique monopolization equilibrium where firms have multiple owners. When the insiders' dilemma does not exist, it is not necessary to acquire an outsider-toehold in a monopolization equilibrium.*

See proof in the appendix.

The next section discusses the validity of the assumptions but also emphasizes a policy implication of the results.

2.3 Empirical validity and policy implications

Changes in consumer surplus are crucial for the competition authorities when deciding whether to block a merger. Unfortunately, the merging firms with

which the competition authorities deal with are often hard cases and the effects on consumers are difficult to measure. However, merging firms may hold shares in competing firms to extract profits from the positive externality a merger may have on other firms within the industry. This externality harms consumers and may be blocked. Although there may be other reasons for holding shares in other firms, outsider-toeholds may be used as signals of anti-competitive mergers and these cases need deeper investigations.

Policy implication *Holding outsider-toeholds is a signal of an anti-competitive merger.*

The empirical literature studying profits from merging firms reports a considerable positive reaction on the stock price of target firms when an acquisition is announced. Stock price reactions for the acquirer are more ambiguous and in general show no significant deviations from zero (see e.g. Bradley, 1988 and Betton Eckbo, 2000). Table 1 reports profits for firms after the strategies described in this paper have been carried out. Viewing sellers as one unity, we can see that the buyer in the single owner case takes the lion's share. Sellers will receive the initial triopoly profit. This appears not to be consistent with the existing literature but may have an explanation. Only firms listed on the stock market are included in empirical studies (so-called event studies) measuring the general effects of a merger and the lack of results from non-listed firms still holds the consistency question open.

When firms are listed on the stock market, i.e. have multiple owners, the theoretical results are more consistent with the literature when the insiders' dilemma exists, since the sellers (firm c) now receive the lion's share. This is also true when the dilemma is not prominent if the monopoly profit is not too large in relation to the duopoly profit.

Table 1: Buyer and Seller Profits			
		Merger Profitable	
		No Insider' Dilemma	Insiders' Dilemma
Single Owners	Buyer	$\pi(1) - 2\pi(3)$	$\pi(1) - 2\pi(3)$
	Seller b	$\pi(3)$	$\pi(3)$
	Seller c	$\pi(3)$	$\pi(3)$
Multiple Owners	Buyer	$\pi(1) - \pi(2) - \pi(3)$	$\pi(3)$
	Seller b	$\pi(3)$	$\pi(3)$
	Seller c	$\pi(2)$	$\pi(1) - 2\pi(3)$

Comparing equation 6 and 12, we see that $\widehat{v}_a > \widehat{v}_a^v$ for all $p_c \in (0,1)$ implying that the value of a buyer is smaller when firms have multiple owners. This is due to the higher price a buyer must pay for the outsider-toehold. In the single owner case, however, the buyer wants the outsider-toehold to be large for two reasons. First, the insiders' dilemma is decreasing in p_c and second, by equation 5, the bid for p_c may be negative when the outsider-toehold is too low. This implies that the outsider is giving money to the buyer when selling out the share p_c. Negative bids may not be accepted or not even allowed in reality. Hence, the buyer must raise the bid to at least zero if p_c is too low, which implies a lower profit for the buying firm.

So far, there are no restrictions for the buyer. Introducing a maximum size of the outsider-toehold may restrain the concentration rate. By definition, the outsider-toehold is just a share of another firm. If this share is too large, an acquisition takes place and the target firm disappears from the market. In reality, the maximum share an owner can hold in a firm without acquiring it depends on the ownership structure in the rest of the firm.[8] The only reason for the buyer to hold a large share in the outsider is to gain

[8] According to European Commission IV/M.025 - Arjomari/Wiggins Teape of February 10, 1990, an acquisition takes place if a majority of the voting rights are held. A minority

from its profit, and not to have voting power. If the voting power becomes too strong, an acquisition takes place, which is not the intention. In fact, in countries where different shares (A- and B-shares) have different voting power[9], concentrations of markets are facilitated according to the outsider-toehold theory. A buyer can receive a majority of the profit in the outsider, i.e. $p_c > 0.5$, by holding a large part of the B-shares (weak voting power) but still being a minority voter (if no or few A-shares are held).

Conjecture 5 *Shares with different voting power mitigate acquisitions.*

In the acquisition game of the model, only one firm can make acquisitions. To give you a flavour of what will happen when this assumption is relieved, we can consider the following. Assume that firm a holds, exogenously, an outsider-toehold, p, in firm c. Firms are listed on the stock market and have multiple atomistic stockholders, only one merger is allowed and agents in the stockmarket do not expect a merger. Four cases are possible; no merger, mergers a-b, a-c or c-b. If no merger occurs firms a, b and c profit $(1+p)\pi(3)$, $\pi(3)$ and $(1-p)\pi(3)$ respectively. If one merger occurs, a-b generates a combined profit of $(1+p)\pi(2)$, a-c of $\pi(2)$, and b-c of $(1-0.5p)\pi(2)$. The split of p in the last case is due to the assumption that firms b and c are of equal size and firm a's ownership in c, as a percentage, is only half of the initial size in the new firm, b-c.

The a-b merger surplus is $(1+p)\pi(2) - (1+p)\pi(3) - \pi(3)$ and hence positive iff $p > (2\pi(3) - \pi(2))/(\pi(2) - \pi(3))$. In fact, this is the only merger that may be profitable since a-c creates a surplus of $\pi(2) - 2\pi(3)$, which is

of the voting rights may also be treated as an acquisition if these votes obtain a majority at the shareholders' meeting, due to the remaining votes being spread out among many small shareholders. In the US, the so-called supermajority is applicable in many antitakeover amendments, stating that a change in control requires shareholder approval by at least a two-third vote and sometimes as much as 90 percent of the voting power.

[9]Such as in e.g. France and Sweden.

negative since merger to duopoly is unprofitable and the b-c surplus is always negative.

Now, ignore all assumptions from Figure 1 and simply assume that one merger takes place (without expectation from the stockmarket). The relative change in the combined stockvalue from the a-b merger is thus $(1+p)\pi(2)/(\pi(3)+(1+p)\pi(3)) = \frac{1+p}{2+p}\frac{\pi(2)}{\pi(3)}$. The two other mergers both result in a smaller relative change, i.e. $\frac{1}{2}\frac{\pi(2)}{\pi(3)}$ respectively. Hence, in this perspective, it can be argued that allowing all firms to merge would not change the market outcome, i.e. firms a and b would still merge. Note, however, that although a merger and an acquisition can be treated equally, this analysis does not specify an equilibrium bidding price, as in sections 2.1 and 2.2.

Conjecture 6 *Merging firms with an outsider-toehold generate a larger relative surplus than merging firms without outsider-toeholds.*

3 Conclusions

It has been shown in economic theory that there exists an important obstacle to anti-competitive mergers in oligopolies: being an outsider to an anti-competitive merger is often more profitable than participating, since outsiders benefit from a price increase, but need not reduce their own output. This implies that unprofitable mergers may not occur, i.e. the insiders' dilemma. However, this paper demonstrates that this theoretical puzzle can be solved. Holding a share in a competing firm, an *outsider-toehold*, dissolves the dilemma and all profitable mergers occur in equilibrium.

The analysis is split into firms with single owners and firms with multiple owners, i.e. firms listed in the stock market. In the single owner case there exist multiple monopoly equilibria, since the size of the outsider-toehold can

vary independently of the buyer's profit. When firms have multiple owners it is only necessary to buy an outsider-toehold when the insiders' dilemma exists.

There is a *policy implication* of this result. The insiders' dilemma arises from the assumption of a positive externality on the outsider firm and acquiring an outsider-toehold is thus a signal of an anti-competitive merger. Furthermore, the theoretical results indicate that the target receives the large portion of the merger surplus, which is consistent with the empirical findings. In some countries stocks for one firm are divided into two different categories on the stock market; stocks with strong and weak voting power. It has been argued that this split of the stocks thwart takeovers since a small capital share may be enough for controlling the firm if the capital is invested in the strong voting power stocks. This conclusion is contrary to the result in this paper. The only reason for buying an outsider-toehold is to extract profit from the corresponding firm and not to have voting power. In fact, the less voting power for a buyer, the larger an outsider-toehold can be without taking over the firm (acquiring it). Hence, weak voting power stocks mitigate acquisitions.

Finally a word of caution. Theoretically, it has been proved that profitable mergers may not occur since outsider firms may gain more than merging firms. One solution to this theoretical problem is to write contingent contracts between all firms in the industry making a market concentration possible. However, this is not legal. Furthermore it may be questioned if the insiders' dilemma is also relevant in the real world. Nevertheless, this paper offers a legal way of solving this theoretical problem created in the merger literature.

References

[1] Bagnoli, Mark, and Barton L. Lipman (1988), "Successful Takeovers without Exclusion," *Review of Financial Studies*, 1(1), 89-110.

[2] Betton, Sandra, and B. Espen Eckbo (2000), "Toeholds, Bid Jumps, and Expected Payoffs in Takeovers," *Review of Financial Studies*, 13(4), 841-82.

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

[4] Bulow, Jeremy, Ming Huang and Paul Klemperer (1999), "Toeholds and Takeovers," *Journal of Political Economy*, 107(3), 427-54.

[5] Deneckere, Raymond, and Carl Davidson (1985), "Incentives to Form Coalitions with Bertrand Competition," *Rand Journal of Economics*, 16(4), 473-86.

[6] European Commission (1990), IV/M.025 - Arjomari/Wiggins Teape, February 10.

[7] Franks, Julian R. and Robert S. Harris (1989) "Shareholder Wealth Effects of Corporate Takeovers: The U.K. Experience 1955-1985," *Journal of Financial Economics*, 23(2), 225-49.

[8] Fridolfsson, Sven-Olof and Johan Stennek (2000), "Should Mergers be Controlled?," Working Paper 541, The Research Institute of Industrial Economics.

[9] Grossman, Sanford J. and Oliver D. Hart (1980), "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation," *The Bell Journal of Economics*, 11, 42-64.

[10] Högfeldt, Peter and Kenneth Högholm (2000), "A Law and Finance Theory of Strategic Blocking and Preemptive Bidding in Takeovers," *Journal of Corporate Finance: Contracting, Governance and Organization*, 6(4), 403-25.

[11] Horn, Henrik, and Lars Persson (2001), "Endogenous Mergers in Concentrated Markets," *International Journal of Industrial Organization*, September, 19(8), 1213-44.

[12] Jarrell, Gregg A. and Annette B. Poulsen (1989), "Stock Trading before the Announcement of Tender Offers: Insider Trading or Market Anticipation?," *Journal of Law, Economics and Organization*, 5(2), 225-48.

[13] Jennings, Robert H. and Michael A. Mazzeo (1993), "Competing Bids, Target Management Resistance, and the Structure of Takeover Bids," *Review of Financial Studies*, 6(4), 883-909.

[14] Kamien, Morton I. and Israel Zang (1990), "The Limits of Monopolization Through Acquisition," *Quarterly Journal of Economics*, May, 105(2), 465-99.

[15] Kamien, Morton I. and Israel Zang (1993), "Monopolization by Sequential Acquisition," *The Journal of Law, Economics, & Organization*, October, 9(2), 205-29.

[16] Lindqvist, Tobias (2003) "Acquisition Strategies: Empirical Evidence of Outsider-Toeholds," Stockholm University.

[17] Lindqvist, Tobias and Johan Stennek (2001), "The Insiders' Dilemma: An Experiment on Merger Formation," The Research Institute of Industrial Economics, Working Paper No. 563.

[18] Malueg, David A. and Marius Schwartz (1991), "Preemptive Investment, Toehold Entry, and the Mimicking principle," *RAND Journal of Economics*, 22(1), 1-13.

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

[20] Ravid, Abraham S. and Matthew Spiegel (1999), "Toehold Strategies, Takeover Laws and Rival Bidders," *Journal of Banking and Finance*, 23(8), 1219-42.

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

[22] Stigler, George J. (1950), "Monopoly and Oligopoly by Merger," *American Economic Review*, 40, 23-34.

[23] Stulz, René M., Ralph A. Walkling and Moon H. Song (1990), "The Distribution of Target Ownership and the Division of Gains in Successful Takeovers," *Journal of Finance*, 45(3), 817-33.

[24] Szidarovszky, Ferenc and Sidney J. Yakowitz (1982), "Contributions to Cournot Oligopoly Theory," *Journal of Economic Theory*, 28, 51-70.

[25] Van Hulle, Cynthia, Theo Vermaelen and Paul de Wouters (1991), "Regulation, Taxes and the Market for Corporate Control in Belgium," *Journal of Banking and Finance*, 15(6), 1143-70.

A Proofs

A.1 Proof of Proposition 1

Consider three periods where firm a in period 1 buys p_c of firm c, in period 2 acquires firm b and in period 3 acquires $(1 - p_c)$ of firm c. Firm a offers $(p_c^1, \pi(3) - (1 - p_c^1)\pi(2))$, $(1, \pi(3))$ and $((1 - p_c^1), (1 - p_c^1)\pi(2))$ respectively, in the three periods and sellers respond by *accept*, *accept* and *accept*. By backward induction, firm c profits $(1 - p_c^1)\pi(2)$ in period 3 by rejecting, which is not larger than accepting. In period 2, firm b profits $\pi(3)$ by rejecting, which is not larger than accepting since merger to duopoly is unprofitable. Firm c profits $\pi(3)$ by rejecting in period 1, since merger to duopoly is unprofitable and responses are irrevocable. This profit is not larger than the profit from accepting, i.e. the sum of bids from periods 1 and 3. Hence, conditional on the proposed bids, the responses from sellers constitute a subgame perfect Nash equilibrium.

In period 3, firm a offers the bid if it results in at least as high a net profit as that received by not bidding, i.e.

$$\pi(1) - (1 - p_c^1)\pi(2) \geq \pi(2) + p_c^1\pi(2) \Leftrightarrow \pi(1) \geq 2\pi(2). \tag{13}$$

Bidding according to the strategy must result in a higher net profit than not bidding in period 2, i.e.

$$\pi(1) - (1 - p_c^1)\pi(2) - \pi(3) \geq \pi(3) + p_c^1\pi(3). \tag{14}$$

Another strategy is to acquire $(1 - p_c)$ of firm c in period 2 and acquire firm b in period 3, paying $(1 - p_c)\pi(3)$ and $\pi(2)$ respectively. This cannot be profitable for firm a since these payments can never be smaller than the payments in the prevailing strategy. In the first period, firm a's strategy must be more profitable than not bidding, i.e.

$$\pi(1) - (1 - p_c^1)\pi(2) - \pi(3) - (\pi(3) - (1 - p_c^1)\pi(2)) \geq \pi(3). \qquad (15)$$

$$\Longleftrightarrow \pi(1) \geq 3\pi(3).$$

A higher bid, in all respective periods, is giving money away and a lower bid is not accepted by the seller. If $\pi(1) > 2\pi(2)$ and $\pi(1) > 3\pi(3)$, $\exists$ a $p_c \in (0, 1)$ where inequality 14 is fulfilled. Consequently there exist an infinite number of equilibria. QED.

A.2 Proof of Proposition 2

Only inequality 14 is dependent on p_c^1 and rewrites

$$\pi(p_c^1) = \pi(1) - (1 - p_c^1)\left[\pi(2) - \pi(3)\right] + 3\pi(3) \geq 0$$

implying

$$\frac{d\pi(p_c^1)}{dp_c^1} = \pi(2) - \pi(3) > 0.$$

QED.

A.3 Proof of Proposition 4

Consider the first period bid $([2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)]$, $[[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)]]\pi(3))$ if $[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)] > 0$ and

$(1; \pi(3))$ otherwise, assuming everything else equal as in proposition 1.

If $[2\pi(3)+\pi(2)-\pi(1)]/[\pi(2)-\pi(3)] > 0$, rejecting implies $[[2\pi(3)+\pi(2)-\pi(1)]/[\pi(2)-\pi(3)]]\pi(3)$ since merger to duopoly is not profitable, which is not larger than accepting. The buyer bids iff

$$\pi(1) - (1 - [[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)]])\pi(2) - \pi(3)$$

$$-[[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)]]\pi(3) \geq \pi(3)$$

$$\Longleftrightarrow \pi(3) \geq \pi(3).$$

A higher bid or a lower share, p_c^1, is hence unprofitable and a lower bid is not accepted by sellers. A higher share, p_c^1, will not ensure acceptance from all sellers in equilibrium.

If $[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)] \leq 0$, rejecting implies $\pi(3)$ since merger to duopoly is not profitable, which is not larger than accepting. The buyer bids iff

$$\pi(1) - \pi(2) - \pi(3) \geq \pi(3)$$

which holds since $[2\pi(3) + \pi(2) - \pi(1)]/[\pi(2) - \pi(3)] \leq 0 \Longleftrightarrow \pi(1) \geq 2\pi(3) + \pi(2)$. A higher bid means giving money away and a lower bid is not accepted. Consequently, it is only necessary to acquire an outsider-toehold when the insiders' dilemma exists, i.e. $[2\pi(3)+\pi(2)-\pi(1)]/[\pi(2)-\pi(3)] > 0$, assuming the merger to be profitable. QED

Essay II

Acquisition Strategies: Empirical Evidence of Outsider-Toeholds*

Tobias Lindqvist

IUI and Stockholm University

Abstract: Theoretically, cross ownership may mitigate mergers, i.e. market concentrations. Holding a share in a competing firm before the acquisition of another firm, outsider-toehold, is more profitable in some market constellations, due to the positive externality on the outsider (competing) firm when a merger occurs. The purposes of this paper are to empirically observe when US firms buy outsider-toeholds and through event-studies estimate the gains of buyers, outsider firms and competitors when firms holding outsider-toeholds merge.

Keywords: acquisition, antitrust, insiders' dilemma, mergers, toeholds

JEL code: G34, L12, L13, L41

* Thanks to Matias Eklöf and Johan Stennek and participants at NORIO'05 in Copenhagen and a seminar at Stockholm University for comments and Marianne och Marcus Wallenbergs Stiftelse for financial support. Email: TobiasL@iui.se, Postal address: The Research Institute of Industrial Economics (IUI), P.O. Box 5501, SE-114 85 Stockholm.

1. INTRODUCTION

Back in 1985, on September 3, the firm Petrie Stores bought a 25-percent share in Paul Harris Stores, a competitor in women's clothing in the US. On May 13 in the following year, Petrie Stores publicly announced a bid for a takeover of Lerner Stores, another firm in the industry. This announcement caused a 30 percent (abnormal) increase in the stock price of Paul Harris Stores, a firm not directly involved in the Petrie Stores – Lerner Stores deal. Why did the value of Paul Harris Stores increase? It may be due to a market concentration, increasing the producer surplus or increased expectations of becoming a target in a future Petrie Stores acquisition. Nevertheless, the value of the $80 million firm Paul Harris Stores increased by $24 million (30 percent) from the acquisition announcement and a quarter of that increase, $6 million, benefited Petrie Stores. The 25 percent ownership may thus have been bought for strategic reasons in mitigating the spring acquisition of Lerner Stores, an acquisition that would otherwise not have been motivated.

In the economics literature, there exists an important obstacle to anti-competitive mergers, demonstrating that competing firms outside the merger may benefit more than the buyer and the target firm, since they gain from an increase in price but need not reduce their own output. Stigler (1950) first spelled this out, mentioning a potential coordination problem for firms since it is preferable to stay outside the merger and wait for other firms within the industry to merge. More recently, in a simultaneous acquisition game, Kamien and Zang (1993) prove the existence of a no-merger equilibrium even though a merger is profitable, i.e. the total producer surplus increases when a merger occurs. Further work by Fridolfsson and Stennek (2000a) and Lindqvist and Stennek (2001) also supports a no-merger equilibrium, which is consistent with simple Bertrand and Cournot models. This puzzle is referred to as *the insiders' dilemma.*

As the first paragraph may hint, there can be a solution to this puzzle. Lindqvist (2003) proves that for some specifications, the insiders' dilemma can be eliminated and all profitable mergers occur in equilibrium. For this to be possible, an acquirer buys a portion of a rival firm before the acquisition of another rival firm. However, this is only necessary when the dilemma is prominent. The share held by an acquirer in a rival firm (25 percent in the initial example) is called an *outsider-toehold.*

Cross ownership among firms is common and may have many reasons. However, this paper focuses on cross ownership, i.e. outsider-toeholds, within the own industry. Firms buy a share of a rival firm to extract positive externalities from a market concentration. Table 1 presents all outsider-toeholds bought among 330 000 worldwide observations included in the Thomson Financial mergers and acquisitions database.

TABLE 1: Outsider-toeholds within the same industry

	U.S.A.	**World (incl. U.S.A.)**
2-SIC (83 industries)	1,429 (20 %)	10,217 (30 %)
4-SIC (1021 industries)	783 (11 %)	6,617 (19 %)
Total	7,289	34,254

Conditional on buying a share of another firm, 30 percent of these purchases occur within the same industry including observations from all over the world. Industries are defined as firms having the same 2-digit sic code. Firms are thus clustered in 83 different industries and assuming them all to be of equal size and randomly choosing target firms in which to buy outsider-toeholds, firms within the same industry would, on average, be targets slightly above one percent (1/83) of the time. A random choice of where to buy an outsider-toehold can definitely be rejected, also on the US data with 20 percent buying shares in firms within the same industry. Narrowing the definition of industries to a 4-digit sic code (with 1021 industries) makes the result even more obvious with 19 and 11 percent of the outsider-

toeholds being bought within the industry for firms all over the world and US firms, respectively.

Firms holding shares in other firms are not an exceptional feature. The reasons for these cross ownerships may e.g. be investment strategies for diversifying risk or acquisition strategies such as the outsider-toehold theory in this paper or the toehold theory, where a share of the target firm is bought before an acquisition. The investment reason may be motivated, since information about the own industry is superior. In contrast diversifying risk would imply investments in other industries. Acquisition strategies may thus be stronger reasons for explaining the vast investment results within the same industry in Table 1.

The main purposes of this paper are to demonstrate the existence of outsider-toeholds, test if acquirers benefit from holding outsider-toeholds and estimate gains for merging parties with and without outsider-toeholds. Looking at US mergers and acquisitions in 1985 to 2000, event studies are used to estimate premiums from stock market reactions and regressions to search for possible variables explaining these premiums.

