Honesty, Vanity and Corporate Equity

Four microeconomic essays

Sten Nyberg

The honest society:
Stability and policy considerations

Vanity and congestion:
A study of reciprocal externalities

Deregulating taxi services:
A word of caution

Reciprocal shareholding
and takeover deterrence

STOCKHOLM SCHOOL OF ECONOMICS

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Foreword

The Industrial Institute for Economic and Social Research (IUI) has a long tradition in studying dynamic markets and their institutional characteristics. This ambition is currently pursued within the umbrella project *The limits of the market economy*. In the four essays contained in this volume Sten Nyberg applies standard economic principles to such diverse problems as the role of private precaution in supporting honest behavior, the effects of negative consumption externalities on imperfectly competitive markets and the effect of reciprocal shareholding on corporate control.

This book has been submitted as a Ph.D. thesis at the Stockholm School of Economics and is the 45th doctoral or licentiate dissertation completed at the Institute since its foundation in 1939. IUI would like to thank Karl-Göran Mäler, Per-Olov Johansson and Stefan Lundgren of the dissertation committee and Kenneth Burdett for contributing expertise and guidance. The generous financial support received from the Jan Wallander and Tom Hedelius foundation and the Swedish Transport Research Board is gratefully acknowledged.

Stockholm in February 1993

Gunnar Eliasson

Acknowledgements

This thesis consists of four essays, two of my own and two written jointly with my colleague Jonas Häckner. The process of writing these essays has been a lengthy one involving everything from figuring out what an academic paper is really supposed to be, to actually writing it. This endeavor has left me greatly indebted to a number of people.

My advisor, Karl-Göran Mäler, and the members of my dissertation committee, Per-Olov Johansson and Stefan Lundgren provided encouragement, as well as insightful and constructive advice. The comments and suggestions of Karl Jungenfeldt, Hans Wijkander and Henrik Horn were also very helpful. Gunnar Eliasson, the director of IUI, radiated support and ceaseless enthusiasm, and has provided a stimulating and congenial research environment.

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Maria Hedström and Jeannette Åkerman greatly facilitated the preparation of this book. Cynthia Miller's expert advice ironed out many rough spots in the English prose. Jörgen Nilson and Torsten Dahlquist made my work less frustrating by giving me the upper hand in the battle against uncooperative computers and software. Finally, I would like to thank my wife Anna for inspiration and support.

Stockholm in February 1993

Sten Nyberg

Contents

Introduction

This thesis consists of four applied theoretical essays on quite diverse topics. The first chapter concerns honesty in society. The analysis focuses on transactions, or joint undertakings, subject to opportunistic behavior, and the effect of the participants' efforts to safeguard the transaction on the aggregate level of honesty in society. Chapters II and III examine negative externalities in oligopolistic markets with price competition. The simple model developed in the first, and more general, essay indicates that negative consumption externalities dampen price competition. In chapter III the model is modified and applied to the market for phone-ordered taxi services. Finally, chapter IV contains an essay on the effects of reciprocal ownership links in a takeover situation. If a firm faces the prospect of being taken over, how does reciprocal shareholding affect shareholder wealth and managerial compensation?

Does it pay to be honest?

The trust we are willing to place in other people is determined both by circumstances and peoples' characteristics. If the incentives are right not even the vilest of crooks will deceive us while if the temptation to cheat is sufficiently great even persons of great integrity may succumb. In ongoing relationships cooperation is generally easier to sustain even under adverse circumstances. This has been explored at length in the repeated game literature. [See Fudenberg (1992) for a comprehensive review.]

Individual qualities cannot easily be determined at a mere glance but observation of a person's behavior over some time may reveal that person's true characteristics. (Granted that there is something to learn, i.e., that people actually are different.) Some people may, however, have incentives to misrepresent their type. Unless there is some probability of revelation, e.g., that a dishonest person actually cheats, nothing will be learned. Hence, cheating must at least occasionally be as profitable, or better, than pretending to be honest. If dishonesty is widespread then honest individuals may refrain from trying to establish a relationship to begin with. The prior beliefs of individuals concerning the probability of meeting dishonest people may thus determine how risky a transaction, in terms of the scope for opportunistic behavior, people are willing to participate in. The prior beliefs in this sense constitute a social capital.

When agents meet randomly, the prior belief simply corresponds to the prevalence of "honesty" in the population. The purpose of chapter I is to endogenize the proportion of honest individuals in the population within an evolutionary model. The analysis focuses on the role of private precautions in determining the equilibrium level of honesty in society and the stability of this equilibrium.