In Section 2, a short model description demonstrates the acquisition strategy, section 3 the testing procedures, section 4 spells out the results and section 5 concludes.

2. MODEL

Consider an industry with three firms; one buyer (firm *a*) and two sellers (firms *b* and *c*). An acquisition game of two periods precedes the one period market game, where each firm initially gets a triopoly profit, $\pi(3)$ and if two firms merge, they each get a duopoly profit, $\pi(2)$. Only one merger can take place and a merger to duopoly is assumed to be profitable, i.e. $2\pi(2) > 3\pi(3)$.

If firm *a* offers a bid to a seller, it must be at least the size of a triopoly profit for a seller to accept in equilibrium. A buyer would only make such an offer if this implies a

higher profit than the initial triopoly profit, i.e. $\pi(2)- \pi(3) > \pi(3)$. This inequality is stronger than the assumption of profitable mergers to a duopoly and some of the profitable mergers may thus not occur.

Now, consider the acquisition strategy in Figure 1. Before the acquisition takes place, the acquirer buys an outsider-toehold, p, in firm c.

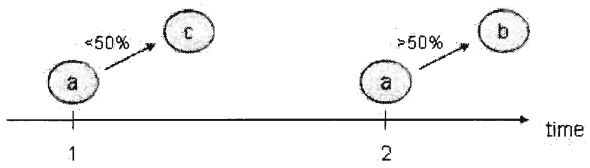


FIGURE 1: Acquisition Strategy

For this strategy to be profitable for firm a, the following must hold:

$$\pi(2) + p\pi(2) - \pi(3) - p\pi(3) > \pi(3). \qquad \text{Eq. 1}$$

In the market, firm a profits from a duopoly profit, $\pi(2)$, from its own firm and its holding share in the rival firm. A triopoly profit, $\pi(3)$, is paid in the second period of the acquisition game when firm b is acquired and a portion, p, of a triopoly profit when the outsider-toehold is bought from firm c. Rewriting Equation 1, we get $(\pi(2) - \pi(3))*(1 + p) > \pi(3)$, which demonstrates that there always exists a $p \in [0,1]$ where this and the profitability inequality hold. Hence, all profitable mergers can occur in equilibrium.

Lindqvist (2003) presents a more extensive three-period model, cf. the above example with only two periods. To facilitate empirical tests, only two periods are used in this study. In both cases, however, the results are driven by the positive externality on the outsider firm, the existence of which is the main focus of this empirical paper.

Theoretically, the size of an outsider-toehold is somewhere between zero and 100 percent. However, it is necessary for a buyer not to acquire a firm in the first period, but only buy a share of this firm. In reality, outsider-toeholds cannot be too large for an acquisition to take place and in Figure 1, the outsider-toehold is illustrated as a share less than 50 percent, which is also a necessary constraint in the empirical analysis. Although the definition of an acquisition is more complex than this simple majority rule, there may be good reasons for excluding shares larger than 50 percent, since majority ownership can have similar characteristics as an acquisition in terms of e.g. production quantities, prices and takeover decisions. In fact, holding more than 50 percent of the stock value is often not enough for taking control of a company. In the US, the so-called supermajority is applicable in many antitakeover amendments, stating that a change in control requires shareholder approval by at least a two-third vote and sometimes as much as 90 percent of the voting power. Also when countries have different voting power for different stocks, such as e.g. France and Sweden, it is possible to hold more than 50 percent of the firm value, but less than half the votes. In contrast, holding less than half of the value of a company may be considered as an acquisition if the strong voting power shares are acquired. Also in countries without different voting power shares, holding a minority of the shares may be sufficient for an acquisition if the remaining ownership structure is dispersed.[1] In the empirical analysis an outsider-toehold is defined as buying less than 50 percent of the stocks, holding less than 50 percent afterwards and not being defined as an acquisition in the database. An acquisition is defined as holding less than 50 percent before the deal, more than 50 percent after the deal and being defined as an acquisition in the database.

[1] According to European Commission IV/M.025 - Arjomari/Wiggins Teape of February 10, 1990, an acquisition takes place if a majority of the voting rights are held. A minority of the voting rights may also be treated as an acquisition if these votes obtain a majority at the shareholders' meeting, due to the remaining votes being spread out among many small shareholders.

3. TESTING PROCEDURES

3.1 Merger Premiums with Event Studies

To evaluate acquisition strategies, stock market reactions are used as approximations for gains from involving firms and estimations of premiums are calculated using event studies. Using stock market data has potential problems. In general, to find positive or negative reactions from the stock market in event studies, the events must be unexpected. Even if the particular event is unexpected, problems may arise in interpreting the data since investors may have other expectations that can affect stock prices in one direction or the other. Furthermore, the event itself may be endogenous and signaling something else than what should be tested. Fridolfsson and Stennek (2000b) demonstrate how difficulties can arise in interpreting results from mergers using event studies, without knowing the market expectations.[2]

There are several advantages in using stock market data when studying mergers and acquisitions, such as stock market reactions also being available for blocked mergers, it is relatively easy to obtain data, evaluations are relatively independent from insiders and all long- and short-term aspects can be captured in the reactions. Despite potential problems, event studies do not seem to have any clear superior methods for evaluating events such as mergers and acquisitions, M&As.

The market model is used to estimate abnormal returns from acquisitions. For any security *i*, the market model is

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \qquad \text{Eq. 2}$$

where R_{it} and R_{mt} are the period-t returns on security i and the market portfolio, respectively, and ε_{it} is the zero mean disturbance term. S&P 500 Index is used as returns from the market portfolio and 250 observations (trading days) to estimate parameters for each security i. Observations are based on daily closing stock prices adjusted for dividends and splits on the trading day -270 to -21, relative to the event day, i.e. day zero.

To calculate abnormal returns, an event day and an event window need to be established. In this study, two different events will be evaluated for each security, using the same estimated parameters from Equation 2. The first event day is when the purchase of an outsider-toehold is announced and the second the day of announcement of an acquisition. The assumption of ineffective markets implies including some days before and after the event day to capture possible market reactions due to e.g. insider trading before and delayed reactions after the announcement. These days (including the event day) are called the event window. The length of this window is not definite; some figures commonly used are 1, 3, 11, 21 and 41 days. What kind of event is evaluated but also efficiency in the market, e.g. availability of information, are, of course, crucial. On the one hand, a long window is preferred since the probability of capturing the entire effect then increases, but on the other hand, a short window is advocated to avoid other effects, not related to the evaluating event.

There are two strong reasons for using at least one day before and after the event day (three-day window). First, we have the "newspaper effect" which arises when announcement days are defined as when first appearing in the financial press. Since news usually has a one day delay in newspapers, the day before the event day should be included. The second is the "closing time effect" due to the closing times on stock markets. Announcements of events

---

[2] See also Duso et al (2003) for an extensive discussion on problems concerning event studies for merger

after the stock exchange market has closed affect stock prices at the opening time the subsequent day in an efficient market. In the US, this effect may be more prominent due to different time zones. The main reason for including more than one day after the event is slow market reactions caused by e.g. weak information channels or liquidity constraints. Including more than one day before the event day is rather related to insider trading, i.e. some investors are trading on non public information. At the end of the last millennium in the computer age, information channels are likely to be strong and investors (such as large investment banks) liquid, which would favor few days of inclusion after the event. In contrast, non public information may be more difficult to conceal and larger trading volumes with larger possibilities for substantial gains may make it more tempting to trade on inside information. This supports more than one day before the event within the window. In fact, most event studies concerning M&As in the last twenty years have shown a pattern supporting these arguments.[3] Some days (five to ten) before the event, the stock price starts reacting but reactions more than one day after the event are rare. My belief before running any empirical tests is to include day +1 to -1 or some days before (here +5) to -1 in the event window. These two windows will be more important in the main conclusions, but other intervals will also be examined.

Using the market model to measure the normal return, the sample abnormal return, AR_{iT}, is

$$AR_{iT} = R_{iT} - \hat{\alpha}_i - \hat{\beta}_i R_{mT} \qquad \text{Eq. 3}$$

where T is each day in the event window. For each day, the average abnormal returns, $\overline{AR_T}$, of all securities are estimated and summed up over the event window, thereby forming the

evaluations.

[3] See e.g. Bradley et al (1988) or Betton and Eckbo (2000).

cumulative average abnormal return, CAAR. Standard errors from Equation 2 will be used to estimate variances in the hypothesis testing of the CAAR.[4] When testing for differences between two CAARs, the two standard deviations from these samples are used for calculating t-values.[5]

3.2 Data description and hypothesis testing

M&As are collected from the Thomson Financial database and firm-specific data from Compustat. Only US firms are considered during the years 1985 to 2000. As illustrated by the acquisition strategy in Figure 1, two different observations are necessary for firms to be included. In the first period, an outsider-toehold is acquired, defined as buying a share less than 50 percent and holding less than 50 percent in the target firm afterwards, not being an acquisition. In the second stage, an acquisition takes place, which is defined as holding less than 50 percent before and more than 50 percent after the deal, being an acquisition. Hence, three types of firms are involved; *buyer*, B, and *outsider-toehold* firm, O-T, in period 1 and buyer and *seller*, S, in period 2. All firms must belong to the same line of business, i.e. being rivals, which is defined as the same 4-digit sic code at the time of the announcement for buying an outsider-toehold (firms can change sic codes). Furthermore, all firms not directly involved in this strategy but having the same sic code in that year will also be examined, referred to as *competitors*, C. Four different types of firms are thus considered at two different events. To ensure as clean observations as possible, all three firms directly involved in the two-period-strategy must not be part of any other deal with any other firm before the

[4] Autocorrelation does not seem to be a general problem for individual regressions. The Durbin-Watson test could not reject the null hypothesis at the 1 percent significance level of no positive autocorrelation against the alternative hypothesis of positive autocorrelation in any of the 186 regressions. However, negative autocorrelation was found in about 10 percent (18/186) of the regressions. Since regression results are aggregated, thereby diminishing the influence of individual estimations, there have been no adjustments in variances.

[5] For a detail description of event studies and statistical interpretation, see e.g. MacKinlay (1997).

announcement of the acquisition in period 2. This (as will be seen in the result section) disqualifies a vast majority of the observations in the Thomson database.

Hypotheses will be formed to test the theoretical results from Lindqvist (2003), briefly discussed in section 2. In the first period, the outsider-toehold firm may increase or may not be different from zero. If expectations about the later market concentration are considerably higher after this event, there will be an increase in value since outsider-toehold firms will gain from this. In contrast, if there is no change in expectations, the value will be unaffected and only increase in the second period, when the acquisition occurs.

Although expectations of later acquisitions may be diffuse and not as clear as in the theoretical case, the empirical literature points at other reasons for an increase in value. In M&As, targets receive a large bid premium (20-40 percent) whereas buyers are not affected.[6] Hence, an outsider-toehold can be treated as a "partial" acquisition with a proportionate bidding premium. Furthermore, the share bought may be treated as a toehold by the stock market, as in the finance literature, i.e. a share of a target firm is bought before the acquisition. Grossman and Hart (1980) and Bagnoli and Lipman (1988) prove that this can be profitable for the acquirer and the outsider-toehold firm may thus be expected to become a target at a later stage.[7] Although expecting an increase in outsider-toehold firms, the alternative hypothesis is set as no differences rather than being larger than zero since the theoretical predictions are ambiguous. A two-sided test also requires larger t-values for significant differences and is more neutral, making the test "stronger" in this perspective.

Target premium hypothesis:

---

[6] See e.g. Franks and Harris (1989) and Bradley et al (1988).

[7] Buying toeholds is not rare. In the sample of Bradley et al (1988), 34 percent of the buyers held a toehold in the target when an acquisition was announced. Jennings and Mazzeo (1993) and Jarrell and Poulsen (1989) find toeholds in more than 50 percent of the acquisitions, the former also find most of them to be small (on average 3 percent). In Betton and Eckbo (2000), more than half the buyers held toeholds and the target premium was

$H_0 : CAAR_{O\text{-}T} = 0$

$H_a : CAAR_{O\text{-}T} \neq 0$.

Abnormal returns for buyers and competitors are assumed not to be different from zero when the outsider-toehold is bought, i.e. the expectations for a future acquisition have not changed.

In the second stage, when the acquisition takes place, the outsider-toehold firm is expected to have a positive abnormal return, unconditional on the effect in the first period. A buyer is assumed to extract gains from the outsider-toehold to mitigate the acquisition. This is crucial, since this is what the theoretical assumption leans on. Also in this hypothesis is a two-sided test applicable.

Outsider-toehold externality hypothesis:

$H_0 : CAAR_{O\text{-}T} = 0$

$H_a : CAAR_{O\text{-}T} \neq 0$.

Also in this second stage is the assumption of no effects on buyers consistent with theory. The effect on competitors is ambiguous. If markets are concentrated, a positive reaction is expected but otherwise, no effects are assumed.

The next hypothesis will test if buyers are randomly choosing outsider-toehold firms within the same industry or if these firms have different CAARs as compared to their competitors. This test also concerns the second stage.

Outsider-toehold vs. competitor firm hypothesis:

$H_0 : CAAR_{O\text{-}T} = CAAR_C$

$H_a : CAAR_{O\text{-}T} \neq CAAR_C$.

---

decreasing in the size of the toehold. Franks and Harris (1989) did not find any differences in target premiums with and without toeholds.

For the buyer, however, one more test may be necessary to further support the theoretical results. Consider no effects in the value of buyers in the two periods, but an increase in the outsider-toehold firm in the second stage. This implies that despite the external gains extracted from holding shares in a rival firm, the total value of the buyer remains unchanged. One explanation to this may be an endogenous choice of whether to buy an outsider-toehold. Firms may only use the outsider-toehold acquisition strategy when mergers are difficult and costly, i.e. when the insiders' dilemma is prominent. Lindqvist (2003) proves that this may be valid; when the insiders' dilemma does not exist, buyers do not benefit from buying outsider-toeholds. Hence, one may expect not to observe any differences in the abnormal return from a buyer holding an outsider-toehold, as compared to one not holding any. For this to be tested, we need to extend the sample and include pure acquisitions, i.e. involving firms that do not hold any shares in other firms, and make a comparison with the buyers included in the tests above.

A buyer not holding any outsider-toehold is referred to as a *buyer of type 2*, B2, and its opponent a *seller of type 2*, S2. These acquisitions are similar to those with outsider-toeholds in all respects but the outsider-toehold existence. Hence, these firms have the same 4-digit sic code and both firms lack in transactions of shares with other firms. In that sense, it can be treated as a clean acquisition.

Comparing buyers using the outsider-toehold strategy with buyers who do not, may indicate if strategies are exogenously chosen.

Buyer profitability hypothesis:

$H_0 : CAAR_B = CAAR_{B2}$

$H_a : CAAR_B \neq CAAR_{B2}$.

3.3 Regressions

The desired effect of buying an outsider-toehold may depend on many variables not considered in the above hypothesis testing. To examine possible explanatory factors determining the CAARs for outsider-toehold firms, O-T, in the second stage when an acquisition announcement occurs, the regression in Equation 4 is run

$$CAAR_{O-T} = \beta_0 + \beta_1 T_i + \beta_2 C_i + \beta_3 S_i + u_i . \qquad \text{Eq. 4}$$

Variable T is the time in years between the announcement of buying an outsider-toehold and the announcement of the acquisition. When these two events are close in time, the externality of buying an outsider-toehold may be more profitable, since it may be easier to identify a firm generating a gain closer in time.

A concentrated market with few firms may imply larger profits for the remaining firms after a merger, since in e.g. a simple linear Cournot model, the single firm profit is decreasing and convex in the number of firms within the industry. Variable C is the number of competitors (def. as equal 4-digit sic code) in the database, used as an approximation of the number of firms within the industry for testing for decreasing profits. Variable S is the size of the outsider-toehold.

Note that the model in Lindqvist (2003) is consistent with $\beta_0>0$, $\beta_2<0$ and $\beta_3=0$. Parameter β_1 does not affect the profits of a buyer in the model and is thus not expected to differ from zero. However, for simplicity, no discounting factor is used in the theoretical model (section 2 and Lindqvist (2003)) but introducing one would predict a negative sign on β_1.

A second regression is executed to test for possible differences between CAARs for buyers holding an outsider-toehold versus buyers who do not, i.e. B vs. B2. For buyers with outsider-toeholds (B), the CAARs from both periods are aggregated to compare with buyers only realizing an acquisition (B2). Independent variables are given in Equation 5

$$CAAR_{Buyer} = \alpha_0 + \alpha_1 A_i + \alpha_2 M_i + \alpha_3 F_i + u_i . \qquad \text{Eq. 5}$$

All variables are dummies, where A is one if an acquisition takes place after the announcement, and zero otherwise. Note that CAARs are estimated at the time of the announcement and an acquisition does not necessarily occur at a later stage. M equals one if the offer is made in a multiple bidder contest, and zero otherwise. Including the number of bidding firms instead of this dummy variable may be motivated but since most bidding contests only have two firms involved in this sample, this was not considered. F will be used to compare CAARs for different firm types and is one when a buyer holds an outsider-toehold (B), and zero otherwise (B2). All parameters are expected not to differ from zero, i.e. $\alpha_0 = \alpha_1 = \alpha_2 = \alpha_3 = 0$.

4. RESULTS

4.1 Outsider-toehold results

The acquisition strategy in Figure 1 may look simple. Finding observations for empirical testing of this strategy is demanding, however, due to the two-stage game. Events such as other shares being bought or sold by any involved firm before or between the stages create noise and have thus been excluded. Hence, only pure observations are considered in the empirical tests.

All acquisitions (and sometimes mergers) studied are presented in the Appendix, Table A1. The sample includes 18 buyers (B), 36 outsider-toehold firms (O-T), 97 competitors (C) and 35 buyers without outsider-toeholds (B2). Sellers are specified for some observations in Table A1, although not included in the statistical testing.

In Table 1, CAARs for buyers, outsider-toehold firms and competitors are presented. Six different event windows have been used for each firm type but the focus, motivated in

section 3.1, for the conclusions will be on -5 to +1 and -1 to +1 (bold figures in all tables) and the remaining windows are more like robustness tests. CAARs from Table 1 are plotted in Figure 2.

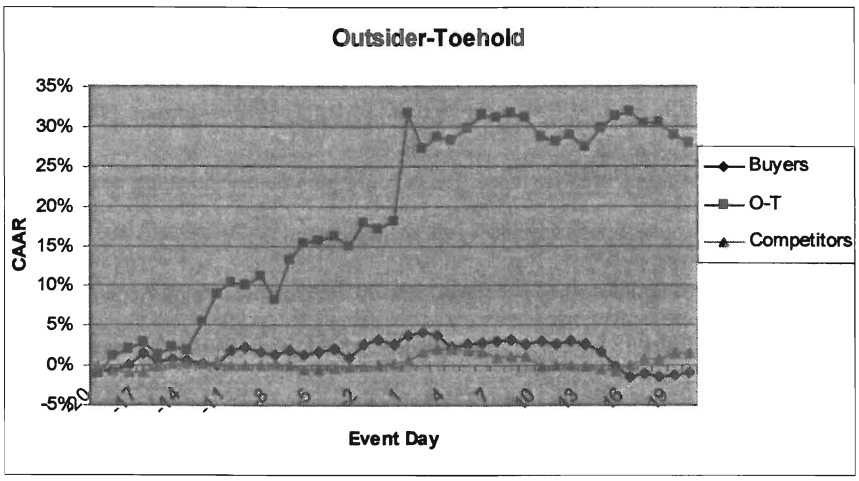
TABLE 2: CAARs at the announcement of outsider-toehold

Event window	Buyers, B		Outsider-toehold firms, O-T		Competitors, C	
	CAAR	*t-value*	*CAAR*	*t-value*	*CAAR*	*t-value*
-20 to +20	-0.008	0.185	0.279**	2.281	0.016	0.740
-10 to +10	0.010	0.326	0.182**	2.080	-0.001	0.069
-5 to +5	0.013	0.580	0.146**	2.308	0.024**	2.188
-5 to +1	**0.024**	**1.313**	**0.164****	**3.241**	**0.011**	**1.323**
-1 to +1	**0.011**	**0.894**	**0.138****	**4.165**	**0.009**	**1.508**
Event day	-0.005	0.663	0.011	0.558	0.002	0.516

* Significantly different from zero at the 90 percent level.
** Significantly different from zero at the 95 percent level.

Firms where an outsider-toehold is bought have a significantly (95 percent level) positive response in the stock price, as indicated by Figure 2. Note that all ranges of the event window but the actual event day have a definite increasing CAAR. This can exemplify misinterpretations when not including more days around the single event day.

FIGURE 2: CAARs at the announcement of outsider-toehold



As illustrated by Figure 2, buyers and competitors are generally not affected by this event, although competitors show a significantly increasing CAAR for the -5 to +5 event

window. However, these returns can not compare to the nearly 30 percent CAAR from outsider-toehold firms over the -20 to +20 window. Furthermore, the pattern of this CAAR is similar to reactions to target firm stock prices upon the announcement of an acquisition, i.e. without outsider-toeholds. Some days before the announcement, the stock price is increasing and a sudden shift occurs just before the event day, followed by no trend. The null hypothesis of CAARs being equal to zero for outsider-toehold firms is rejected.

Target premium hypothesis result: *Stock prices increase heavily for firms where an outsider-toehold is bought.*

4.2 Acquisition results

Table 3 presents the results for the second stage, at the announcement of the acquisition.

TABLE 3: CAARs at the announcement of an acquisition with outsider-toeholds

Event	**Buyers, B**		**Outsider-toehold firms, O-T**		**Competitors, C**	
window	*CAAR*	*t-value*	*CAAR*	*t-value*	*CAAR*	*t-value*
-20 to +20	-0.114**	2.549	-0.006	0.062	-0.083**	4.293
-10 to +10	-0.058	1.606	0.020*	1.667	-0.013	0.917
-5 to +5	-0.033	1.430	0.017	0.313	-0.003	0.303
-5 to +1	**-0.020**	**1.086**	**0.040***	**1.837**	**-0.022**	**1.618**
-1 to +1	**-0.027**	**1.193**	**0.042****	**2.524**	**-0.013**	**1.479**
Event day	-0.018	1.624	0.027*	1.698	-0.005	1.613

* Significantly different from zero at the 90 percent level.
** Significantly different from zero at the 95 percent level.

Stock price reactions for buying and competing firms tend to decrease, but only the -20 to +20 event window differs significantly from zero. In contrast, outsider-toehold firms experience a CAAR significantly different from zero. On average, about a four-percent increase due to the acquisition announcement is found a few days around the event. This result indicates that firms holding outsider-toeholds extract external gains when realizing an acquisition and the null hypothesis of CAARs equaling zero is thus rejected.

Outsider-toehold externality hypothesis: *Buyers extract gains from holding an outsider-toehold when announcing an acquisition.*

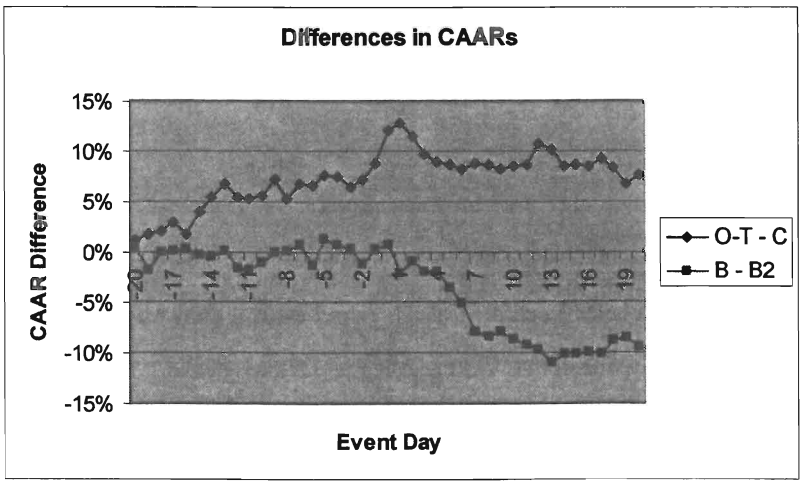
The theory states that outsider-toeholds are bought in rival firms. However, many rivals with various reactions to stock prices may exist. Further analysis is necessary to examine whether firms tend to invest shares in rivals experiencing positive and relatively superior stock price reactions. Table 4 presents CAARs for buyers not holding any outsider-toehold, B2, in the second column and differences between CAARs for outsider-toehold firms and competitors in the fourth column and finally, in the sixth column, CAAR differences between buyers with and without outsider-toeholds, B-B2. Note that CAARs for buyers, B, are presented in Table 3. The two differences are also plotted in Figure 3.

TABLE 4: Differences in CAARs at the announcement of an acquisition

Event window	Buyers, B2		O-T - C		B - B2	
	CAAR	*t-value*	*CAAR*	*t-value*	*CAAR*	*t-value*
-20 to +20	-0.020	0.332	0.076	0.730	-0.094	1.242
-10 to +10	-0.010	0.239	0.032	0.432	-0.068	1.263
-5 to +5	-0.010	0.326	0.020	0.364	-0.023	0.585
-5 to +1	**-0.013**	**0.498**	**0.061***	**1.722**	**-0.008**	**0.242**
-1 to +1	**-0.018**	**1.069**	**0.055****	**1.965**	**-0.009**	**0.437**
Event day	-0.022**	2.307	0.032**	1.977	0.004	0.305

* Significantly different from zero at the 90 percent level.
** Significantly different from zero at the 95 percent level.

FIGURE 3: Differences in CAARs at the announcement of an acquisition



CAAR differences between outsider-toehold firms and competitors are positive and significantly different from zero a few days around the event day, i.e. -5 to +1, -1 to +1 and the event day. The null hypothesis of no differences is thus rejected. Furthermore, the stock price increases for outsider-toehold firms in 26 of the 36 firms studied (72 percent).

Outsider-toehold vs. competitor firm hypothesis: *Buyers tend to invest outsider-toeholds in firms with a positive and, relative to its rivals, superior CAAR.*

According to the result so far, buyers extract gains from buying an outsider-toehold before making an acquisition. Hence, if the choice of holding an outsider-toehold is exogenous, these buyers should experience a larger CAAR as compared to buyers not holding outsider-toeholds. But if the choice of buying an outsider-toehold is endogenous, we may not observe differences in CAARs. In fact, Lindqvist (2003) suggests that only when the insiders' dilemma is prominent is it necessary for buyers to hold outsider-toeholds for an acquisition to occur in equilibrium. Hence, buyers neither gain nor lose from the acquisition when holding outsider-toeholds, since this strategy is only used when mergers are difficult.

CAARs in the sixth column of Table 4 do not differ from zero and thus, the null hypothesis of equal CAARs for buyers with and without outsider-toeholds cannot be rejected. This indicates an endogenous choice of whether to buy an outsider-toehold. Furthermore, even though these differences are not significantly different from zero, they are mostly negative, thereby supporting the theory of only using outsider-toeholds when mergers are difficult.

Buyer profitability hypothesis: *CAARs are not significantly different from zero at the announcement of an acquisition for buyers with and without outsider-toeholds.*

4.3 Regression results

The results in the previous section indicate a positive reaction to the stock price of outsider-toehold firms at the acquisition announcement. To search for variables explaining positive CAARs, Table 5 reproduces regression results from Equation 4.

Table 5: OLS on CAARs from outsider-toehold firms [a]

Dependent Variable	β_0	β_1	β_2	β_3	F-statistic	R^2
$CAAR_{-20/+20}$	0.3986**	-0.0328	-0.0107	-1.2784	2.29*	0.486
	(2.09)	(-0.72)	(-0.74)	(-1.61)		
$CAAR_{-10/+10}$	0.1918**	-0.0537**	0.0026	-0.3851	3.42**	0.595
	(1.99)	(-2.34)	(0.35)	(-0.96)		
$CAAR_{-5/+5}$	0.0746	-0.0288*	0.0009	0.0035	1.89	0.448
	(1.01)	(-1.64)	(0.16)	(0.01)		
$CAAR_{-5/+1}$	**0.1292***	**-0.0272***	**0.0014**	**0.0583**	**1.55**	**0.399**
	(1.63)	**(-1.53)**	**(0.25)**	**(0.19)**		
$CAAR_{-1/+1}$	**0.0031**	**-0.0023**	**-0.0043**	**0.3895**	**1.34**	**0.364**
	(0.05)	**(-0.16)**	**(-0.94)**	**(1.56)**		
$CAAR_{EventDay}$	0.0376	-0.0043	-0.0043	0.0960	0.33	0.124
	(0.53)	(-0.25)	(-0.80)	(0.33)		

[a] Ordinary least square estimators for 36 firms on $CAAR_{O-T} = \beta_0 + \beta_1 T_i + \beta_2 C_i + \beta_3 S_i + u_i$ at the announcement date of acquisition, where T_i is the time in years between outsider-toehold and acquisition announcements, C_i the number of competitors and S_i the size of the outsider-toehold. The length of the event window determines the CAARs (cumulative average abnormal returns) for each of the six dependent variables used. One-sided tests are used for testing $\beta_0 > 0$, $\beta_1 < 0$ and $\beta_2 < 0$ and two-sided tests for testing $F - statistic \neq 0$ and $\beta_3 \neq 0$ against the null hypotheses of not being different from zero (t-statistics in parentheses). White's test did not detect heteroskedasticity (highest $nR_w^2 = 10.907 \sim \chi_9^2$ for $CAAR_{-5/+1}$). Mutual correlations between variables are not significantly different from zero (highest |corr(T, C) |=0.338).

* Significant at the 90 percent level.

** Significant at the 95 percent level.

Different dependent variables, i.e. varying lengths of the event window, are used as a robustness test for establishing relations between variables. Bold results are somewhat more important (see the discussion in section 3.1) for general conclusions.

The constant β_0 is positive in all regressions, but the null hypothesis of this constant equaling zero is only rejected in favor of the alternative hypothesis of a positive constant for some of the regressions. Altogether, when controlling for the variables in Equation 4, the

results weakly support a positive reaction on the stock price of the outsider-toehold firm, which is consistent with theory and the hypothesis testing result in section 4.2.

Column three in Table 5 indicates a negative relation between the time between buying an outsider-toehold and making an acquisition, T, and the CAAR. The null hypothesis of parameter β_1 equaling zero is rejected in some regressions in favor of the alternative hypothesis of a negative relation. This weakly supports the hypothesis that when firms use the outsider-toehold acquisition strategy, the time between the two events is short, whereas when much time has passed, this strategy is less pronounced.

The number of competitors, C, does not seem to affect the CAAR. A null hypothesis of β_2 being equal to zero cannot be rejected in favor of the alternative hypothesis of a negative parameter. This contradicts theory, but the definition of a competitor in this study may not be appropriate or more observations may be needed to establish stronger results. Also for the last parameter, β_3, the null hypothesis of equaling zero cannot be rejected in favor of the alternative hypothesis of not being equal to zero. Hence, the share of the outsider-toehold does not seem to determine CAARs, which is consistent with theory.

Results on CAARs for outsider-toehold firms at the acquisition announcement: *Stock prices tend to increase in general but are decreasing in the time between outsider-toehold and acquisition announcements.*

Table 6 presents OLS results on buyers' CAARs at the acquisition announcement.

Table 6: OLS on CAARs from buyers[a]

Dependent Variable	α_0	α_1	α_2	α_3	F-statistic	R^2
$CAAR_{-20/+20}$	-0.0295	0.0136	0.0095	-0.1039	0.27	0.018
	(-0.29)	(0.12)	(0.03)	(-0.86)		
$CAAR_{-10/+10}$	0.0093	0.0016	-0.0756	-0.0471	0.19	0.013
	(0.12)	(0.02)	(-0.34)	(-0.50)		
$CAAR_{-5/+5}$	0.0504	-0.0885	-0.0826	0.0049	0.39	0.026
		(-1.08)	(-0.41)	(0.06)		

	(0.72)					
$CAAR_{-5/+1}$	**0.0096**	**-0.0322**	**-0.0554**	**0.0256**	**0.15**	**0.010**
	(0.19)	**(-0.56)**	**(-0.39)**	**(0.43)**		
$CAAR_{-1/+1}$	**-0.0430**	**0.0370**	**-0.0024**	**0.0012**	**0.38**	**0.025**
	(-1.34)	**(0.99)**	**(-0.03)**	**(0.03)**		
$CAAR_{EventDay}$	-0.0589**	0.0539*	0.0307	-0.0070	1.27	0.078
	(2.47)	(1.94)	(0.45)	(-0.24)		

[a] Ordinary least square estimators for 53 firms on $CAAR_{Buyer} = \alpha_0 + \alpha_1 A_i + \alpha_2 M_i + \alpha_3 F_i + u_i$ at the announcement date of the acquisition (for buyers with outsider-toeholds, the CAAR from this announcement is also included), where A_i is a dummy variable equaling one if an acquisition occurs and zero otherwise, M_i a dummy equaling one if the offer is made in a multiple bidder contest and zero otherwise and F_i a dummy equaling one if the buyer holds an outsider-toehold and zero otherwise. The length of the event window determines the CAARs (cumulative average abnormal returns) for each of the six dependent variables used (t-statistics in parentheses). White's test did not detect heteroskedasticity (highest $nR_w^2 = 3.798 \sim \chi_4^2$ for $CAAR_{EventDay}$). Mutual correlations between variables are not significantly different from zero (highest |corr(M, F)|=0.326).

* Significantly different from zero at the 90 percent level.

** Significantly different from zero at the 95 percent level.

The null hypothesis of a parameter equal to zero against the alternative hypothesis of not equaling zero is used for all parameters in Table 6. In fact, the null cannot be rejected for any parameter except α_0 and α_1 when using CAARs from the event day as the dependent variable. However, the event day is not sufficient for drawing conclusions and since the other regression results are insignificant and also have different signs, no general relations can be established.

Variable F is a dummy variable used to test whether buyers with outsider-toeholds, F=1, experience a larger positive reaction to the stock price than buyers without a share in another firm in the industry. However, this is not supported in the regression results from Equation 5 in Table 6, which are consistent with the conclusions from section 4.2. Note that the definition of the CAAR is different in this section, since CAARs from both the outsider-toehold and the acquisition announcements are aggregated.

Acquisitions occurring after the announcement, A=1, and offers made in a multiple bidding contest, M=1, do not significantly affect the CAAR.

Results on CAARs for buyers at the announcement of acquisition: *CAARs are not different for buyers with and without outsider-toeholds.*

In general, the observations used in this section are not as many as desired. Excluding outliers may be one way of increasing the significance, particularly when having few observations. However, no outliers significantly increasing the t-statistics were found. Low R^2s (particularly in Table 6) and insignificant estimated parameters indicate that the results are somewhat weak and should not be considered to be too generalized and established without further testing on additional data.

5. CONCLUDING REMARKS

In the economics literature, there exists an important obstacle to anti-competitive mergers, demonstrating that competing firms outside the merger often benefit more than the buyer and the target firm, since they benefit from an increase in price but need not reduce their own output. Hence, sometimes profitable mergers do not occur in equilibrium.

Lindqvist (2003) proves that for some specifications, this puzzle may be solved if a buyer purchases a share of a rival firm before the acquisition, referred to as an outsider-toehold. The main purposes of this paper have been to demonstrate the existence of these outsider-toeholds, test if acquirers benefit from holding outsider-toeholds and estimate gains for merging parties with and without outsider-toeholds. Looking at US mergers and acquisitions in 1985 to 2000, event studies are used to estimate premiums from stock market reactions and regressions to search for possible variables explaining these premiums.

Two different stages in the acquisition strategy are examined in the event studies; the announcement of buying an outsider-toehold and the announcement of an acquisition. The results exhibit a positive cumulative average abnormal return, CAAR, for the outsider-toehold firm in the first stage. More interestingly, CAARs are also significantly positive for

outsider-toehold firms in the second stage, at the announcement of an acquisition implying a positive external gain for a buyer holding an outsider-toehold. Furthermore, this CAAR is negatively related to the time between outsider-toehold and acquisition announcements, but not affected by the number of competitors and the size of the outsider-toehold. Hence, when buyers hold a share of another firm, they mitigate later acquisitions, due to a positive externality on the rival firm. In fact, buyers also tend to invest outsider-toeholds in firms with a positive and, relative to its rivals, superior CAAR.

According to these result, buyers extract gains from buying an outsider-toehold before making an acquisition. If the choice of holding an outsider-toehold is exogenous, these buyers should experience a larger CAAR as compared to buyers not holding outsider-toeholds. But if the choice of buying an outsider-toehold is endogenous, we may not observe differences in CAARs. As an example, buyers may neither gain nor lose from the acquisition when holding outsider-toeholds, since this strategy is only used when mergers are difficult. In fact, CAARs are not significantly different from zero at the announcement of an acquisition for buyers with and without outsider-toeholds. This proposes an endogenous choice of whether to buy an outsider-toehold.

This paper may have interesting policy implications; when rivals gain from a merger, this usually implies a decrease in consumer surplus. Firms using outsider-toeholds may thus be used as a signal for blocking a merger or an acquisition. In general, however, this paper has focused on clean but few observations and further studies on cross ownership are necessary to explore the implications of these phenomena.

REFERENCES

Bagnoli, Mark, and Barton L. Lipman (1988), "Successful Takeovers without Exclusion," *Review of Financial Studies*, 1(1), 89-110.

Betton, Sandra, and B. Espen Eckbo (2000), "Toeholds, Bid Jumps, and Expected Payoffs in Takeovers," Review of Financial Studies, 13(4), 841-82.

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

Duso, Tomaso, Damien J. Neven and Lars-Hendrik Röller (2003), "The Political Economy of European Merger Control: Evidence using Stock Market Data," Working Paper CEPR.

European Commission (1990), IV/M.025 - Arjomari/Wiggins Teape, February 10.

Franks, Julian R. and Robert S. Harris (1989) "Shareholder Wealth Effects of Corporate Takeovers: The U.K. Experience 1955-1985," *Journal of Financial Economics*, 23(2), 225-49.

Fridolfsson, Sven-Olof and Johan Stennek (2000a), "Should Mergers be Controlled?," Working Paper 541, The Research Institute of Industrial Economics.

Fridolfsson, Sven-Olof and Johan Stennek (2000b), "Why Event Studies Do Not Detect Anti-Competitive Mergers," Working Paper 542, The Research Institute of Industrial Economics.

Grossman, Sanford J. and Oliver D. Hart (1980), "Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation," *The Bell Journal of Economics*, 11, 42-64.

Jarrell, Gregg A. and Annette B. Poulsen (1989), "Stock Trading before the Announcement of Tender Offers: Insider Trading or Market Anticipation?," *Journal of Law, Economics and Organization*, 5(2), 225-48.

Jennings, Robert H. and Michael A. Mazzeo (1993), "Competing Bids, Target Management Resistance, and the Structure of Takeover Bids," *Review of Financial Studies*, 6(4), 883-909.

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

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

Lindqvist, Tobias (2003) "Mergers by Partial Acquisition," Stockholm University.

Lindqvist, Tobias and Johan Stennek (2001), "The Insiders' Dilemma: An Experiment on Merger Formation," The Research Institute of Industrial Economics, Working Paper No. 563.

MacKinlay, Craig A. (1997), "Event Studies in Economics and Finance," *Journal of Economic Literature*, March, 35, 13-39.

Stigler, George J. (1950), "Monopoly and Oligopoly by Merger," *American Economic Review*, 40, 23-34.

APPENDIX

Table A1: Mergers and acquisitions included in sample [a]

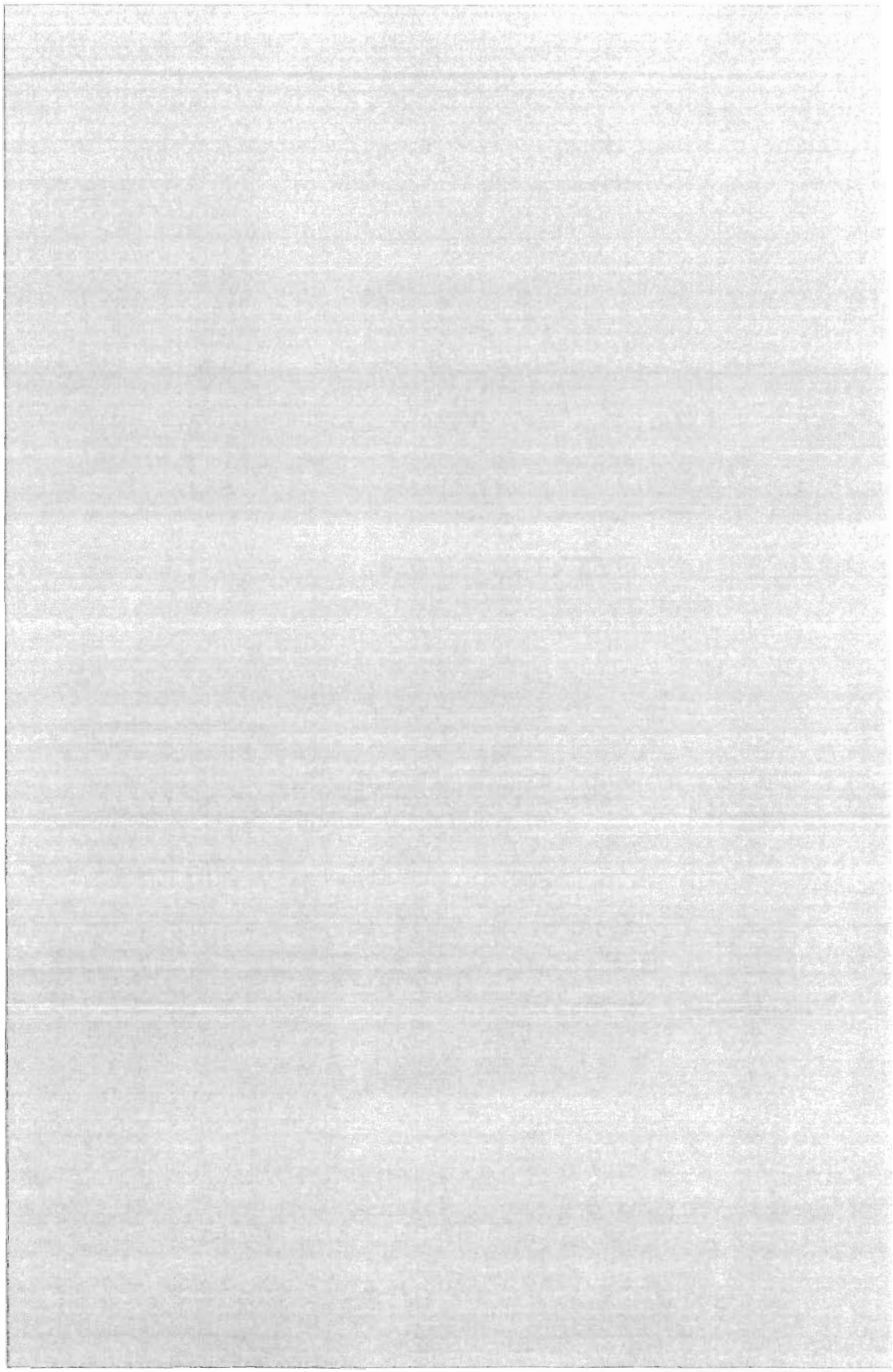
	OUTSIDER-TOEHOLD (< 50 %)		ACQUISITION (> 50 %)	
BUYER	**SELLER**	**DATE**	**SELLER**	**DATE**
PETRIE STORES	PAUL HARRIS STORES	9-3-1985	LERNER STORES	5-13-1986
NA	ZONDERVAN CORP	9-12-1985	NA	5-5-1987
NA	COMAIR HOLDINGS INC	7-29-1986	NA	8-6-1986
NA	HORIZON BANCORP	8-22-1986	NA	12-15-1986
YOUNG (CHAS. P.) CO	PANDICK INC	12-29-1986	SORG INC	2-23-1987
NA	CALNY INC	2-17-1987	NA	1-14-1991
NA	CENERGY CORP	3-2-1987	NA	4-6-1989
NA	BUCKHORN INC DEL	3-2-1987	NA	8-3-1987
NA	US AIRWAYS GROUP INC	3-4-1987	NA	11-7-1988
DIGITAL COMMUNICATIONS ASSC	UNGERMANN-BASS INC	10-23-1987	DIGITAL TRANSMISSION SYSTEMS	12-30-1988
NA	SKYWEST INC	1-25-1988	NA	6-8-1988
NA	SABINE CORP	3-10-1988	NA	8-10-1988
NA	STANDARD MICROSYSTEMS CORP	4-7-1988	NA	6-18-1998
NA	IMAGINE FILMS ENMT INC	4-7-1988	NA	6-18-1998
NA	HERITAGE COMMUNICATIONS INC	6-13-1988	NA	5-4-1989
NA	VONS COMPANIES INC	7-18-1988	NA	8-18-1989
NA	CRYSTAL GAS STORAGE INC	9-19-1988	NA	1-11-1995
NA	SKIPPER'S INC	1-30-1989	NA	9-30-1992
NA	XILINX INC	7-27-1989	NA	12-3-1990
ADVANCED MICRO DEVICES	ECHOCATH INC -CL A	3-20-1990	NEXGEN INC	10-20-1995
VITAL SIGNS INC	NORTH AMERICAN RECYCLING SYS	6-3-1991	BIOMEDICAL DYNAMICS CORP	11-6-1991
NA	CORTEX PHARMACEUTICALS INC	7-25-1991	NA	12-3-1991
NA	CONVEX COMPUTER CORP	1-7-1992	NA	11-20-1992
NA	COMPLINK LTD	3-18-1992	NA	6-23-1992
NA	CHICAGO & NO WESTN TRANS CO	5-5-1992	NA	12-23-1992
UNION PACIFIC CORP	GENERAL COMMUNICATION -CL A	12-1-1992	SANTA FE PACIFIC CORP	6-29-1994
NA	AMERICAN MOBILE SYS	1-8-1993	NA	6-2-1993
NA	LA QUINTA MOTOR INNS - LP	4-7-1993	NA	6-9-1993
NA	RODMAN & RENSHAW CAPITAL GP	5-28-1993	NA	7-28-1993
NA	NA	7-16-1993	NA	7-7-1994
TORCHMARK CORP	KIRSCHNER MEDICAL CORP	1-17-1994	AMERICAN INCOME HOLDING INC	9-15-1994
NA	PREFERRED ENTMT INC	5-25-1994	NA	8-30-1999
NA	AMERICAN EXPLORATION CO	5-31-1994	NA	3-28-1995
NA	HAMPTON RES CORP	8-9-1994	NA	10-6-1994
NA	PLAINS PETROLEUM COMPANY	9-19-1994	NA	7-1-1999
NA	DATALOGIX INTERNATIONAL INC	9-19-1994	NA	7-1-1999
NA	YOUNKERS INC	9-20-1994	NA	11-29-1994
NA	NA	9-22-1994	NA	11-30-1994
NA	SOUTHERN PERU COPPER	10-28-1994	NA	1-3-1996
AMERICAN GENERAL CORP	COPLEY PROPERTIES INC	12-1-1994	INDEPENDENT INS GRP	10-19-1995
ASARCO INC	EASTN ENVIRONMENT SVC	4-4-1995	CYPRUS AMAX MINERALS CO	7-15-1999
NA	AMERICAN INDL PPTYS REIT	4-26-1995	NA	9-7-1995
NA	DELAWARE OTSEGO CORP	5-24-1995	NA	6-28-1995
PUBLIC STORAGE INC	COOPER & CHYAN TECH INC	11-22-1995	PUB STRG PPTYS IX	12-14-1995
CSX CORP	NORTH COAST ENERGY INC	2-13-1996	CONRAIL INC	10-15-1996
SYNOPSYS INC	NA	5-7-1996	EPIC DESIGN TECHNOLOGY	1-16-1997