The model is set up as a random matching game where individuals interact once, but it could be interpreted as a collapsed repeated game model where the one-shot payoffs represent the total value of interacting over time with a specific type. The basic premise in the non-genetic evolutionary model used here is that a behavioral trait can only survive if it is as beneficial for the individual carrying it as any other trait.[1]

The formation of traits such as honesty, adherence to religion and sense of fairness is influenced by the social environment. For instance, we could think of individuals as actively learning or imitating characteristics of people they look up to, who serve as "models" or "cultural parents," and that successful people are more likely to be used as models. Through their upbringing, individuals are also subjected to the indirect influence of their caretakers' models. [For an in-depth discussion of these issues see Boyd and Richerson's (1985) treatise on cultural evolution.]

The survival prospects for honesty as a trait hinge on the ability of honest individuals to avoid being exploited. To that end they may take various precautions like check the credit history of prospective business partners or write comprehensive contracts. If such measures are not too costly, then a stable population equilibrium featuring both honest and dishonest individuals is viable. Both honest and dishonest people benefit from a higher proportion of the population being honest. Individual

[1]The individuals should be conceived of as hosts of behaviors, or "memes" in Dawkins' (1989) terminology, where the behaviors, not the individuals, are under selective pressure.

precautions make dishonesty less profitable and push the population equilibrium toward more honesty. However, honest individuals fail to consider the socially beneficial effects of their safeguards. Thus subsidization may increase social welfare. By contrast, sharply increased safeguard costs, e.g., soaring litigation costs, can undermine the viability of honesty. Occasionally calls are made for a moral restoration lest we become a society of liars and cheats. Is societal honesty inherently unstable and if it becomes undermined does it not suffice to simply return to the previous cost level? These issues are discussed in the last sections of chapter IV.

Negative externalities in consumption

In chapters II and III we study the effects of negative reciprocal consumption externalities on oligopolistic market. Such externalities arise in situations where one individual's consumption of a good or service lowers the value of another persons' consumption. For example, when people decide whether to take the car to work or not they are not concerned with the additional congestion their car causes for other commuters. This results in an equilibrium with too many people using their cars. On markets for publicly provided goods subject to congestion, e.g., road space, efficiency can be restored by setting a price higher than marginal cost. [See, e.g., Diamond (1973).]

Externalities of this type also occur on markets for private goods and services. Again, the transportation sector provides an example. An airline that lowers its prices to attract more passengers increases its likelihood of being overbooked. Other passengers' choices of airline affect the individual's decision. Reciprocal consumption externalities can also be found on markets for prestigious brand-name goods where substantial output expansions may cause brand-name debasement. For instance, ordering Perrier instead of ordinary table-water would not lend you an air of sophistication if everybody else did it too, similarly, the appearance of identical evening-dresses at the same gala-dinner may spell social disaster, or at least cause some unease, on the part of their wearers.[2]

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[2]Exclusive boutiques often offer only a small number of each garment in order to reassure the customer of a small probability of such embarrassment.

On markets for private goods and services, externalities of this type affect the strategic interaction between firms. These strategic considerations have not been subject to much attention until quite recently in the literature on clubs. [See Scotchmer (1985a), (1985b).]

The focus of chapter II is to analyze firms' pricing and capacity decisions and their effects on social welfare in a simple oligopoly model with price competition. As in the literature on clubs we find that Bertrand competition does not ensure marginal cost pricing in the presence of congestion. The reason for this is that increased demand automatically lowers consumer valuation of the product, which makes price competition softer and yields an equilibrium price above marginal cost. However, the socially efficient price is also higher than marginal cost. The question is whether the equilibrium price is high enough or too high.

Chapter III applies a duopoly version of the model outlined above, with minor modifications, to examine pricing and capacity decisions on the market for phone-ordered taxicabs. The negative consumption externality on this market arises because the demand for taxi services is likely to depend not just on prices but on waiting time as well. If one taxi-company cuts its fares it will gain some new customers but the additional demand also translates into longer waiting time, for a given capacity, which reduces the willingness to pay for the services. If capacity is large relative to demand, the externalities will be of little significance for price setting and market efficiency. This provides firms with incentives to try to restrict inflow of new cabs. In this context it is interesting to examine whether profit maximizing firms differ from cooperative firms with respect to capacity choices.

M&As and reciprocal shareholding

The latest wave of mergers and acquisitions quickly reached the shores of academic economics, which were flooded with papers examining and reexamining the causes, consequences and welfare effects of this phenomenon. There are many ways in which acquisitions can generate a surplus to be shared between buyers and target shareholders. Takeovers can be value creating. Firms may be able to achieve technical or financial synergies not attainable while operating as separate units. The control shift can also bring in a more competent management, something that may be difficult for the shareholders to achieve themselves, due to lack of information, and other reasons.