			INC	
NA	PAXSON COMM CORP -CL A	9-24-1996	NA	-19971-2
MEDTRONIC INC	U S BIOSCIENCE INC	12-13-1996	PHYSIO-CONTROL INTL CORP	6-29-1998
NA	NA	12-16-1996	NA	12-26-1996
ALZA CORP	EXCITE INC	2-4-1997	SEQUUS PHARMACEUTICALS INC	10-5-1998
INTEL CORP	NA	3-19-1997	CHIPS & TECHNOLOGIES INC	7-28-1997
NA	NA	6-11-1997	NA	5-18-1998
INTL SPEEDWAY CORP -CL A	NA	7-23-1997	PENSKE MOTORSPORTS INC	5-10-1999
NEWPORT NEWS SHIPBUILDING	NA	3-18-1998	AVONDALE INDUSTRIES INC	1-19-1999
PEREGRINE SYSTEMS INC	-	12-17-1999	HARBINGER CORP	4-5-2000
SYMANTEC CORP	-	7-24-2000	AXENT TECHNOLOGIES INC	7-27-2000
JORGENSEN (EARLE M.) CO	-	-	TULL (J.M.) INDUSTRIES INC	3-22-1985
TOLEDO EDISON CO	-	-	CLEVELAND ELECTRIC ILLUM	6-30-1985
WEST POINT-PEPPERELL	-	-	CLUETT PEABODY & CO	7-26-1985
ONYX IMI LTD	-	-	CORVUS SYSTEMS INC	9-25-1985
PIEDMONT AVIATION INC	-	-	EMPIRE AIRLINES INC	9-25-1985
LOUISIANA GENERAL SERVICES	-	-	TRANS LOUISIANA GAS CO INC	11-4-1985
AVERY INC	-	-	UNIROYAL CHEMICAL CP	11-8-1985
DECOR CORP	-	-	ART EXPLOSION INC	1-15-1986
STV GROUP INC	-	-	GREINER ENGINEERING INC	5-6-1986
SPERRY CORP	-	-	TELEX CORP	5-8-1986
SONIC INDUSTRIES INC	-	-	CHURCH'S FRIED CHICKEN INC	2-5-1987
MORINO INC	-	-	BGS SYSTEMS INC	2-11-1988
TRANS WORLD CORP/NV	-	-	DE LAURENTIIS ENTMNT GROUP	10-5-1988
FINALCO GROUP INC	-	-	CONTINENTAL INFO SYS - OLD	1-11-1989
BIO-MEDICUS INC	-	-	HEMOTEC INC	2-2-1989
SPRINGBOARD SOFTWARE INC	-	-	SPINNAKER SOFTWARE CORP	5-3-1989
COLUMBIAN ENERGY CO -LP	-	-	MUSTANG COS INC	8-31-1989
UNITED STATES EXPLORATION	-	-	PRAIRIE PRODUCING CO	12-21-1989
HADSON ENERGY RESOURCES CP	-	-	BARUCH-FOSTER CORP	3-16-1990
MICROLOG CORP	-	-	GENESIS HEALTH VENTURES INC	10-15-1990
GREASE MONKEY HOLDING CORP	-	-	PIT STOP AUTO CENTERS INC	10-24-1990
HINGHAM INSTN FOR SAVINGS	-	-	COHASSETT SAVINGS BANK/MA	12-21-1990
PINNACLE WEST CAPITAL	-	-	TUCSON ELECTRIC POWER CO	5-22-1991
AMERICAN GENERAL FINANCE CP	-	-	PROVIDENT ENERGY TRUST	8-12-1992
GULL LABORATORIES INC	-	-	BIO-PLEXUS INC	10-2-1992
IPALCO ENTERPRISES INC	-	-	PSI RESOURCES INC	12-11-1992
NUVEEN SELECT MAT MUN FD	-	-	NUVEEN SELECT MATS MUN FD 2	7-28-1993
SPECTRANETICS CORP	-	-	ADVANCED INTERVENTIONAL SYS	10-7-1993
INTRENET INC	-	-	PST VANS INC	1-7-1994
SITE HOLDINGS INC	-	-	METROVISION OF NA	3-30-1994
NUVEEN SLCT TX FR INCM PTL 3	-	-	NUVEEN SLCT TX FR INCM PTL 4	4-20-1994
NUVEEN TEX QUAL INCM MUN FD	-	-	NUVEEN TEX PREM INCM MUN FD	6-29-1994
DAVCO RESTAURANTS INC	-	-	SOUTHERN HOSPITALITY	7-14-1994
WELLSFORD RES PROP TRUST	-	-	HOLLY RESIDENTIAL PPTYS INC	8-3-1994
SOFTWARE ETC STORES INC	-	-	BABBAGES INC	8-25-1994
HF BANCORP INC	-	-	PALM SPRINGS SVGS BK FSB	5-7-1996
NUVEEN INSD PREM INC FUND 2	-	-	NUVEEN INSD PREM INCM MUN FD	7-26-1996
DSP COMMUNICATIONS INC	-	-	PROXIM INC	10-29-1996
FCB FINL CORP	-	-	OSB FINL CORP	11-14-1996
DAKOTA MINING CORP	-	-	USMX INC	1-6-1997

STAGE STORES INC	-	-	ANTHONY (C.R.) CO -OLD	2-19-1997
ULTIMATE ELECTRONICS INC	-	-	AUDIO KING CORP	3-4-1997
MONTEREY RESOURCES INC	-	-	MCFARLAND ENERGY INC	6-17-1997
OMI CORP	-	-	MARINE TRANSPORT LINES INC	6-24-1997
HMN FINANCIAL INC	-	-	MARSHALLTOWN FINANCIAL CP	7-1-1997
POST PROPERTIES INC	-	-	COLUMBUS REALTY TRUST	8-4-1997
ELCOTEL INC	-	-	TECHNOLOGY SVC GROUP INC	8-14-1997
MARSHALL INDUSTRIES	-	-	STERLING ELECTRONICS	9-19-1997
PUTNAM MASTER INTERM INCOME	-	-	PUTNAM INTER GVT INCOME	10-9-1997
DISCOUNT AUTO PARTS INC	-	-	HI-LO AUTOMOTIVE INC	10-14-1997
TAURUS MUNI CALIF HLDGS	-	-	MUNIYIELD CALIF FD INC	11-26-1997
AMERICAS INCOME TR INC	-	-	HIGHLANDER INCOME FD INC	4-13-1998
AVIVA PETE INC -DEP	-	-	GARNET RESOURCES CORP	4-17-1998
TROPICAL SPORTSWEAR INTL CP	-	-	FARAH INC	5-4-1998
INFORMATION ADVNTGE SOFTWARE	-	-	IQ SOFTWARE CORP	6-29-1998
VERDANT BRANDS INC	-	-	CONSEP INC	7-14-1998
DIME COMMUNITY BANCSHARES	-	-	FINANCIAL BANCORP INC	7-20-1998
PITTSBURGH BREWING	-	-	INDEPENDENCE BREWING CO	7-27-1998
R & B FALCON CORP	-	-	CLIFFS DRILLING CO	8-10-1998
MESA AIR GROUP INC	-	-	CCAIR INC	8-28-1998
FIRST FINANCIAL CORP/RI	-	-	MAYFLOWER CO-OPERATIVE BK/MA	10-14-1998
SUPERIOR TELECOM INC	-	-	ESSEX INTERNATIONAL INC	10-22-1998
INTEGRATED DEVICE TECH INC	-	-	QUALITY SEMICONDUCTOR INC	11-2-1998
PROLOGIS	-	-	MERIDIAN INDL TRUST INC	11-17-1998
ARDENT SOFTWARE INC	-	-	PRISM SOLUTIONS INC	11-19-1998
SPEEDFAM-IPEC INC	-	-	INTEGRATED PROCESS EQ	11-20-1998
KALEIDOSCOPE MEDIA GROUP INC	-	-	ODYSSEY PICTURES CORP	1-27-1999
ESENJAY EXPLORATION INC	-	-	3DX TECHNOLOGIES INC	5-12-1999
FRIEDE GOLDMAN HALTER INC	-	-	HALTER MARINE GROUP INC	6-2-1999
PHARMACIA & UPJOHN INC	-	-	SUGEN INC	6-15-1999
UNION FINL BANCSHARES INC	-	-	STH CAROLINA CMNTY BNCSHRS	7-1-1999
GELTEX PHARMACEUTICALS INC	-	-	SUNPHARM CORP	8-16-1999
DELHAIZE AMERICA INC -CL A	-	-	HANNAFORD BROTHERS CO	8-18-1999
INVIVO CORP	-	-	PROTOCOL SYSTEMS INC	12-17-1999
SOUTH FINANCIAL GROUP INC	-	-	ANCHOR FINANCIAL CORP/SC	1-10-2000
BROADVISION INC	-	-	INTERLEAF INC	1-26-2000
OPENTV CORP	-	-	SPYGLASS INC	3-27-2000
WEBMETHODS INC	-	-	ACTIVE SOFTWARE INC	5-22-2000
GUILFORD PHARMACEUTICAL INC	-	-	GLIATECH INC	5-30-2000
BROADWING INC	-	-	INTERMEDIA COMMUNICATNS INC	6-8-2000
TROY FINANCIAL CORP	-	-	CATSKILL FINANCIAL CORP	6-8-2000
CEPHALON INC	-	-	ANESTA CORP	7-17-2000
SEACOAST FINL SVCS CORP		-	HOME PORT BANCORP INC	7-24-2000
LEVITZ FURNITURE INC -VTG		-	SEAMAN FURNITURE CO	8-10-2000

[a] "NA" is a firm not listed on any stock market and "-" is an observation without an outsider-toehold. Competitors are not specified.

Essay III



The Insiders' Dilemma:
An Experiment on Merger Formation*

Tobias Lindqvist
IUI and Stockholm University

Johan Stennek
IUI and CEPR

Abstract

This paper tests the insiders' dilemma hypothesis in a laboratory experiment. The insiders' dilemma means that a profitable merger does not occur, because it is even more profitable for each firm to unilaterally stand as an outsider (Stigler, 1950; Kamien and Zang, 1990 and 1993). The experimental data provides support for the insiders' dilemma, and thereby for endogenous rather than exogenous merger theory. More surprisingly, our data suggests that fairness (or relative performance) considerations also make profitable mergers difficult. Mergers that should occur in equilibrium do not, since they require an unequal split of surplus.

Keywords: coalition formation, experiment, insiders' dilemma, mergers, antitrust

JEL classification: C78, C92, G34, L13, L41

*Our work has been much improved due to discussions with Martin Dufwenberg. We are grateful for comments from Jonas Björnerstedt, Matias Eklöf, Henrik Horn, Kai Konrad, Wieland Müller, Lars Persson, Arno Reidl, Per Skedinger and participants in the ESA'01 meeting in Barcelona, the Second Summer School in Experimental Economics in Trento, EARIE'01 in Dublin, ESA'02 in Boston, IUI and Stockholm University. Thanks also to Magnus Wiberg for assistance during the experimental sessions, participants in the pilot experiment at the IUI and Christina Lönnblad for editorial assistance. Lindqvist (TobiasL@iui.se) thanks Marianne och Marcus Wallenbergs Stiftelse for financial support. Stennek (JohanS@iui.se) thanks Jan Wallander och Tom Hedelius Stiftelse för samhällsvetenskaplig forskning for financial support. Postal address: The Research Institute of Industrial Economics (IUI), P.O. Box 5501, SE-114 85 Stockholm.

1 Introduction

Market power is one of the motives for mergers between competitors. Stigler (1950) points out two important obstacles to such mergers, however. First, even if an anti-competitive merger increases aggregate industry profits, it may be unprofitable for the firms involved. The reason is that the increased price triggers new entry and induces existing competitors to increase their production, thereby reducing the merging firms' market share. Second, even if the merger is profitable, remaining outside an anti-competitive merger is usually more profitable than participating, since outsiders benefit from an increase in price, but need not reduce output themselves. Firms may thus not have an incentive to participate in anti-competitive mergers, even if these are profitable, a phenomenon that we call *the insiders' dilemma.*

These obstacles have important implications for competition policy. Anti-competitive mergers are difficult to form, while mergers creating sufficient efficiency gains are not. These considerations suggest that horizontal mergers are primarily formed for other reasons than market power, for instance cost synergies. Allowing competition authorities to control mergers may thwart or delay such gains. Despite its potential importance for merger policy, there does not exist any empirical evidence indicating the strength of the insiders' dilemma, partly due to the difficulty in collecting and interpreting data about mergers that did not occur.[1] Running a laboratory experiment overcomes these difficulties and the purpose of this paper is to test the significance of the insiders' dilemma in such an experiment.[2]

[1] Event studies may provide some information about externalities from mergers that actually occur, see e.g. Eckbo (1983). However, not knowing the market's expectations before a merger implies difficulties in interpreting such data (Fridolfsson and Stennek, 2000b). Moreover, such studies cannot estimate the extent to which profitable mergers are blocked due to the insiders' dilemma.

[2] The previous experimental literature on mergers (Huck, Konrad, Müller and Normann,

Stigler's first idea has subsequently received partial support in the so-called exogenous merger literature. Horizontal mergers are unprofitable in a Cournot oligopoly with constant marginal costs, unless the merger involves a large proportion of all firms (Szidarovszky and Yakowitz, 1982; Salant, Switzer and Reynolds, 1983). However, if the marginal cost is increasing, or if firms compete in prices, mergers are typically profitable (Perry and Porter, 1985; Deneckere and Davidson, 1985). The exogenous merger literature also provides some support for Stigler's second point, showing that outsiders in anti-competitive mergers gain more than insiders. A potential drawback of the exogenous merger literature, however, is that it analyzes mergers in isolation and builds on the presumption that mergers occur if, and only if, they are profitable. As a result, these externalities are considered to be irrelevant for the merger decision.

More recently, the endogenous merger literature, using non-cooperative models of the acquisition process, indicates that externalities actually are of importance. This literature has formalized the insiders' dilemma. Kamien and Zang (1990, 1991 and 1993) show that a profitable merger from ($n \geq 3$ firm) oligopoly to monopoly may not be an equilibrium. Since each target becomes a duopolist by *unilaterally* rejecting its bid, they will require too large a premium to make an acquisition profitable for a prospective buyer.[3]

This formalization of the insiders' dilemma is best illustrated in an example with three symmetric firms. If there is no merger, every firm earns the triopoly profit denoted T. If there is a merger to duopoly, both firms earn D.

2000) has focused on the effects of mergers and not on the actual merger decision.

[3]Fridolfsson and Stennek (2000) formalize the existence of an insiders' dilemma also in the case of mergers between two firms. In their model of multi-person bargaining, mergers are delayed rather than completely blocked, however. Gomes (2000) shows that the insiders' dilemma may be overcome if firms use contingent bids. Using a cooperative model of the acquisition process, Horn and Persson (2001) argue that firms may be able to overcome the insiders' dilemma.

If there is a merger to monopoly the firm earns M. Kamien and Zang (1990) consider an acquisition game where all firms simultaneously submit a bid for every other firm and an asking price for his own firm. The firm offering the highest bid above the asking price buys the target firm. The key issue is then whether there exists a Nash equilibrium where one firm buys both competitors to create a monopoly. The answer is that such an equilibrium may not exist, even if the merger would be profitable, i.e. $M > 3T$. To understand why, assume that monopolization is an equilibrium, where the buyer offers b to each competitor. At the same time, both sellers are supposed to announce an asking price $a = b$ (asking for less would be giving money). Each selling firm knows that by raising the asking price somewhat above b, it will become a duopolist and earn D. Therefore, for the acquisition to be an equilibrium, it is necessary that $a = b \geq D$. The buyer does not have an incentive to announce such a high bid unless $M - 2D \geq T$. Thus, monopolization is an equilibrium if, and only if, $M \geq T + 2D$. This condition is more strict than $M \geq 3T$ whenever $D > T$, i.e. whenever a merger to duopoly exerts a positive externality on the outsider.

Kamien and Zang (1993) consider a sequential model, consisting of the static model repeated in a number of periods. The key insight is that the insiders' dilemma remains, although in a weaker form. In a game of two periods, a buyer still needs to pay D for the last firm, but he can buy the first firm for T. Thus, there exists an equilibrium with merger to monopoly if, and only if, $M \geq 2T + D$.

The primary purpose of this paper is to test a particular mechanism, namely Kamien and Zang's formalization of the insiders' dilemma, but it also serves a broader aim. The paper is a first attempt to empirically discriminate between the old exogenous and the new endogenous merger theory.

The former only focuses on how the merger changes the insiders' profits in comparison to the outset. The latter, which is an application of the theory of coalition formation, indicates that merger incentives are also affected by externalities. We include different treatments where the profitability of the merger is constant, but where the externalities vary. If merger frequencies indeed vary with externalities, this may be taken as support for the endogenous merger theory over the exogenous merger approach. Even more broadly, our paper can be viewed as one of the first attempts to empirically test the theory of coalition formation, since endogenous merger theory is an application of this field.

2 Theoretical Predictions

We will test the insiders' dilemma in two different environments. The first environment concerns simultaneous acquisitions (corresponding to Kamien and Zang, 1990), the second sequential acquisitions (corresponding to Kamien and Zang, 1993). We simplify Kamien and Zang's models in several ways to make them amenable to experimental testing.

There are three players in our model of simultaneous acquisitions: one buyer and two sellers. At date one, the buyer makes an offer b, the same to both buyers. At date two, the sellers simultaneously and independently decide whether to accept or reject the offer. There are three possible outcomes in terms of market structure. If both sellers reject, there is triopoly, and all players receive payoff T. If one seller rejects and the other accepts, there is duopoly. The buyer receives payoff $D - b$, the rejecting seller receives D and the accepting seller, b. If both sellers accept, there is monopoly. The buyer

receives payoff $M - 2b$ and the sellers receive b each.[4]

Exactly as Kamien and Zang, we assume that a merger from triopoly to duopoly is not profitable, that is $D < 2T$. A merger from triopoly to duopoly exerts a positive externality on the outsider, i.e. $D > T$. It is also assumed that mergers from duopoly to monopoly and from triopoly to monopoly are profitable, that is $M > 2D$ and $M > 3T$. All these assumptions are consistent with simple oligopoly models.

The equilibrium concept is a subgame perfect equilibrium.

Proposition 1 *Consider the model of simultaneous acquisitions. If* $M - 2D > T$, *the buyer bids* $b = D$, *both sellers accept the bid, and there is merger to monopoly. If* $M - 2D < T$, *the buyer bids* $b \leq T$, *both sellers reject the bid, and the triopoly remains.*

Proof: At date two, the equilibrium depends on the bid b. If $b \leq T$, rejection is an equilibrium. All players receive T. If $b \geq D$, acceptance is an equilibrium. To maximize his payoff, the buyer offers $b = D$. In this case, the buyer receives $M - 2D$ and the sellers receive D. If $b \in (T, D)$, there are three possible equilibria at date two. There are two asymmetric equilibria in pure strategies requiring one seller to accept and the other to reject. There is also a symmetric equilibrium in mixed strategies. The rest of this proof, however, demonstrates that the buyer will not bid $b \in (T, D)$ in equilibrium. First, consider the case of (asymmetric) pure strategies. To maximize his payoff, the buyer offers $b = T+1$. In this case, the buyer receives $D-T-1$. By offering $b \leq T$, inducing rejection, the buyer can guarantee himself $T > D-T-1$.

[4] To simplify the analysis we assume that both firms in the duopoly (the merged firm and the outsider) earn the same profit. Although extreme, this assumption is consistent with a homogenous good Cournot oligopoly with constant returns to scale. The assumption is not essential for the insiders' dilemma mechanism, however, and was also used by Kamien and Zang.

Second, consider the symmetric equilibrium in mixed strategies, where the probability of acceptance is $p = (b-T)/(D-T) \in (0,1)$. The buyer's payoff is $p^2[M-2b] + 2p(1-p)[D-b] + (1-p)^2 T$. Assume first that $M-2b > T$, then $M-2b > D-b$ (since $b < D$ and merger from duopoly to monopoly is profitable, i.e. $M > 2D$), implying that $b = D$ and monopoly is a better choice. Assume next that $T > M-2b$, then $T > D-b$ (since $b > T$ and merger from triopoly to duopoly is unprofitable, i.e. $D < 2T$), implying that $b = T$ and triopoly is a better choice. QED.

Consider next the model of sequential acquisitions. There are four periods with perfect information, and the buyer can only bid for one firm at a time. At date one, the buyer makes an offer b_1 to the first seller. At date two, the first seller accepts or rejects the offer and at date three, the buyer makes an offer b_2 to the second seller. At date four, the second seller accepts or rejects the offer. If both sellers reject, there is triopoly, in which case all players receive payoff T. If seller i accepts and the other rejects, there is duopoly. The buyer receives payoff $D-b_i$, the rejecting seller receives D and the accepting seller b_i. If both sellers accept, there is monopoly; the buyer receives payoff $M-b_1-b_2$ and seller i receives b_i.

Proposition 2 *Consider the model of sequential acquisitions. If $M > D+2T$, the buyer bids $b_1 = T$ and $b_2 = D$, both sellers accept and there is merger to monopoly. If $M < D+2T$, the buyer bids $b_1, b_2 < T$, both sellers reject and the triopoly remains.*

Proof: At date four, seller two accepts if, and only if, $b_2 \geq D$ (in case seller one accepted) or $b_2 \geq T$ (in case seller one rejected). At date three, the buyer offers $b_2 = D$ in case seller one accepted, since then $M-b_1-b_2 > D-b_1$ is maximized. In case seller one rejected, the buyer offers $b_2 < T$ since

$D - b_2 < T$ for all $b_2 \geq T$. At date two, seller one accepts if, and only if, $b_1 \geq T$. At date one, the buyer offers $b_1 = T$ if $M - T - D \geq T$ and $b_1 < T$ otherwise. QED.

Finally, we should motivate our key simplifications of Kamien and Zang's models. There are two distinct reasons why a profitable merger may not occur in Kamien and Zang's models. First, there is the insiders' dilemma and second, there is a coordination problem in the allocation of roles. Who should be the buyer and who should be the seller? This is not a trivial problem since different roles yield different payoffs. This is not, however, the problem on which Kamien and Zang have focused. Instead, they eliminate it by studying asymmetric equilibria where the roles are allocated to the firms as part of the equilibrium prescription. Since we only want to test for the importance of the insiders' dilemma, we also wish to eliminate this coordination problem in the experimental design. Since we cannot select an equilibrium, this is done by changing the rules of the game. In particular, we assign roles (buyer and seller) to the different firms as part of the description of the game. Kamien and Zang's models also contain a second coordination problem. Since the split of surplus is determined in the same way as in a Nash demand game, all prices between a buyer's valuation and a seller's reservation price constitute an equilibrium price. To eliminate this problem, we let sellers observe the bids before responding.

3 Experimental Design

The experiment consists of four treatments, summarized in Table 1. Treatments Sim-T and Sim-M concern the simultaneous acquisition game and treatments Seq-T and Seq-M the sequential acquisition game. In all treat-

ments, $M = 43.5$ and $T = 11.5$ are held constant. Thus, the profitability of a merger to monopoly, that is $M - 3T > 0$, is held constant throughout the experiment. We use the duopoly profit D as a control variable. In the *test treatments* Sim-T and Seq-T, the duopoly profit is sufficiently high for endogenous merger theory to predict that no merger occurs, even though a merger to monopoly is profitable. In the *control treatments* Sim-M and Seq-M, the duopoly profit is sufficiently low for a merger to monopoly to occur according to endogenous merger theory.

Table 1. Summary of treatments ($T = 11.5$, $M = 43.5$)

Duopoly profit	Simultaneous acquisitions	Sequential acquisitions
High ($D = 21.5$)	-	**Treatment: Seq-T** Prediction: Triopoly
Moderate ($D = 17.5$)	**Treatment: Sim-T** Prediction: Triopoly	**Treatment: Seq-M** Prediction: Monopoly
Low ($D = 12.5$)	**Treatment: Sim-M** Prediction: Monopoly	-

In the tests, we will investigate if the occurrence of merger to monopoly differs significantly between different pairs of treatments, a test treatment and a control treatment. The procedure for comparing the outcome in test treatments with the outcome in control treatments ensures that the absence of mergers in Sim-T and Seq-T is due to the insiders' dilemma, and not to any other factors that are not part of endogenous merger theory.

The appropriate null-hypothesis is the assertion which should be considered valid, unless evidence throws serious doubts on it. We let exogenous

merger theory provide the null-hypothesis for two reasons. Exogenous merger theory is the more established framework for analyzing mergers and it is also simpler than endogenous merger theory. The null-hypothesis is that there is no difference in the outcomes between any pair of treatments, since the profitability of merger to monopoly is the same in all treatments and since the exogenous merger theory asserts that externalities are irrelevant.[5] The alternative hypothesis is the assertion provided by endogenous merger theory. As indicated in Table 2, we perform three types of comparisons.

Table 2: Summary of tests.

Test	Test treatment	Control treatment
Simultaneous	Sim-T	Sim-M
Sequential	Seq-T	Seq-M
Simultaneous vs sequential	Sim-T	Seq-M

In Section 4.1, we compare test treatment Sim-T with control treatment Sim-M of the simultaneous game. In Section 4.2, we compare test treatment Seq-T with control treatment Seq-M of the sequential game. In both cases, the alternative hypothesis provided by endogenous merger theory is that the higher duopoly profit in the test treatments reduces firms' incentive to merge from triopoly to monopoly. Finally, in Section 4.3, we compare the simultaneous acquisition treatment Sim-T with the sequential acquisition treatment Seq-M. In these two treatments, all profit parameters, including the duopoly

[5]It is not obvious what the predictions of exogenous merger theory are. The problem is that the exogenous merger theory analyzes each merger in isolation, while we allow several possible but mutually exclusive mergers. To reduce the problem of interpretation, we assume that all mergers, except merger to monopoly, are unprofitable. Furthermore, we interpete the exogenous merger literature only to posit that externalities do not matter for merger incentives. An alternative would have been to use the stronger assertion that mergers occur if, and only if, they are profitable.

profit, are the same. This test will reveal if sequential acquisitions mitigate the insiders' dilemma, as suggested by endogenous merger theory.

We planned to run ten trials of each treatment. New subjects were used in every treatment. Groups of three subjects (one buyer and two sellers) were randomly formed in each trial, which means that each subject only participated in one trial where the subject only played the game once. Since new subjects were used in each trial, we did not need to use random matching. Subjects first played four rounds of practice without monetary rewards but with feedback about the outcomes after each round. Each group remained the same in the real round and the practice rounds. The members of the group were anonymous.

The subjects were recruited from Stockholm University. An announcement was posted at different places allover the University where people were told to send an e-mail to sign up for the experiment. The announcement contained information about a one-hour-experiment, including 15 minutes for instructions and 35 minutes for practice rounds, with a show up fee of SEK 50 (approximately $ 5) and the possibility of making more money. We asked for thirty-three people in each treatment (including three to cover for no-shows). The experiment was carried out in Swedish in March and April 2001, pen-and-paper style.

The procedure was as follows. A single class room was used for each treatment. Participants were randomly given a number (1-30) to allocate their seats in the class room. When all participants were seated, they received instructions, reproduced in Appendix A.1 for simultaneous treatments and Appendix A.2 for sequential treatments. After reading the instructions, each participant received a private answer form, also informing the participant about his role (buyer or seller).

In the simultaneous treatments, each buyer offered one bid on the reply form. Each bid was copied by the experimenter and distributed to two of the sellers. The bid was either rejected or accepted by the sellers on their reply form. Their answers were copied by the experimenter and distributed to the buyer and the other seller in the group. In the sequential treatments, the buyers first offered a bid to one seller and then, after all player had been informed about the response (but not the size of the bid), a possibly different bid to the second seller. After this single round, the participants could, anonymously, convert their individual profit into cash before leaving the class room. The profits were given in points in the experiment where 1 point = SEK 10 (approximately $ 1).

The buyers' bids are restricted to be non-negative integers, while all profit parameters (T, D and M) are non-integers. As a result, players have strict incentives to follow the equilibrium recommendation, i.e. there exists no node where a player is indifferent between his equilibrium action(s) and some other action. A maximum bid was introduced to ensure that no subject could lose money, including the show-up fee.

4 Results

4.1 Simultaneous Treatments

Treatments Sim-T and Sim-M concern simultaneous acquisitions. As described in Proposition 1, endogenous merger theory suggests a triopoly outcome in the test treatment Sim-T, since buyers should offer a bid below the triopoly profit $T = 11.5$, and sellers should reject this bid.[6] In the control

[6] According to the equilibrium the buyer should acually offer an even lower bid, i.e. $b < D - T$. However, the sellers reject all bids below the triopoly profit, T, in equilibrium. To simplify our analyse and make the buyer behavior correspondent with the seller behavior

treatment, Sim-M, the equilibrium outcome is monopoly, since buyers should bid just above the duopoly profit $D = 12.5$, and sellers should accept this bid. A complete description of the raw data is presented in Table 3. Due to no-shows, we could only run nine trials in Sim-M. In all tables, bold indicates that behavior or outcome is consistent with the equilibrium in the relevant subgame.

Table 3: Raw data for simultaneous acquisitions

Sim-T										
Bid	15	14	13	13	12	**11**	8	**6**	**6**	**0**
Seller	**Yes**	**Yes**	**Yes**	**No**	**Yes**	Yes	**No**	**No**	**No**	**No**
Seller	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**
Sim-M										
Bid	15	14	14	**13**	**13**	**13**	12	7	0	-
Seller	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	-
Seller	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**No**	**No**	**No**	-

The first test investigates whether there are any differences between the treatments in terms of the resulting market structure (triopoly, duopoly, or monopoly). Table 4 reports the market outcomes for simultaneous treatments.

we lump all the bids below T in this section and treat all these bids as an attempt to avoid an acquisition.

Table 4: Market outcomes for simultaneous treatments				
Treatment	Monopoly	Duopoly	Triopoly	Total
Sim-T	1	4	5	10
Sim-M	5	2	2	9
Difference in frequency (significance level)	0.456** (0.0495)	-0.178 (0.3622)	-0.278 (0.2199)	-

In treatment Sim-M, five trials out of nine (56 percent) resulted in a monopoly whereas only one out of ten (10 percent) in Sim-T. The last row presents the difference between the two treatment frequencies ($5/9 - 1/10 \approx 0.456$). Although the difference is not as extreme as suggested by endogenous merger theory, it has the predicted sign. There is more monopolization in Sim-M than in Sim-T. There is also a difference in the triopoly outcomes; in treatment Sim-T five trials out of ten (50 percent) resulted in triopoly, whereas only two out of nine (22 percent) in Sim-M. This difference also has the predicted sign.

The next step is to test if the differences between Sim-T and Sim-M are statistically significant. Since this and all subsequent tests concern two independent samples, with categorical data (monopoly versus triopoly), and since we will have few observations, the appropriate test is Fisher's exact test (Bradley, 1968). A peculiarity of this test, when there are more than two different outcomes (monopoly, duopoly, triopoly), is that the differences in the frequencies are investigated one by one. We start with the frequency of monopoly.[7] The null hypothesis is that the frequency of monopoly is the

[7]To apply Fisher's exact test for 2×2 tables, the 3×2 table must be partitioned (see Bradley, 1968). When testing the difference in monopoly frequency, one starts by comparing the triopoly and duopoly outcomes. If there is no significant difference between the two treatments (10 percent level), the duopoly and triopoly observations are clustered to create a 2×2 matrix (monopoly vs. non-monopoly).

same in Sim-T and Sim-M. The alternative hypothesis is that the monopoly frequency is larger in Sim-M than in Sim-T. The last row in Table 4 indicates that the difference between the two monopoly frequencies (0.456) is statistically different from zero (i.e. positive) at the five-percent level, using a one-sided test.[8] Thus, we can reject the null hypothesis at the five-percent level. The difference in triopoly frequencies is not significantly different from zero.

To acquire a deeper understanding of merger incentives, we proceed to test if buyers and sellers conform to their equilibrium strategies, prescribed by endogenous merger theory. Note that even if the outcome in terms of market structure conforms to the predictions of endogenous merger theory, the strategy profile may not. Conversely, insignificant deviations from the equilibrium strategies may result in significant deviations from the equilibrium outcome.

Working backwards, we start by analyzing seller behavior. Since sellers find themselves in different subgames depending on the buyers' bids, we need to take the level of the bid into account. We divide bids into the three categories suggested by theory. Bids above the duopoly profit should be accepted and bids below the triopoly profit rejected. For bids between the triopoly and duopoly profits, theory does not deliver sharp predictions. There are three different equilibria in the subgame, two asymmetric pure strategy equilibria and one symmetric equilibrium in mixed strategies. Table 5 aggregates the sellers' behavior in treatments Sim-T and Sim-M. Overall, there were 12 bids above the duopoly level, 12 bids at the intermediate level, and 14 bids below the triopoly level.

[8] The significance level is the probability that we would observe the actual outcome, or a more extreme outcome, given that the null hypothesis is true. In all tables, stars * (**) indicate that the difference is statistically different from zero and thus, that the null hypothesis is rejected, with a 10 (5) percent level of significance.

Table 5: Seller behavior in simultaneous treatments				
Bid	Total	Accept	Reject	Difference in acceptance rate (sig.)
$D < b$	12	**11**	1	0.417** (0.034)
$T < b < D$	12	**6**	**6**	0.429** (0.021)
$b < T$	14	1	**13**	-

Table 5 indicates that the sellers' behavior is determined by the level of the bid, as suggested by the equilibrium recommendation. Out of 12 bids above the duopoly profit, 11 were accepted as prescribed by the equilibrium recommendation. Out of the 14 bids below the triopoly profit, 13 were rejected as prescribed.

The next step is to test if the sellers' behavior differs significantly due to the level of the bid. The last column of Table 5 compares the acceptance rate in a given row with that in the following row. The acceptance rate was 42 percent ($11/12 - 6/12 \approx 0.417$) higher for bids above the duopoly profit than for bids at the intermediate level. Similarly, the acceptance rate was 43 percent higher for bids at the intermediate level than for bids below the triopoly profit. Using Fisher's test, we must consider the two differences separately. In the case of the two top rows, the null hypothesis is that the acceptance rate is the same for bids $b > D$ as for intermediate bids, $T < b < D$. The alternative hypothesis is that the acceptance rate is higher when $b > D$. Both differences turn out to be significantly different from zero at the five percent level and thus, we reject the null hypothesis. The sellers' acceptance rate is determined by the bid. In particular, to ensure acceptance, bids must exceed the duopoly profit rather than the triopoly profit, as suggested by endogenous merger theory.

Table 6 summarizes buyer behavior from Table 3. In treatment Sim-T, the equilibrium prescribes that buyers should bid below T to induce rejection. In treatment Sim-M, buyers should bid the smallest amount above D. In Table 6, we have lumped all bids above the duopoly profit together since they all indicate an attempt to monopolize the market.

Table 6: Buyer behavior for simultaneous treatments

Treatment	$b < T$	$T < b < D$	$D < b$	Total
Sim-T	5	5	0	10
Sim-M	2	1	6	9
Difference in frequency	-0.278	-0.389	0.667**	-
(significance level)	(n.a.)	(n.a.)	(0.0031)	

Table 6 shows that the proportion of low bids ($b < T$) is higher in Sim-T than in Sim-M ($-0.278 \approx 2/9 - 5/10$), and that the proportion of high bids ($D < b$) is higher in Sim-M than in Sim-T, as suggested by the equilibrium recommendation. Fisher's exact test shows that the latter, but not the former difference, is statistically significant.[9] Hence, we reject the null hypothesis that the proportion of high bids is the same in the test treatment Sim-T and the control treatment Sim-M, in favor of the alternative hypothesis that the proportion of high bids is larger in Sim-M than in Sim-T.

To summarize the analysis of simultaneous treatments, we have found that all differences have the predicted sign, but that not all are statistically significant.

[9] Given our data, Fisher's test is not available for computing significance levels for the differences between Sim-T and Sim-M in terms of the frequencies of low bids ($b < T$) and intermediate bids ($T < b < D$). For example, for low bids to be compared with non-low bids ($b > T$) we have to cluster intermediate bids and high bids. This cannot be done however, since they are significantly different from each other.

Conclusion 1 *In the simultaneous acquisition game, the duopoly profit affects the behavior of both buyers and sellers, and also the incidence of monopolization. In particular, monopolization is more difficult when the duopoly profit is higher, as suggested by endogenous merger theory.*

4.2 Sequential Treatments

Treatments Seq-T and Seq-M concern sequential acquisitions. As described in Proposition 2, endogenous merger theory suggests a triopoly outcome in the test treatment Seq-T, since buyers should offer bids below the triopoly profit $T = 11.5$, and both sellers should reject their bids. In the control treatment Seq-M, the equilibrium outcome is monopoly, since buyers should first bid just above the triopoly profit $T = 11.5$ (i.e. 12) and then just above the duopoly profit $D = 17.5$ (i.e. 18), and both sellers should accept their bids. A complete description of the raw data is presented in Table 7. In treatment Seq-T, we only have eight trials due to no-shows.

Table 7: Raw data for sequential acquisitions

Seq-T										
Bid 1	13	13	13	13	12	**11**	**4**	**0**	-	-
Seller 1	Yes	Yes	Yes	No	No	**No**	**No**	**No**	-	-
Bid 2	**14**	**13**	**13**	**9**	**10**	**6**	**6**	**0**	-	-
Seller 2	**No**	**No**	**No**	**No**	**No**	Yes	**No**	**No**	-	-
Seq-M										
Bid 1	16	15	15	14	13	**12**	**12**	5	**0**	**0**
Seller 1	**Yes**	**Yes**	**Yes**	No	No	No	No	**No**	**No**	**No**
Bid 2	16	15	8	16	**5**	**3**	**2**	**3**	**5**	**1**
Seller 2	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**

The first test investigates whether there are any differences between treatments in terms of the resulting market structure (triopoly, duopoly, or monopoly). Table 8 reports the market outcomes for sequential treatments.

Table 8: Market outcomes for sequential treatments

Treatment	Monopoly	Duopoly	Triopoly	Total
Seq-T	0	4	4	8
Seq-M	0	4	6	10
Difference in frequency (significance level)	0.000 (1.0000)	-0.100 (0.8158)	0.100 (0.8158)	-

The test treatment Seq-T seems to conform to endogenous merger theory, since subjects do not succeed in monopolizing the market. A potential explanation for this is the insiders' dilemma. Unexpectedly, however, monopoly did not occur in the control treatment Seq-M either. Actually, the frequency of triopoly is even larger in Seq-M than in Seq-T ($0.100 = 6/10 - 4/8$). The null hypothesis, which entails no difference between the treatments in terms of market structure, cannot be rejected by Fisher's test in any of the three cases. This result casts doubts on the insiders' dilemma as a cause of failure to monopolize the market in sequential games. The lack of monopoly can, however, be explained when analyzing the strategies of the player in more detail.

The primary question is why there is so little monopolization in Seq-M. Are the buyers' bids too low, or the sellers' demands too high? If anything, Table 7 shows that buyers have offered more than the equilibrium prescribes. However, some of the first sellers in Seq-M have rejected bids over $T = 11.5$, even though the equilibrium prescribes acceptance. If they had accepted a bid of for example 12, the buyer would (in equilibrium) have offered a bid

of 18 to the second seller and thereby monopolized the market. The returns would then have been 12 for seller 1 and 18 for seller 2. The equilibrium in the subgame after seller 1 rejects prescribes the buyer to offer a non-attractive bid to seller 2 and the triopoly would remain. Thus, all will receive 11.5.

One potential explanation for the first sellers' high demands is *fairness* or perhaps *envy*. Seller 1 does not accept 12 if seller 2 gets 18. Seller 1 does not accept an unfair outcome. But what is fair? If there is merger to monopoly, fair might mean that the firms split the surplus equally. In our treatments a fair bid would then be $43.5/3 = 14.5$. Thus, a seller caring for fairness may accept bids above 14.5 and reject lower bids. As can be seen in Table 7, there is indeed a cut-off point between 14 and 15 in the data for treatment Seq-M. The problem is that if the buyer has to pay 14.5 to the first seller, while still having to pay the duopoly profit to the second seller (the data suggests that the second seller demands the duopoly profit), the buyer would earn a higher profit by remaining in the triopoly. This may explain some of the failures to monopolize the market. In particular, the three right-most buyers in Table 7, treatment Seq-M, do not seem to have attempted to acquire the other firms. A potential explanation is that the buyers understood seller 1's demand for fairness.