The benefits can also result from redistribution from consumers, tax authorities or workers. For instance, an obvious source of value in horizontal mergers is increased market power.[3] Wealth can also be transferred from other stakeholders in the firm by breach of implicit agreements. [See Shleifer and Summers (1988).] Leaving the sources of benefits aside there is compelling empirical evidence that takeovers benefit target shareholders. The evidence on how the shareholders in the buying firm fare is less clear.

Hostile takeovers normally involve a replacement of the incumbent management in the target firm. This naturally gives management incentives to raise barriers against takeovers. A wide variety of innovative defense mechanisms with names like poison pills and shark repellents have been devised. Since takeovers generally benefit target shareholders these defenses have been argued to be detrimental to shareholder wealth. Yet, some of these defense mechanisms are however voluntarily adopted by the shareholder via the board of directors. This raises the question why shareholders would be willing to adopt anything that is contrary to their interests. Managerial resistance in response to a takeover attempt can, at least in theory, increase the premium paid if a takeover takes place and thus benefit shareholders, but it may also reduce the probability of a takeover occurring at all.

Reciprocal shareholding has been argued to make hostile takeovers much more difficult, in that large blocks of shares are controlled by other managers. Chapter IV studies the effect of reciprocal shareholding on shareholder wealth and managerial compensation. Reciprocal shareholding gives leverage to managerial defence activities since the effort can be concentrated on fewer shares. The level of managerial compensation determines the managers' opportunity cost of losing their position.

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[3]M&As have traditionally been divided into three main categories determined by the relationship between the merging parties in terms of market residency. Mergers between parties in the same industry are called horizontal while integration of vertically related businesses, e.g., a producer and a subcontractor, is labeled vertical. Finally, mergers between business-wise unrelated parties are called conglomerate. The legislators' concern for market power problems is reflected in antitrust law in the U.S., and competition law in the EC.

If reciprocal shareholding gives managers indirect control over a fraction of the voting rights in their firm, the beneficial effects of increased takeover premiums may be offset by increased managerial discretion. In the model, this is reflected in higher managerial compensation but could also be interpreted more generally as reduced firm performance as a result of managers pursuing, to an increasing extent, their own objectives. The effects of reciprocal shareholding on shareholder wealth and managerial compensation are determined by the mechanisms mentioned above, and their relative strength.

A summary of the thesis

Chapter I features an evolutionary model with honest and dishonest individuals who are indistinguishable. The players are matched randomly. Agents can however partially safeguard their transactions making them less vulnerable to cheating. The basic assumption about safeguards is that it becomes increasingly expensive to move toward complete protection, i.e., the technology is assumed to exhibit diminishing returns. The model is used to study the stability of equilibria featuring some proportion of honest agents and to examine the desirability of safeguard subsidies.

The positive external effects of safeguard investments mean that subsidies increase social welfare. Furthermore, the optimal level of subsidies is shown to be high and, more surprisingly, spending on safeguards decreases with subsidization. Sharply increased safeguard costs, on the other hand, may initiate a process of disintegration of honesty in society. Moreover, there is a strong element of hysteresis in this transition. Simply returning to the initial cost level does not suffice to restore the previous equilibrium. If feasible, a return requires some degree of overshooting and is likely to be very costly.

Chapters II and III examine the effects of negative consumption externalities in oligopolistic private goods markets with price competition. The first of these chapters presents a simple n-firm Bertrand model in which price formation and economic efficiency can be analyzed. Even though products are undifferentiated in equilibrium, the price-cost margin is positive. Furthermore, the equilibrium price is higher than the socially optimal price that compensates for the negative externality. In fact, the price can come close to the monopoly price if the externality is very strong and fixed costs are high.

In chapter III a duopoly version of the model is applied to the market for phone-ordered taxi services. Taxi firms first choose the size of their taxi fleets and then they compete in prices. For a given fleet size an increase in demand translates into longer waiting time which lowers the customer's valuation of the service.

Equilibrium capacities are shown to be larger if both firms maximize total profits than if they maximize profits per cab, i.e., work as cooperatives. If fixed costs for entrant cabs are small, the market is more efficient in the former case. Since entry on the cab level improves efficiency the regulator might want to allow firms to set hookup fees but to require them to accept new entrant cabs.