The behavior of the four left-most buyers in Table 7, treatment Seq-M, strengthens the fairness argument. They offered bids of at least 14 to the first sellers. All but one also tended to offer fair bids to the second sellers. This (out of equilibrium) behavior may indicate that they intended to monopolize the market with a fair split of the surplus. These four buyers may have been governed by their own preferences for fairness, and not only by taking seller 1's fairness considerations into account. They fail to understand, however, that the second sellers will use their bargaining power and demand

the duopoly profit. We do, however, still consider fairness to be an open question. Future work on this topic may follow the lines suggested by Fehr and Schmidt (1999).[10]

One might ask why we do not discuss fairness in the simultaneous treatments. The reason is that our data indicates that fairness is more important in sequential than in simultaneous treatments. This, in turn, may be explained by the fact that the equilibrium only prescribes unequal payoffs to different sellers in the sequential treatments. It might be more surprising, that the sellers in the simultaneous treatments do not appear to have been concerned with the equality between buyers and sellers. Sellers conform to their equilibrium strategy, even though the equilibrium in Sim-M gives the buyer a profit of 17.5, while the sellers only receive 13. This result differs from experiments on ultimatum bargaining which, in the present context, can be considered as an acquisition game with only one seller. A possible reason for this difference is that in an acquisition game with two sellers, the first-mover advantage is not as pronounced. Sellers do receive a share of the surplus since the duopoly profit rather than the triopoly profit is the relevant threat point.

Conclusion 2 *In the sequential acquisition game, profitable monopolization did not only fail in the test treatment (with high duopoly profit) but also in the control treatment (with low duopoly profit). The data suggests that fairness might be the reason for this. Mergers that should occur in equilibrium do not, since they require an unequal split of surplus.*

[10] Additional treatments could be executed in many different ways to test the fairness hypothesis, e.g. Seq-3 with D=12.5 where b=14.5 is fair but still profitable. However, tests of fairness is beyond this paper but we definitely encourage researcher to futher investigate in this hypothesis.

A related question concerns how the roles are assigned. In our experiment, the roles of buyers, first-sellers and second-sellers were randomly distributed. If these roles had instead been determined by historical profits or some other performance indicator, giving rise to asymmetric strength, fairness considerations might be weaker. It may be accepted that stronger (weaker) firms profit more (less) when each firm has deserved its role in the market. In reality, targets may also reject early offers, hoping to sell out later as a second seller. Such waiting strategies arise in the dynamic acquisition game studied by Fridolfsson and Stennek (2000). These issues are left for future experimental work, however.

4.3 Simultaneous vs. Sequential

Finally, we should investigate if sequential acquisitions make monopolization easier as suggested by the endogenous merger theory. Table 9 provides a comparison between Sim-T and Seq-M, which have equal profit parameters but different timing in the acquisition procedure.

Table 9: Market outcomes: simultaneous vs sequential

Treatment	Monopoly	Duopoly	Triopoly	Total
Sim-T	1	4	5	10
Seq-M	0	4	6	10
Difference in frequency (significance level)	-0.100 (0.5000)	0.000 (0.6750)	0.100 (0.8151)	-

It is immediately clear that there is no significant difference between the two treatments in terms of the resulting market structure. Monopolization fails in both treatments. This failure can only be attributed to the insiders' dilemma in Sim-T, since merger is predicted in Seq-M.

5 Conclusions

The purpose of this paper is to test the insiders' dilemma hypothesis in a laboratory experiment. Are profitable mergers to monopoly blocked because it is more profitable for individual firms to unilaterally be outsiders?

Our first two treatments concern simultaneous acquisitions. Although the profitability of a merger from triopoly to monopoly is the same in both the test treatment and the control treatment, the sellers' outside option is different since the duopoly profit is higher in the test treatment. There are significantly less mergers to monopoly when the duopoly profit (threat point) is high, as suggested by the insiders' dilemma hypothesis. Furthermore, data on the buyers' and sellers' strategies suggests that the duopoly profit is an important determinant of merger activity.

The result that merger intensity is not only determined by profitability, but also by externalities, can also be viewed as a rejection of exogenous merger theory in favour of endogenous merger theory. We should point out, however, that our test hinges on Kamien and Zang's model of the acquisition process, while exogenous merger theory is silent on the details of the acquisition process. For this reason, further tests, using other models of the acquisition process such as unstructured bargaining, would be welcome complements to our results.

In the treatments concerning sequential acquisitions, monopoly outcomes were not observed either in the test treatment (with high duopoly profit) or in the control treatment (with low duopoly profit). The failure to monopolize the market in the control treatments indicates that the insiders' dilemma is not an appropriate explanation here.

The data is consistent with the idea that the first seller cares for fairness and does not accept a lower payoff than an equal split of the monopoly

profit. But monopolization at such high acquisition prices is unprofitable to the buyer. It might be questioned, however, if the fairness result is an artifact of the methodology of running a laboratory experiment with student subjects. Do real-world managers and shareholders care about fairness? Although we cannot provide a conclusive answer in the present paper, we see no reason to exclude this possibility. Managers and shareholders might not use the term fairness, but they do care about relative performance. That is, managers and shareholders do not only care about the profit of their own firm, but also about their performance in relation to other firms within the same industry. It is also interesting to note that Kamien and Zang (1993) probably anticipated the fairness result, saying that "...it is not clear why it should be possible to persuade one owner to sell out first and profit less than the other owner who sells out later, and not vice versa." In the end, this is an empirical question and future experimental work on merger formation could test for fairness or relative performance using the ideas of Fehr and Schmidt (1999).

References

[1] Bradley, J. V. (1968), *Distribution-Free Statistical Test*, Prentice-Hall, Englewood Cliffs, New Jersey.

[2] Deneckere, R., and C. Davidson (1985), "Incentives to Form Coalitions with Bertrand Competition," *Rand Journal of Economics*, Winter, 16(4), 473-86.

[3] Eckbo, B. E. (1983), "Horizontal Mergers, Collusion, and Stockholder Wealth," Journal of Financial Economics, 11(1-4), 241-73.

[4] Fehr, E., and K. M. Schmidt (1999) "A Theory of Fairness, Competition, and Cooperation," *Quarterly Journal of Economics*, August, 114(3), 817-68.

[5] Fridolfsson, S-O., and J. Stennek (2000), "Should We Control Mergers?," Discussion Paper 2705, Center for Economic Policy Research.

[6] Fridolfsson, S-O., and J. Stennek (2000b), "Why Event Studies do not Detect Anti-Competitive Mergers," , IUI Working Paper No. 542.

[7] Gomes, A. (2000), "A Theory of Negotiation and Formation of Coalitions," University of Pennsylvania, September.

[8] Horn, H., and L. Persson (2001), "Endogenous Mergers in Concentrated Markets," *International Journal of Industrial Organization* September, 19(8), 1213-44.

[9] Huck, S., K. A. Konrad, W. Müller, and H. T. Normann (2001), "Mergers and the Perception of Market Power: An Experimental Study," mimeo. Royal Holloway.

[10] Kamien, M. I., and I. Zang (1990), "The Limits of Monopolization Through Acquisition," *Quarterly Journal of Economics*, May, 105(2), 465-99.

[11] Kamien, M. I., and I. Zang (1991), "Competitively Cost Advantageous Mergers and Monopolization," *Games and Economic Behavior*; 3(3), 323-38.

[12] Kamien, M. I., and I. Zang (1993), "Monopolization by Sequential Acquisition," *The Journal of Law, Economics, & Organization*, October, 9(2), 205-29.

[13] Perry, M. K., and R. H. Porter (1985), "Oligopoly and the Incentive for Horizontal Merger," *American Economic Review*, March, 75(1), 219-27.

[14] Salant, S. W., S. Switzer, and R. J. Reynolds (1983), "Losses from Horizontal Merger: The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium," *Quarterly Journal of Economics*, May, 98(2), 185-99.

[15] Stigler, G. J. (1950), "Monopoly and Oligopoly by Merger," *American Economic Review*, 40, 23-34.

[16] Szidarovszky, F., and S. Yakowitz (1982), "Contributions to Cournot Oligopoly Theory," *Journal of Economic Theory*, 28, 51-70.

A Instructions

Originally, the instructions were written in Swedish. We include the instructions for the subjects participating in treatments Sim-T and Seq-M. For the other treatments, the duopoly profits must be changed.

A.1 Simultaneous Treatments

You are about to participate in an experiment in economic decision making. The experiment will be repeated in 5 rounds. All bids and profits in the experiment are given in points. The first four rounds are practice rounds and will not give any points, that is, you cannot make any money from these. Only the outcome in the last round will give points transferable into money, where 1 point = SEK 10. No one, except the experimenter, will know the decisions and payoffs of other people participating in this experiment. All payments are financed out of a grant from Marianne och Marcus Wallenbergs

Stiftelse. You receive SEK 50 each as a show up fee. The experiment will last for about 30 minutes.

People in this room will be divided into groups of three. Each group contains one buyer and two sellers. You will be informed of whether you are a seller or a buyer. The other two members of your group will be unknown to you.

Here is what will happen. The sellers hold one asset each. The buyer can buy these assets from the sellers. One round is divided into two phases:

Phase 1	The buyer offers one and the same bid to the two sellers.
Phase 2	The sellers receive the bid and accept or reject it. No seller can observe the decision of the other seller before he/she
	makes his/her own decision.

The bid must be an integer, minimum 0 and maximum 22.

How many points you receive will be determined by the following:

Buyers

Bought	Your profit
2	43.5-2*your bid (you have to pay the bid to each of the sellers)
1	17.5-your bid (you have to pay the bid to the accepting seller)
0	11.5

Hence, how many points you will receive as a buyer depends on how many assets you have bought and how much you have paid for them.

Sellers

Your answer	Your profit
Yes	You receive the bid.
No	Your payoff depends on the other seller:
	1. If the other seller also rejects = 11.5
	2. If the other seller accepts = 17.5

Hence, how many points you will receive as a seller depends on your own

decision and the decision of the other seller (if you reject).

After one round, we will observe your choices and announce your payoffs. Do not talk to the others and make sure that no one can see the choices you make on the reply form or your type (buyer or seller).

How many points you receive can also be illustrated in the following payoff matrix for buyers, offering a bid = b:

The buyer's matrix

		Seller 2: Yes	Seller 2: No
Seller 1	Yes	43.5-2b	17.5-b
	No	17.5-b	11.5

How many points you receive can also be illustrated in the following payoff matrix for sellers, receiving a bid = b:

The seller's matrix

		Answer of the other seller: Yes	Answer of the other seller: No
Your answer	Yes	b	b
	No	17.5	11.5

A.2 Sequential Treatments

//The first two paragraphs are identical to the simultaneous instruction.//

Here is what will happen. The sellers hold one asset each. The buyer can buy these assets from the sellers. However, it is only possible for buyers to buy one asset at a time, according to the following:

Phase 1	The buyer offers one bid to seller 1.
Phase 2	Seller 1 receives the bid and may accept or reject it.
Phase 3	Buyer and seller 2 are informed about the response of seller 1.
Phase 4	The buyer offers a bid to seller 2.
Phase 5	Seller 2 receives the bid and accepts or rejects.

The bid must be an integer, minimum 0 and maximum 22.

How many points you receive will be determined by the following:

Buyers

Bought	Your profit
2	43.5-bid1-bid2 (you have to pay the bids to each of the sellers)
1	17.5-your bid (you have to pay the bid to the accepting seller)
0	11.5

Hence, how many points you will receive as a buyer depends on how many assets you have bought and how much you have paid for them.

Sellers

Your answer	Your profit
Yes	You receive the bid.
No	Your payoff will depend on the other seller:
	1. If the other seller also rejects = 11.5
	2. If the other seller accepts = 17.5

Hence, how many points you will receive as a seller depends on your own decision and the decision of the other seller (if you reject).

After each round, we will observe your choices and announce your payoffs. Do not talk to the others and make sure that no one can see the choices you make on the reply form or your type (buyer or seller).

How many points you receive can also be illustrated in the following payoff matrix for buyers, offering the first bid = b_1 and the second bid = b_2:

The buyer's matrix

Seller 2

		Yes	No
Seller 1	Yes	$43.5-b_1-b_2$	$17.5-b_1$
	No	$17.5-b_2$	11.5

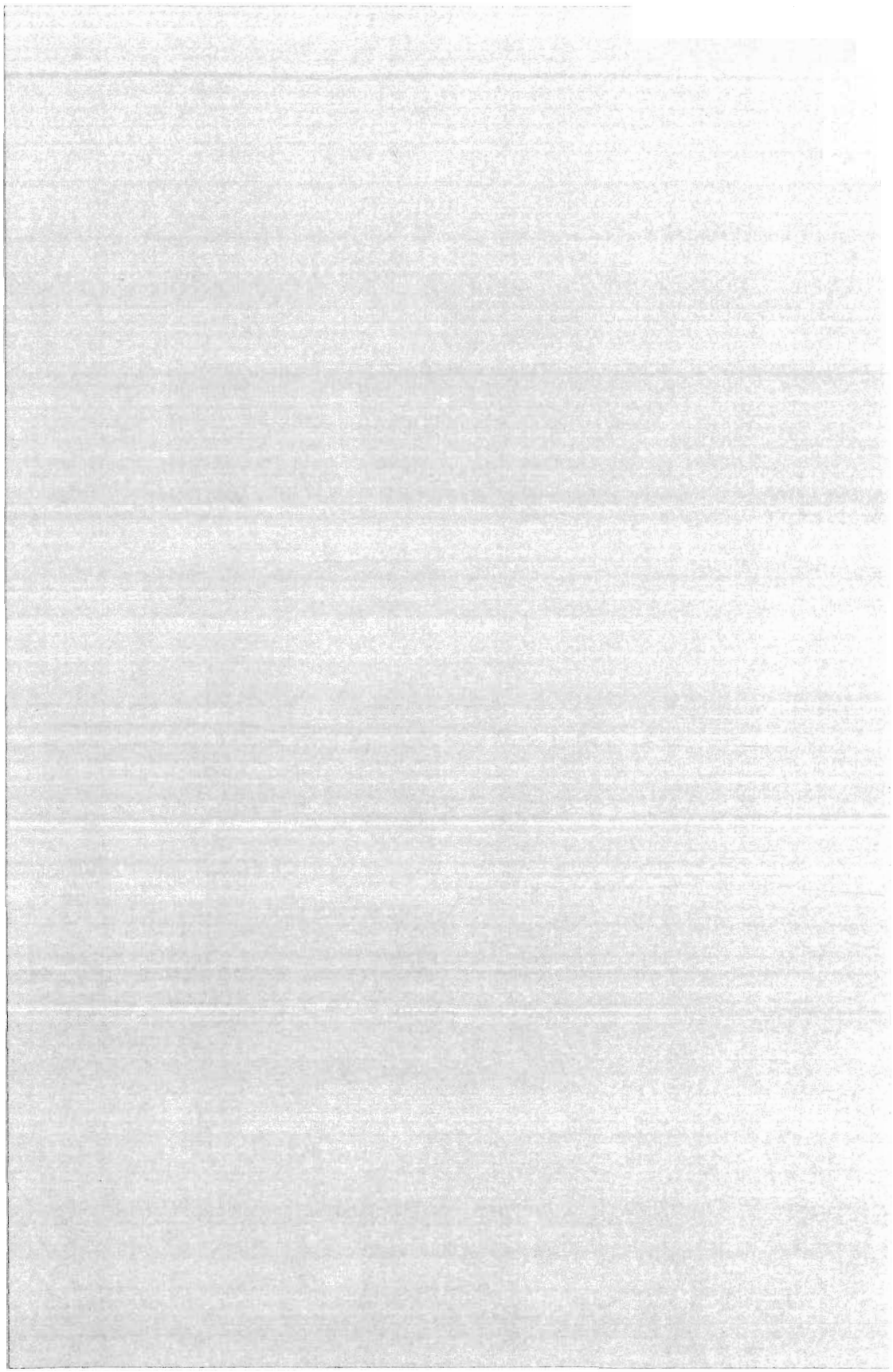
How many points you receive can also be illustrated in the following payoff matrix for sellers, receiving a bid = b:

The seller's matrix

Answer of the other seller

		Yes	No
You answer	Yes	b	b
	No	17.5	11.5

Essay IV



Bubbles and Experience: An Experiment on Speculation*

Martin Dufwenberg**, Tobias Lindqvist*** & Evan Moore****

Abstract: We investigate experimentally how the share of experienced traders in double-auction asset markets affects trading, in particular the occurrence of bubble-crash pricing patterns. In each session, six subjects trade in three successive market rounds and gain experience. In a fourth round, depending on the treatment, two or four experienced subjects are replaced by inexperienced subjects. The results are compared to earlier findings when all traders were either inexperienced or experienced. We explore what can be learned by analogy between these laboratory findings and the performance of naturally occurring markets.

Keywords: asset market, bubble, crash, experience, experiment, speculation

JEL code: C92, G12

---

* We thank Matias Eklöf, Dan Friedman, Uri Gneezy, Henrik Horn, Steffen Huck, Kai Konrad, Wieland Müller, Rosemarie Nagel, Charles Noussair, Bob Slonim, Hans Wijkander, and participants at CEEL'01 in Trento, ESA'01 in Tucson, the Workshop on Experimental Economics'02 in Siena, MERSS'02 in Mannheim, ESA'02 in Boston, METU'02 in Ankara, ESA'02 in Strasbourg, Summer Institute on Bounded Rationality in Psychology and Economics'03 in Berlin, and seminars at IUI, Stockholm School of Economics, and Stockholm University for helpful comments. We are grateful to Urs Fischbacher for permission to use the z-Tree software; the Laboratory for the Study of Human Thought & Action at Virginia Tech where the experiment was run; and the Swedish Competition Authority for financial support.

** University of Arizona; md@ne.su.se

*** Research Institute of Industrial Economics & Stockholm Univ.; TobiasL@iui.se

**** Auburn University Montgomery; emoore@monk.aum.edu

1. INTRODUCTION

History contains many colorful examples where speculative trade in some commodity or financial asset generated a phase of rapidly increasing prices, followed by a sudden collapse (see e.g. Chancellor, 1999 or Kindleberger, 2001). One famous case cited by many economists (see Garber 1990, pp. 36-37 for references) is the Dutch "tulipmania" of the 1630s. The prices of certain tulip bulbs reached peaks in excess of several times a normal person's yearly income, and then suddenly lost almost all value in February 1637 (see Dash, 1999). In more recent times, we have the development of the NASDAQ share index up till March 2000, and the subsequent dramatic loss of value in that market.

It is hard to describe such developments in other than bubble-crash terms, where the term "bubble" is meant to suggest that prices exceed the traded asset's "fundamental" value. Commentary often invokes terms suggestive of folly or hysteria, like "mania", "panic", or (Alan Greenspan's) "irrational exuberance", as in the titles of Kindleberger's (1994) and Shiller's (2000) books on the topic. However, it is difficult to establish empirically the degree (or nature) of "the madness of the market", because it is hard to pin down what is the fundamental value of an asset. In fact, skeptics have called to question the bubble-crash description, arguing that what at first glance appears like a bubble-crash hype at closer scrutiny becomes explicable with reference to fundamentals. See, *e.g.*, the work of Peter Garber (1989, 1990, 2000).[1]

---

[1] One example of a fundamental explanation could be that present value calculations are very sensitive to discount factors, so sudden shifts of interest rates may create dramatic shifts in valuation. Garber (1990; see p. 35) mentions several other fundamental explanations: "the perception of an increased probability of large returns [which] might be triggered by genuine economic good news, by a convincing new economic theory about payoffs or by a fraud launched by insiders acting strategically to trick investors. It might also be triggered by uninformed market participants correctly inferring changes in the distribution of dividends by observing price movements generated by the trading of informed insiders." He adds: "While some of these perceptions might in the end prove erroneous, movements in asset prices based on them are fundamental and not bubble movements."

A strong case against this view, or at least a case for the independent relevance of bubble-crash phenomena, can be articulated with reference to results obtained by experimental economists. In a classic paper, Smith, Suchanek & Williams (1988) report results from several laboratory financial markets. In the settings they consider it is pretty clear what the fundamental value of the assets traded should be. The experimenters control both the (stochastic) dividend process and the time span of the assets, and this information is made public so that valuations can be derived by backward induction. Yet, in the experiments, bubble-crash phenomena are frequent and strong. This suggests drawing an analogy: *bubbles and crashes may be relevant in financial markets since they are relevant in the lab.*

Several subsequent papers have corroborated the Smith *et al* findings.[2] Lei, Noussair & Plott (2001, p. 831) summarize the evidence, and explain how the observed bubble-crash phenomena seem robust with respect to a variety of manipulations. They do, however, point out that bubbles can be eliminated if the trading subjects are experienced: "The only manipulation that has been shown to reliably eliminate bubbles and crashes is prior participation in at least two sessions in the same type of assets market". This interesting finding does not, however, detract that much from the lab-reality analogy. In most experimental sessions that have been run either none or all subjects were experienced, but in non-laboratory financial markets there is likely to be a *mixture* of experienced and inexperienced traders. Although Smith *et al* (1988) and Peterson (1993) ran a few markets with a mixture of inexperienced and experienced subjects, the issue of heterogeneity of experience levels was not the main focus of these studies and was not systematically

[2] See King, Smith, Williams & Van Boening (1993), Peterson (1993), Van Boening, Williams & LaMaster (1993), Porter & Smith (1995), Fisher & Kelly (2000), and Lei, Noussair & Plott (2001).

explored.[3] It is thus natural to seek deeper insights regarding what happens in the lab if there is a mixture of experienced and inexperienced traders. Does it take many, or only a few, experienced traders for bubble-crash patterns to vanish? Believers in the analogy between laboratory and other financial markets may be curious. Such curiosity has inspired this study!

We examine laboratory financial markets with a mixture of experienced and inexperienced traders. We consider two treatments with different proportions of experienced traders. The setup is as follows: Six subjects trade in three successive market rounds and gain experience. In a fourth round, depending on the treatment, *two or four experienced subjects are replaced by inexperienced subjects.*

We consider these two treatments because if bubbles and crashes occur or vanish in an environment with a mixture of experienced and inexperienced traders, then it is interesting to learn something about how many experienced or inexperienced traders this takes. The issue is related to the literature on "noise-trading" in financial markets (see *e.g.* De Long, Shleifer, Summers & Waldmann, 1989, 1990; Palomino 1996; Abreu & Brunnermeier 2002). How many irrational noise-traders does a market need to work very differently from a market without noise trading? Our lab markets may be viewed as one particular test-bed for this issue, given that one adopts the view that the inexperienced subjects of the design may be regarded as noise-traders.

The introduction so far (and the abstract) has been written in an *ex ante* mode, describing the motivation for our study such as it appeared to us *before* we ran the experiment. We have not yet mentioned any results. At this point we would like to invite you,

[3] King *et al* (1993) performed a related test, but instead of using a mixed experience population they let some "insiders" read Smith *et al* (1988) in preparation for the experiment. The bubbles remained, except in a market that allowed for short-selling. For a completely different game, mixed-experience conditions similar to ours are examined by Slonim (2002). Some features of his and our results are similar. We discuss this in section 3.3.

our reader, to test your strategic and financial intuition by *guessing the results*, before we report them:

> **Quiz:** It is known from previous research that in markets where no traders are experienced bubble-crash pricing patterns are common, and that in markets where all traders are experienced, bubble-crash pricing patterns tend to vanish. We consider markets where, respectively, *one third* or *two thirds* of the traders are experienced. For which of these markets do you think the bubble-crash pricing patterns vanish?

You may find it interesting to compare your answer to the answers we received at the 2002 meeting of the *Economic Science Association* in Tucson, Arizona. In the session where we presented our paper about thirty participants ventured a guess. Three of them guessed that having one third experienced traders is enough for bubbles to vanish. One of them guessed that it takes two thirds experienced traders for bubbles to vanish. The remaining vast majority guessed that both markets typically would exhibit bubble-crash pricing patterns.

Bear with us for a few more pages and we shall report the actual results in due course. Section 2 spells out the design; section 3 reports results; section 4 concludes.

2. DESIGN & TESTING PROCEDURES

We consider markets in which assets that generate stochastic streams of dividends are bought and sold. An asset has a finite life of ten periods. In each period it pays a dividend of 0 or 20 cents, with equal probability. Trade takes place in each period, before dividends are determined. The dividend process coupled with a backward inductive argument defines time-dependent theoretical asset values. Our main interest lies in comparing actual pricing in the lab to these theoretical values, controlling for the experience levels of the traders. The rest of this section decribes our approach in detail.

The experiment was conducted in October 2001 at the Laboratory for the Study of Human Thought & Action at Virginia Tech. The subjects were undergraduate students with no previous experience in any similar experiment.

We used the double auction environment of the z-Tree software.[4] Double auction markets mimic the key features of stock exchange markets. Since the pioneering work of Smith (1962, 1964), they are known to possess extraordinarily competitive properties.[5]

Each market involved six traders, who could both buy and sell assets, and lasted for ten distinct two-minute trading periods. Trade was denominated in US cents. Before a market opened, half of the subjects, *i.e.* three subjects, each started with a cash endowment of 200 cents and six assets; the other half each started with 600 cents and 2 assets. Each asset held at the end of a trading period paid a dividend of either 0 or 20 cents, with equal probability for each of these two outcomes. A trader's cash holding at any point in time differed from his or her cash endowment by accumulated capital gains or losses via market trading, and accumulated dividend earnings via asset units held in inventory at the end of each trading period.

Since the expected dividend in each period is 10 cents (= ½ × 0 cents + ½ × 20 cents), the expected monetary value of holding an asset is 10 cents for each of the remaining periods. Assuming risk-neutrality, one may calculate a theoretical value of the asset by backward induction. We shall refer to this value as the *fundamental value*. In the last period, the fundamental value is 10 cents. If traders anticipate that this will be the trading price in the last period, then with two periods remaining the price should be 20 cents (2 periods × 10 cents per period). If traders anticipate this, then with three periods remaining the price should

[4] See Fischbacher (2003) for a description of the software.

[5] Plott (1989; section 3.1) and Holt (1995; especially sections V.D and VII.B) survey the experimental double auction market literature.

be 30 cents, etc. Using this logic it is evident that the fundamental value of an asset with k periods remaining is $k \times 10$ cents. A bubble obtains if prices in some period are considerably higher than the fundamental value.

The experiment includes two treatments, each of which involves four consecutive markets. In the following, we shall talk in terms of four different *rounds*. Note the distinction between rounds and periods; a round (being a market) consists of ten periods. In both treatments, rounds 1-3 retain the same six-subject groupings so that these subjects gain experience over these rounds. Previous research has indicated that three rounds of repetition is sufficient for bubbles to virtually vanish. The treatments differ only in terms of who interacts in round 4, and our treatment variable concerns the introduction of inexperienced subjects in this round. Depending on treatment, *two* or *four* experienced subjects that had participated in the first three rounds were randomly selected, removed, and replaced by the same number of inexperienced subjects.[6] We shall name our two treatments in terms of the share of experienced traders in the fourth round, referring to the ⅔-EXPERIENCED and ⅓-EXPERIENCED treatments.

Let the notation t-exp mean that a subject has t previous rounds trading experience. Table 1 shows the experience level for the subjects in all the rounds and treatments. For example, in the fourth round of the ⅔-EXPERIENCED treatment there were four 3-exp subjects (that hence had three previous rounds trading experience), and two 0-exp subjects (that hence had no previous rounds trading experience) in the market.

[6] The same number of subjects from each initial endowment class (with 200 cents and six assets *or* with 600 cents and 2 assets) were replaced.

TABLE 1: Experience levels in the two treatments

	Round				
Treatment	**1**	**2**	**3**	**4**	
	0-exp	1-exp	2-exp	3-exp	0-exp
⅔-EXPERIENCED	6	6	6	4	2
⅓-EXPERIENCED	6	6	6	2	4

At the start of each session we read through the instructions (reproduced in the Appendix) for all of the subjects, and then let them play one two-minute practice period. The subjects then made a draw from a box of chips; six chips implied that the subject was seated at a computer, while the other chips (two or four of them, depending on treatment) implied that the subject was sent to another room. The subjects who went to the other room would participate in the fourth round as inexperienced traders, and they had to wait (approximately one hour) until the others had completed their three rounds of trading.

We faced the problem of what to do with the waiting subjects. Our objective was that they should be reimbursed, not be bored, not be allowed to communicate, not interact in some other market, in fact not even strategically interact at all. We instructed them to complete as much as possible of a crossword puzzle, without communicating to any other subjects. For this task they were paid a fixed amount of $10.

At the end of the experiment participants were privately paid, in cash, the amount of their final cash holdings from each round in addition to the show-up fee of $5. Each session (four rounds) lasted for approximately 2 hours and 30 minutes. The expected earnings for a subject participating throughout all the four rounds were on average $37, including the show-up fee.

We focus primarily on comparing *pricing* in the rounds 1 and 4. We are interested in whether mixed-experience markets behave like inexperienced markets. Does the entry, in round 4, of inexperienced traders cause the pattern of pricing to resemble a first round market. In particular, do bubble-crash phenomena "return"? The null hypothesis is that

rounds 1 and 4 are similar; the alternative hypothesis is that prices in round 4 are closer to fundamentals.

If the alternative hypothesis is relevant, we can gain some further insight into *how* "fundamental" the fourth round mixed experience market is by comparing it to the third round market consisting solely of traders with considerable experience. As mentioned above, previous research has indicated that if a market is thrice repeated, this is sufficient for bubbles to virtually vanish. Our experienced traders start round 4 with the corresponding experience level.

We also make comparisons of additional market characteristics other than pricing (volatility, trade volume, opening bids, earnings differences), in order to learn as much as possible about the impact of mixed experience of traders on market outcomes.

We run five sessions of each treatment, which is more than in most previous bubble-experiments. Five is a large enough number to allow us to take a somewhat conservative statistical approach and count one session as one observation. Observations come costly, but each data point has a high degree of independence and there is still enough data to make hypothesis testing meaningful if one is willing to settle for moderate significance levels. The appropriate statistical tool for our significance testing is the permutation test for paired replicates. This is a nonparametric statistical test used for comparisons in dependent two-sample cases (see, for example, Siegel & Castellan (1988) for a detailed description). The test has power-efficiency of 100 percent because it uses all of the information in the sample.

Now you know the details of the design. *Do you wish to revise the guess you made for the quiz in section 1?*

3. RESULTS

In sections 3.1 and 3.2 we report our results on price formation for each of our respective treatments. Section 3.3 presents a bundle of complementary results regarding volatility, trade volume, opening bids, and earnings differences.

3.1 Pricing in the ⅔-EXPERIENCED treatment

Before we report our results in a more systematic fashion, it is intriguing to first visit a particular session as a case study of sorts. This may enhance the intuitive understanding of the setup. We shall get back to whether the results exhibited are typical.

Figure 1 presents the evolution of prices in *one* particular session, out of the *five* we ran for this treatment.

[Insert Fig. 1 here]

As seen in Figure 1, in the first two rounds the market exhibits a distinct bubble (with prices at times exceeding twice the fundamental price), but in round 3 trading prices are fairly close to the fundamental values. When we introduce two inexperienced subjects in round 4, there is little indication that a new bubble occurs. The prices are well below those in round 1. In fact, the prices in round 4 seem to fit the fundamental values just as well as the prices in round 3. (*End of case study!*)

We now move to formal statistics based on the entire data set. We shall evaluate the goodness-of-fit between observed and fundamental values using the Haessel-R^2 statistic, which is appropriate since the fundamental values with which we compare are exogenously

given (by backward induction on the expected dividend).[7] The Haessel-R^2 takes values between 0 and 1, where 1 is a perfect fit. Therefore, as trading prices conform to the fundamental values, the Haessel-R^2 approaches 1. Table 2 reports Haessel-R^2 values for the five sessions.

TABLE 2: Goodness-of-fit in ⅔-EXPERIENCED treatment

Session	Round 1	Round 2	Round 3	Round 4
1	0.014	0.290	0.239	0.001
2	0.082	0.256	0.806	0.924
3	0.822	0.856	0.903	0.925
4	0.268	0.311	0.772	0.868
5	0.582	0.270	0.541	0.954

Our main interest is to examine differences between rounds 1 and 4, comparing how well trading prices conform to fundamental values in inexperienced and mixed-experience markets. From Table 2 we observe that the goodness-of-fit increases in all but the first session.[8] Overall, we can reject the null hypothesis of a similar fit in the two treatments at reasonable significance levels (p=0.063). Therefore, a market with a two thirds majority of experienced traders is trading closer to fundamental values than a market where every trader is inexperienced.

We also wish to get some grip on *how* much closer. We evaluate this by comparing round 4 prices to round 3 prices. Recall that the received wisdom is that bubbles virtually vanish by the third time a market is repeated. We find that the entry of the inexperienced traders in round 4 does not affect prices relative to the outcome in round 3. The null

[7] By contrast, the standard R^2 measure considers goodness-of-fit between a set of data points and a regression line *endogenously* generated from those points.

[8] In session 1, the Haessel-R^2 starts and ends very low. Prices actually *increase* across the ten periods, a pattern opposite to the fundamental. We suspect some subjects in this session did not understand the market.

hypothesis of a similar goodness-of-fit in rounds 3 and 4 (against the alternative hypothesis of a better fit in round 3) cannot be rejected (p=0.719). With two thirds experienced traders, prices are as close to the fundamental price as in a thrice-repeated market (*i.e.*, a market consisting solely of traders with considerable experience).

Overall, the prices illustrated in Figure 1 turn out to be rather typical for the ⅔-EXPERIENCED treatment. We propose the following:

> **Main result in the ⅔-EXPERIENCED treatment:** Bubble-crash pricing phenomena do not occur in a market containing a majority of experienced subjects.

3.2 Pricing in the ⅓-EXPERIENCED treatment

The results from section 3.1 naturally raise the question of whether bubble-crash pricing patterns occur if the experienced subjects are in the minority. We next report on our second treatment where, in round 4, we mix four inexperienced and two experienced traders.

Table 3 reports Haessel-R^2 values for the five sessions.

TABLE 3: Goodness-of-fit in ⅓-EXPERIENCED treatment

Session	Round 1	Round 2	Round 3	Round 4
1	0.895	0.948	0.986	0.978
2	0.834	0.976	0.969	0.951
3	0.065	0.395	0.296	0.027
4	0.002	0.134	0.123	0.118
5	0.112	0.217	0.773	0.799

The goodness-of-fit increases in all but the third session (again an outlier!). Just as before, we can reject the null hypothesis of a similar fit between rounds 1 and 4 at reasonable significance levels (p=0.063). A market with a minority of experienced traders is also trading closer to fundamental values than a market without experienced traders.

How much closer? Again, we evaluate this by comparing round 4 prices to round 3 prices. We find that the entry of the inexperienced traders in round 4 does not affect prices relative to the outcome in round 3. The null hypothesis of a similar goodness-of-fit in rounds 3 and 4 (against the alternative hypothesis of a better fit in round 3) cannot be rejected (p=0.281). We propose the following:

> **Main result in the ⅓-EXPERIENCED treatment:** Bubble-crash pricing phenomena do not occur in a market containing a minority of experienced subjects.

3.3 Additional results

So far we have only looked at market prices, but other characteristics of the market may differ between rounds. In this section we report results concerning volatility, trade volumes, market openings, and earnings differences.

Volatility

Does the volatility of prices vary with the experience composition in the market? Table 12 presents the standard deviations of prices for each of the sessions.

TABLE 4: Market Volatility

	⅔- EXPERIENCED TREATMENT				⅓-EXPERIENCED TREATMENT			
SESSION	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
1	19.3	8.1	10.5	8.8	32.3	28.7	30.6	34.5
2	31.0	53.7	59.1	45.7	38.8	42.8	46.9	22.4
3	14.3	16.4	19.1	19.1	17.4	6.2	5.5	11.9
4	8.2	20.3	30.8	39.6	9.8	9.5	9.7	18.1
5	12.6	6.1	14.3	26.8	23.7	31.6	28.1	14.2
Average	*17.1*	*20.9*	*26.8*	*28.0*	*24.3*	*23.8*	*24.2*	*20.2*
p-value: **R1=R4**	0.937				0.188			
p-value: **R3=R4**	0.813				0.500			

The null hypothesis of the same volatility in rounds 1 and 4 cannot be rejected in either treatment (p=0.937 and p=0.188, as indicated in Table 4); the null of the same volatility in rounds 3 and 4 cannot be rejected in either treatments (p=0.813 and p=0.500). To summarize:

> **Result on Volatility:** Markets where traders have a mixture of experience levels exhibit the same price volatility as markets where all traders are inexperienced, and as markets where all traders are relatively experienced.

Trade Volume

Our findings on pricing suggest that there is no considerable difference between mixed-experience markets (round 4) and markets where all of the traders are experienced (round 3). However, we find significant differences between the mixed-experience markets and markets where all of the traders are inexperienced (round 1). Do analogous results carry over to trade volumes? Table 5 presents the trade volumes from all of our ten sessions (counting any asset changing hands in any period as one unit of trade.)

TABLE 5: Volume of Trade

	⅔-EXPERIENCED TREATMENT				⅓-EXPERIENCED TREATMENT			
SESSION	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
1	170	189	130	162	74	63	61	87
2	93	68	47	82	82	48	45	151
3	120	169	137	165	185	124	124	86
4	107	66	64	38	155	90	63	102
5	133	105	50	81	171	132	125	248
Average	*124.6*	*119.4*	*85.6*	*105.6*	*133.4*	*91.4*	*83.6*	*134.8*
p-value: **R1=R4**	0.125				0.438			
p-value: **R3=R4**	0.063				0.094			

Our results on trade volumes are *not* analogous to those on prices. There is little evidence of differences in the volume of trade between rounds 1 and 4 in either treatment (p=0.125 and p=0.438), but there is such a difference between rounds 3 and 4. In both of the

treatments, the null hypothesis of the same number of trades in rounds 3 and 4 is rejected at reasonable significance levels (p=0.063 and p=0.094), in favor of the alternative hypothesis of a larger number of trades in round 4. Our finding:

> **Result on Trade Volumes:** The trade volume in mixed-experience markets is as high as in markets where all traders are inexperienced, and is greater than in markets where all traders are relatively experienced.

This result made us curious. Is it the experienced or the inexperienced traders who are responsible for the increased trade in round 4? The data shows that both categories have similar trade volumes. It seems like the experienced traders tried to exploit the inexperienced traders, and that in this process the trading volume increased.[9]

Market Openings

Who takes the initiative in the mixed-experience markets? That is, who is first to enter the market and propose a trade? To answer this question we look into the data in round 4, where traders have mixed experience, for all of the sessions. In the beginning of round 4 of each session, *i.e.* the first seconds of period 1, we observe who first offers a bid or makes an ask (not necessary implying a trade). These "market openings" are made visible on the screen for all traders.

It turns out that *no* inexperienced trader was ever the first to enter in period 1, in any of the ten sessions. In the ⅔-EXPERIENCED we did not observe any inexperienced trader as second enterer either.

In the ⅓-EXPERIENCED treatment two of the six traders are experienced. Assuming random entering, the probability that all traders first entering period 1 are experienced in all of the five sessions of this treatment is $(2/6)^5$, which is less than 0.005. The corresponding

probability that all first *and* second traders are experienced is 0.017 ($\approx(4/6)^{10}$) in the ⅔-EXPERIENCED treatment. We conclude that random entering can be rejected in both treatments.

Result on Market Openings: Experienced traders always open the market.

Earnings Differences

Do differences in experience generate differences in earnings? One may suspect that in a mixed-experience market the experienced traders somehow manage to take advantage of the inexperienced traders, the "fresh meat" that just entered. We begin our test of this "fresh meat" conjecture by summarizing the average fourth round earnings in Table 6.

TABLE 6: Earnings

Subject type	Average Earnings for One Subject	
	⅔- EXPERIENCED treatment	**⅓- EXPERIENCED treatment**
Inexperienced	\$6.45	\$6.97
Experienced	\$8.53	\$9.10
p-value: *same earnings*	0.048	0.075

The average expected earning in each round is \$8 (by design), but the realized earnings may deviate from \$8 depending on the realizations of the dividends. As seen in Table 6, on average the experienced traders earn more, and the inexperienced traders less, than \$8. In the ⅔-EXPERIENCED treatment, 3 out of 10 inexperienced traders and 13 out of 20 experienced traders earned above \$8. In the ⅓-EXPERIENCED treatment, 6 out of 20 inexperienced traders versus 7 out of 10 experienced traders earned above the expected average.[10]

[9] This motivation was mentioned by many subjects during the debriefing after the experiment.

[10] An additional inexperienced subject earned exactly \$8.00 in the ⅓-EXPERIENCED treatment.

Statistical tests confirm that this picture is systematic. We use unpaired *t*-tests to examine the hypothesis that mean earnings are the same for each trader category, and reject the hypothesis for each treatment at reasonable significance levels (p=0.048 in the ⅔-EXPERIENCED treatment; p=0.075 in the ⅓-EXPERIENCED treatment). The "fresh meat" hypothesis is thus supported.

Result on Earnings: Experienced traders earn more than inexperienced traders.

It is interesting to compare this result to recent findings by Slonim (2002), who studies the nature of mixed-experience interaction in so-called "beauty contest games". He finds that inexperienced persons do not condition their behavior on their co-players' experience levels, but learn to do so as they gain experience. In Slonim's design, experienced players have higher earnings than inexperienced ones. His findings rhyme well with ours.

4. CONCLUDING REMARKS

Are prices in financial markets driven by irrational exuberance or market fundamentals? The outlook varies among scholars, but it is hard to determine the truth because fundamental values are usually not observable. In this connection experiments may be useful. Fundamental values may be induced and compared to actual prices in laboratory markets. The flip side of such "wind-tunnel" experimenting is obviously that one simplifies or abstracts from certain aspects of non-laboratory markets. One may still hope that the laboratory results give insights about the "real" world.

The analysis of laboratory asset markets, starting with Smith *et al* (1988), has shown that bubble-crash pricing patterns tend to occur if *none of the* market participants are experienced, while prices are close to fundamental values if *all* of the participants are reasonably experienced. The starting point of our investigation is that this work provides a

somewhat incomplete analogy to non-laboratory financial markets, where there is likely to be a *mixture* of experienced and inexperienced traders.

We investigate experimentally how the share of experienced traders in double-auction asset markets affects pricing and other trade characteristics. We consider markets where, respectively, *one third* or *two thirds* of the traders are experienced. In either of these mixed-experience markets bubble-crash pricing patterns were not common. Many researchers will probably find this result surprising, as suggested by the fact that almost all participants at the 2002 ESA meeting in Tucson (and in fact also at other presentations later on) guessed that bubble-crash pricing patterns would be common in both treatments (cf. the results mentioned toward the end of our introduction).

It is time to admit that we were surprised too. When we designed our experiment, we expected to corroborate the finding that bubble-crash pricing patterns are robust with respect to a long list of variations. However, we show that this list does not extend to mixed-experience markets. Our results therefore support the fundamentalist position.

This does not mean that mixed markets function just as markets where all traders are experienced. The number of trades increased when inexperienced subjects entered the market, and even though the market prices stay pretty much in line with fundamentals there is a difference in the earnings of the different subject categories. The experienced subjects fare better than the inexperienced ones.

These results stands in some contrast also to the literature on "noise-trading" in financial markets (see, e.g., De Long et al. 1989, 1990; Palomino 1996; Abreu & Brunnermeier 2002), which examines how the presence of a small portion of somehow irrational traders influences market outcomes. The wisdom seems to be that the effect can be dramatic, causing significant deviations from fundamental pricing and in some cases even allowing the noise-traders to make more money than the other traders. However, if one

adopts the view that the inexperienced subjects of our design may be regarded as noise-traders, then our results do not lend support.

Of course, one should not oversell these conclusions. Laboratory markets are not the same as naturally occurring markets, and analogies only carry so far. Moreover, our study leaves several potentially relevant aspects unexplored.[11] Nevertheless, our finding may induce some shift of the burden of proof between those who believe in "the madness of the market" and the "market fundamentalists". Our results provide arguments in favor of the latter rather than the former position.

We conclude our paper with the following perspective, which to us seems reasonable given the state of knowledge today: The history of finance contains many seeming bubble-crash stories, but it is actually not full of them *all the time*. For example, judging by price-earnings ratios, the U.S. stock market of the twentieth century contains but few examples, spearheaded by the events culminating in the crashes of the fall of 1929 and spring of 2000.[12] Perhaps markets are best understood as being in a fundamental mood, *most of the time*. It may be that only *every now and then* the majority of traders get caught up in a speculative bubble. Our experimental findings do not contradict this view. In the laboratory one can run many sessions and get many observations, but it is impossible to get so many observations that one can systematically record very rare events. Perhaps the best way to understand our results is as suggesting that *bubbles in mixed-experience markets are rare*.

---

[11] Out of the possible suggestions for future research, let us name three: First, inexperience may relate to other things than market participation. What is the effect, for example, of changing after a few rounds the stochastic dividend structure? Second, most markets outside the laboratory do not have an exogenously given duration. Examining markets with a stochastically determined last period may be interesting. Third, in our design the experienced traders knew when and how many inexperienced participants entered the markets. It may be realistic to consider alternative designs where this information is not given.

[12] See Shiller (2000, ch. 1) for an account up till early 2000. What constitutes a bubble/crash is of course a definitional matter. Events in 1901, 1966, and 1987 may qualify too. Five in a century is still not a huge number though.

REFERENCES

Abreu, Dilip & Markus K. Brunnermeier (2002), "Bubbles and Crashes," forthcoming in *Econometrica.*

Chancellor, Edward (1999), *Devil Take the Hindmost: A History of Financial Speculation*, New York: Farrar, Straus & Giraux.

Dash, Mike (1999), *Tulipomania: The Story of the World's Most Coveted Flower and the Extraordinary Passions it Aroused*, Crown Publishers.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers & Robert J. Waldmann (1989), "The Size and Incidence of Losses from Noise Trading," *Journal of Finance*, 44(3), 681-96.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers & Robert J. Waldmann (1990), "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, 98(4), 703-38.

Fischbacher, Urs (2003), "http://www.iew.unizh.ch/ztree/index.php".

Fisher, Eric O'N. & Frank S. Kelly (2000), "Experimental Foreign Exchange Markets," *Pacific Economic Review*, 5(3), 365-87.

Garber, Peter (1989), "Tulipmania," *Journal of Political Economy*, 97(3), 535-60.

Garber, Peter (1990), "Famous First Bubbles," *Journal of Economic Perspectives*, 4(2), 35-54.

Garber, Peter (2000), *Famous First Bubbles: The Fundamentals of Early Manias*, MIT Press.

Holt, Charles A. (1995), "Industrial Organization: A Survey of Laboratory Research", in *Handbook of Experimental Economics*, eds. John Kagel & Al Roth, Princeton Univ. Press.

Haessel, Walter (1978), "Measuring Goodness of Fit in Linear and Nonlinear Models," *Southern Economic Journal*, 44(3), 648-52.

Kindleberger, Charles (2001), *Manias, Panics & Crashes: A History of Financial Crisis*, fourth edition, Wiley.

King, Ronald R., Vernon L. Smith, Arlington W. Williams & Mark Van Boening (1993), "The Robustness of Bubbles and Crashes in Experimental Stock Markets" in Richard H. Day & Ping Chen (ed.), *Nonlinear Dynamics and Evolutionary Economics*, Oxford University Press.

Lei, Vivian, Charles N. Noussair & Charles R. Plott (2001), "Nonspeculative Bubbles in Experimental Asset Markets: Lack of Common Knowledge of Rationality vs. Actual Irrationality, " *Econometrica*, 69(4), 831-59.

Palomino, Frédéric (1996), "Noise Trading in Small Markets", *Journal of Finance*, 51(4), 1537-50.

Peterson, Steven (1993), "Forecasting Dynamics and Convergence to Market Fundamentals: Evidence from Experimental Asset Markets," *Journal of Economic Behavior and Organization*, 22, 269-84.

Plott, Charles R. (1989), "An Updated Review of Industrial Organization: Applications of Experimental Economics," chapter 19 in *Handbook of Industrial Organization*, vol II, Richard Schmalensee and Robert Willig (eds.), Amsterdam: North Holland.

Porter, David P. & Vernon L. Smith (1995), "Futures Contracting and Dividend Uncertainty in Experimental Asset Markets," *Journal of Business*, 68(4), 509-41.

Shiller, Robert J. (2000), *Irrational Exuberance*, Princeton University Press.

Siegel, Sidney & N. John Castellan, Jr. (1988), *Nonparametric Statistics for the Behavioral Sciences*, McGraw-Hill Book Company.

Slonim, Robert L. (2002), "Competing Against Experienced and Inexperienced Players," Department of Economics, unpublished manuscript, Case Western Reserve University.

Smith, Vernon L. (1962), "An Experimental Study of Competitive Market Behavior," *Journal of Political Economy* 70, 111-37.

Smith, Vernon L. (1964), "The Effect of Market Organization on Competitive Equilibrium" *Quarterly Journal of Economics* 78, 181-201.

Smith, Vernon L., Gerry L. Suchanek & Arlington W. Williams (1988), "Bubbles, Crashes and Endogenous Expectations in Experimental Spot Asset Markets," *Econometrica*, 56(5), 1119-51.

Van Boening, Mark V., Arlington W. Williams & Shawn LaMaster (1993), "Price Bubbles and Crashes in Experimental Call Markets," *Economics Letters*, 41(2), 179-85.

APPENDIX: INSTRUCTIONS

1. General instructions

This is an experiment in the economics of market decision-making. The instructions are simple and if you follow them carefully and make good decisions, you might earn a considerable amount of money, which will be paid to you in cash at the end of the experiment. The experiment will consist of a sequence of trading periods in which you will have the opportunity to buy or sell in a market. All trading will be in terms of *cents*. Please do not speak with any other participants during this experiment. The experiment will last for approximately three hours, including one hour of instructions and practice.

Market description:
At the beginning of the market half of you will have an endowment of 6 goods (called X) and 200 cents and the other half will be endowed with 2 goods (called X) and 600 cents. 6 traders will participate in the market.

The market has 10 periods. In each period, you may buy or sell units of a good called X. X can be considered an asset with a life of 10 periods, and your inventory of X carries over from one trading period to the next. Each period lasts for 2 minutes.

At the end of each trading period, each unit of X pays a dividend. The dividend will be either 0 or 20 cents, which is randomly decided by the computer with a 50 % chance of each dividend. Thus, the average dividend per period is 10 cents.

Your profits in the market will be equal to the total of the dividends that you receive on units of X in your inventory at the end of each of the market periods plus the cash you have at the end of the market. The way to calculate your earnings is described in section 3.

Experimental procedure:
The market, as described above, will be repeated four times. Before the first market starts, two (four) people in this room will be randomly selected and asked to leave the room for one hour. These people will not participate in the first three markets and they will not be doing anything connected with this experiment during these markets. In the fourth market they will replace two (four) randomly selected persons among the six that already have participated in three markets.

2. Average Value Holding Table

You can use the table in section 4 to help you make decisions. There are 5 columns in the table. The first column, labeled Ending Period, indicates the last trading period of the market. The second column, labeled Current Period, indicates the period during which the average holding value is being calculated. The third column gives the number of holding periods from the period in the second column until the end of the market. The fourth column, labeled Average Dividend Value Per Period, gives the average amount that the dividend will be in each period for each unit held in your inventory. The fifth column, labeled Average Holding Value Per Unit of Inventory, gives the expected total dividend for the remainder of the experiment for each unit held in your inventory for the rest of the market. That is, for each unit you hold in your inventory for the remainder of the market, you receive in expectation

the amount listed in column 5. The number in column 5 is calculated by multiplying the numbers in columns 3 and 4.

Suppose for example that there are 4 periods remaining. Since the dividend paid on a unit of X has a 50% chance of being 0 and a 50% chance of being 20, the dividend is in expectation 10 per period for each unit of X. If you hold a unit of X for 4 periods, the total dividend paid on the unit over the 4 periods is in expectation $4 \times 10 = 40$.

3. Calculate Your Earnings

Your earnings in each period equal the value of the dividends you receive at the end of the period for the units of X in your inventory at the end of the period. That is,

YOUR EARNINGS FOR A PERIOD =
DIVIDEND PER UNIT × NUMBER OF UNITS IN INVENTORY AT THE END OF PERIOD.

However, when you spend money to buy units of X, the total amount of cash that you have after period 10 is reduced by the amount of the purchase. If you sell units of X, the total amount of cash you have after period 10 increases by the amount of the sale. Your total earnings for one market are the total of your earnings for periods 1-10 plus the amount of cash that you have at the end of period 10. That is

YOUR TOTAL EARNINGS IN THE MARKET =
EARNINGS FOR PERIOD 1 + EARNINGS FOR PERIOD 2 + EARNINGS FOR PERIOD 3 + EARNINGS FOR PERIOD 4 + EARNINGS FOR PERIOD 5 + EARNINGS FOR PERIOD 6 + EARNINGS FOR PERIOD 7 + EARNINGS FOR PERIOD 8 + EARNINGS FOR PERIOD 9 + EARNINGS FOR PERIOD 10 + CASH ON HAND AT THE END OF PERIOD 10.

Your profit for the entire experiment is the sum of the profits from all of the markets that you participate in. Note that you do not have to calculate your profit by yourself. The computer does all the work.

There will also be a show up fee of $5 to all participants. The two people that have to leave for one hour will receive an extra $10 each (plus the $5).

4. Average Value Holding Table

Ending Period	Current Period	Number of Holding Periods	×	Average Dividend Value Per Period	=	Average Holding Value Per Unit of Inventory
10	1	10		10		100
10	2	9		10		90
10	3	8		10		80
10	4	7		10		70
10	5	6		10		60
10	6	5		10		50
10	7	4		10		40
10	8	3		10		30
10	9	2		10		20
10	10	1		10		10

5. Information about the screen

Remaining time (sec) This shows the time remaining in the period in seconds. Each period lasts two minutes so the timer counts down from 120 seconds to 0 seconds.

Period This shows the number of the period you are in for each market. There are 10 periods in each market.

Cents The number of cents that you have.

Units of good X The number of units of good X that you have.

Buttons at the bottom of the screen

Sales ask Type the amount, in cents, that you are willing to sell a unit of good X for in the box marked "Sales ask". Then press the "Sales ask" button at the bottom of the screen to offer the unit for sale.

Purchase bid Type the amount, in cents, that you are willing to pay for a unit of good X in the box marked "Purchase bid". Then press the "Purchase bid" button at the bottom of the screen to place your bid.

Sell Press the "Sell" button if you would like to sell a unit of good X for the highlighted amount in the "Purchase bid" column.

Buy Press the "Buy" button if you would like to buy a unit of good X for the highlighted amount in the "Sales ask" column.

Columns in the middle of the screen

Sales ask column Shows all of the available "Sales asks" in descending order so that the lowest price is at the bottom.

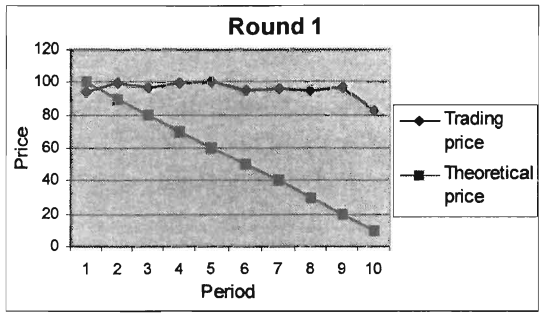
Transaction price column Shows all of the prices at which a unit of good X has been bought or sold in the current period.

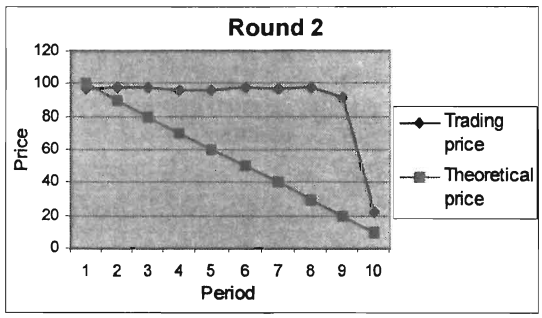
Purchase bid column Shows all of the available "Purchase bids" in ascending order so that the highest price is at the bottom.

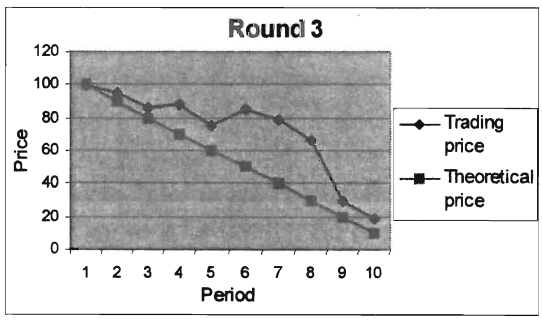
Earnings Report

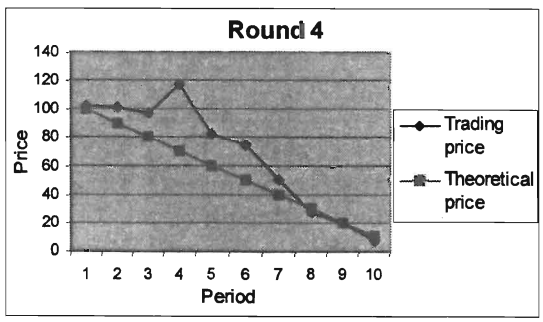
The earnings report appears at the end of each period. After seeing your earnings, press the "Continue" button to go to the next period. The next period will begin once all of you press the "Continue" button.

FIGURE 1: Example of a ⅔-EXPERIENCED treatment









IUI Dissertations

Researchers who have worked on their degree at IUI and the title of their dissertation (doctor's degree in economics unless otherwise stated).

Folke Kristensson (business administration). *Studier i svenska textila industriers struktur* (Studies in the Structure of Swedish Textile Industries). 1946.

Jan Wallander. *Flykten från skogsbygden* (The Exodus from the Forest Regions). 1948.

Erik Dahmén. *Svensk industriell företagarverksamhet* (Entrepreneurial Activity in Swedish Industry). 1950.

Roland Artle. *Svenskt distributionsväsende* (Swedish Distributive Trades). 1952.

Ragnar Benzel. *Inkomstfördelningen i Sverige* (The Distribution of Income in Sweden). 1952.

Odd Gulbrandsen. *Strukturomvandlingen i jordbruket* (The Structural Transformation in Agriculture). 1957.

John Ekström (licentiate). *Den textila konsumtionen* (The Consumption of Textiles). 1958.

Göran Albinsson-Bruhner (licentiate). *Svensk verkstadsindustri. Struktur och utvecklingstendenser* (The Engineering Industries in Sweden. Structure and Tendencies of Development). 1961.

Lars Nabseth. *Löneökningars verkningar inom industrin. En studie av anpassningsprocessen inom företaget* (The Effects of Wage Increases in Industry. A Study of the Process of Adaptation within the Firm). 1961.

Erik Höök. *Den offentliga sektorns expansion. En studie av de offentliga civila utgifternas utveckling åren 1913–58.* (The Expansion of the Public Sector – A Study of the Development of Public Civilian Expenditures in Sweden 1913–58). 1962.

Bengt G. Rundblad (sociology). *Arbetskraftens rörlighet. En studie av en lokal arbetsmarknad* (The Mobility of Labour. A Study of a Local Labour Market). 1964.

Karl G. Jungenfelt. Löneandelen och den ekonomiska utvecklingen. *En empirisk-teoretisk studie* (Labour's Share and Economic Development). 1966.

Bengt Höglund (written at Lund University). *Modell och observationer. En studie av empirisk anknytning och aggregation för en linjär produktionsmodell* (A Study of Empirical Implementation and Aggregation for a Linear Model). 1966.

Gunnar Eliasson. *Kreditmarknaden och industrins investeringar.* (Manufacturing Industry Finance and Short-Run Investment Behaviour). 1967.

Lars Kritz (licentiate, ethnography). *Godstransporternas utveckling i Sverige 1950–66 med utblick mot 1980.* (Freight Transportation Trends in Sweden 1950–66 and the Outlook for the Seventies). 1968.

Lennart Ohlsson (licentiate). *Utrikeshandeln och den ekonomiska tillväxten i Sverige 1871–1966* (Foreign Trade and Economic Growth in Sweden 1871–1966). 1969.

Villy Bergström (licentitate, written at Uppsala University). *Den ekonomiska politiken i Sverige och dess verkningar* (Economic Policies in Sweden and their Results). 1969.

Lars Lundberg (licentiate, written at Umeå University). *Kapitalbildningen i Sverige 1861–1965* (Capital Formation in Sweden 1861–1965). 1969.

Lars Wohlin. *Skogsindustrins strukturomvandling och expansionsmöjligheter* (Forest-Based Industries: Structural Change and Growth Potentials). 1970.

John Skår. *Produksjon og produktivitet i detaljhandelen* (Production and Productivity in the Retail Sector). 1971.

Bengt Rydén. *Fusioner i svensk industri* (Mergers in Swedish Industry). 1971.

Anders Klevmarken (statistics). *Statistical Methods for the Analysis of Earnings Data with Special Application to Salaries in Swedish Industry.* 1972.

Rolf Rundfelt (business administration). *Reklamens kostnader och bestämningsfaktorer* (Advertising Costs in Sweden – Structure and Determinants). 1973.

Ulf Jakobsson och Göran Normann (partly written at Lund University). *Inkomstbeskattningen i den ekonomiska politiken* (Personal Income Taxation and Economic Policy). 1974.

Göran Eriksson. *Företagens tillväxt och finansiering* (Growth and Financing of the Firm). 1975.

Lennart Ohlsson. *Svensk verkstadsindustris internationella specialisering* (Patterns of Engineering Trade Specialization in Sweden). 1976.

Lars Kritz (ethnography). *Transportpolitiken och lastbilarna* (Transport Policy and the Lorries – A Study of the Effects of Regulation and Deregulation). 1976.

Lars Lundberg (written at Umeå University). *Handelshinder och handelspolitik* (Barriers to Trade and Trade Policy – Studies of the Effects on the Swedish Economy). 1976.

Siv Gustafsson. *Lönebildning och lönestruktur inom den statliga sektorn* (Determinants and Structure of Salaries in the Government Sector of Sweden). 1976.

Johan Facht (licentiate). *Emission Control Costs in Swedish Industry.* 1976.

Hans-Fredrik Samuelsson (business administration). *Utländska direkta investeringar i Sverige.* (Foreign Direct Investments in Sweden – An Economic Analysis). 1977.

Birgitta Swedenborg. *The Multinational Operations of Swedish Firms.* 1979.

Tomas Pousette (licentiate). *Efterfrågan på telefontjänster och telefoner* (Demand for Telephone Services and Telephones). 1976; *Teletjänster – priser och investeringar* (Telephone Services – Prices and Investments). 1979.

Gunnar Du Rietz. *Företagsetableringarna i Sverige under efterkrigstiden* (The Firm Establishments in Sweden in the Post-War Period). 1981.

Jonas Agell (written at Uppsala University). *Tax Reforms and AssetMarkets.* 1985.

Kenneth A. Hanson. *Adaptive Economics in Disequilibrium: Essays on Economic Dynamics.* 1986.

Nils Henrik Schager. *Unemployment, Vacancy Durations and Wage Increases: Applications of Markov Processes to Labour Market Dynamics.* 1987.

Joyce Dargay. *Factor Demand in Sweden Manufacturing: Econometric Analyses.* 1988.

Eva Christina Horwitz (licentiate, written partly at the board of Commerce). *Analys av exportutvecklingen: Metoder och tillämpningar* (Analysis of Export Development: Methods and Applications). 1988.

Christina Hartler (licentiate). *Hushållens fastighetskapital och reala sparande.* (Co-author Jan Södersten.) 1989. Agricultural Pricing and Growth. 1991.

Thomas Lindh. Essays on Expectations in Economic Theory. 1992.

Eva M. Meyerson (sociology). *The Impact of Ownership Structure and Executive Team Composition on Firm Performance: The Resolution of a Leadership Paradox.* 1992.

Jonas Häckner. *Price and Quality: Essays on Product Differentiation.* 1993.

Sten Nyberg. *Honesty, Vanity and Corporate Equity: Four Microeconomic Essays.* 1993.

Kent Rune Sjöholm (licentiate). *Hierarchical Modelling of Private Demand in Sweden.* 1993.

Erik Mellander. *Measuring Productivity and Inefficiency Without Quantitative Output Data.* 1993.

Roger Svensson (licentiate) *Production in Foreign Affiliates: Effects on Home Country Exports and Modes of Entry.* 1993.

Karl-Markus Modén. *Tax Incentives of Corporate Mergers and Foreign Direct Investments.* 1993.

Pontus Braunerhjelm. *Regional Integration and the Location of Multinational Corporations.* 1994.

Gunnar Fors. *R&D and Technology Transfer by Multinational Enterprises.* 1996.

Roger Svensson. *Foreign Activities of Swedish Multinational Corporations.* 1996.

Dan Johansson (licentiate). *The Number and Size Distribution of Firms in Sweden and Other European Countries.* 1997.

Mattias Ganslandt (licentiate). *Multi-Market Competition and Coordination in Games.* 1997.

Erika Ekström (licentiate). *Income Distribution and Labour Market Discrimination: A Case Study of Namibia.* 1998.

Mattias Ganslandt. *Games and Markets: Essays on Communication, Coordination and Multi-Market Competition.* 1999.

Sven-Olof Fridolfsson. *Essays on Endogenous Merger Theory.* 2001.

Tobias Lindqvist (licentiate). *Experiments on Mergers and Financial Markets.* 2002.

Tobias Lindqvist. *Essays on Mergers and Financial Markets.* 2003.