Finally, in chapter IV the effects of reciprocal ownership on shareholder wealth and managerial compensation are examined. These issues are analyzed in a two-firm, two-period framework where the firms face a probability of being taken over in the second period. Reciprocal shareholding is assumed to increase managerial influence over the board and to facilitate takeover resistance. The former can lead to excessive compensation while the latter may translate into higher premiums in the event of a takeover, but it also reduces the probability of receiving a tender offer. How hard management is prepared to fight depends on the attractiveness of incumbency, which is determined by the level of managerial compensation.

The net effect is determined by the efficiency of the incumbent management compared with outside entrepreneurs. If the probability of receiving a tender offer is high, perhaps due to inept managers, shareholders are likely to benefit from reciprocal shareholding since it lowers the cost of eliciting managerial resistance. Conversely, if the firm is very efficient, the probability of receiving a tender offer is not so high, and reciprocal shareholding is likely to be detrimental to shareholders.

While symmetric increases in reciprocal shareholding unambiguously make takeovers more difficult, it is not true that the effect on managerial compensation is always positive. The renumeration can be shown to be initially increasing but eventually it will decrease, approaching its lower bound.

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CHAPTER I

The honest society: stability and policy considerations

Introduction

In a society where people are able to rationally trust one another, cooperative undertakings can be realized without devoting considerable resources to contingency contracting and other precautions. In fact, in the absence of trust many cooperative ventures would not be viable. That societal morals may be important for economic prosperity has long been recognized. [See e.g. Banfield (1958)] However, even if honesty is collectively rational it is far from evident that it is rational for the individual to be honest. Akerlof (1983) discusses equilibrium honesty in a partial model where individual characteristics are observable. If agents interact with each other and moral standing is subject to choice, e.g. through upbringing, the game is likely to be of a prisoners dilemma type.[1]

More recently some models explaining the emergence of honest behavior as an outcome of an evolutionary process have appeared. [See e.g. Witt (1986), Frank (1987), (1989) and Harrington (1989).] The basic tenet common to all equilibrium stories about honesty is that the returns from being honest must be greater than or equal to that which would be obtained by being dishonest. If dishonest individuals differ from honest individuals only in that the dishonest are less restricted in their behavior, everyone would be dishonest in an evolutionary equilibrium. To allow for the emergence of trustworthy behavior it is sometimes assumed that there is some probability that other

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[1]See Ullman-Margalit (1977) for a treatise on the role of 'norms' in solving PD problems.

actors can identify a player's type, or that there is some cost involved in adopting the dishonest strategy. By contrast, in this paper evolutionary equilibria featuring honest behavior emerge because, in the spirit of Williamson (1985), honest types may use costly precautions to partially safeguard their transactions.[2]

The primary objective of this paper is to examine the level and stability of the equilibrium proportion of honest in the society, in an evolutionary framework, and to address the social welfare implications of policy measures like safeguard subsidies. In the next section the basic model is presented and the conditions for existence of an interior equilibrium featuring both honest and "naïvely" dishonest agents are discussed. The following section deals with the effect of changes in safeguard costs on equilibrium outcomes and social welfare. In an equilibrium population featuring both honest and dishonest individuals safeguard subsidies are found to increase social welfare. Conversely, it is shown that a moderate deterioration of societal trust, brought about by increased safeguard costs, can initiate a process of disintegration of societal honesty. Furthermore, simply restoring the conditions previously supporting a honest equilibrium is generally not sufficient to return from a dishonest situation. In the final section the implications of some less restrictive assumptions about the types are analyzed. Individuals receive the option of abstaining from interaction if the expected utility falls short of the reservation level. Furthermore, a more sophisticated variety of dishonesty is introduced, allowing for honest behavior when it is more profitable to be honest.

The model

The interaction between agents is modelled as a random matching game with a nonatomistic population of players. The players can be thought of as engaging in team production where they share the fruits of their joint effort but where the individual effort level is difficult to observe [e.g. Alchian & Demsetz (1972), Holmström (1979)], or they could be viewed as participants in a transaction which involves asset specific investments and is subject to opportunistic behavior.

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[2]The significance of costly dishonesty for tranditions from "bad" to "good" equilibria is however considered in the last section.

The players can be one of two types: honest, who would never renege on a promise, or dishonest, who do not feel compelled to honor any agreements. Honesty is viewed as a character trait that is relatively stable over time and not subject to conscious choice by the agent, unlike a strategy. In transactions between honest parties the cooperative outcome is attainable and the proceeds are shared equally yielding an individual payoff α. Whenever dishonest agents are involved, the scope for synergies is diminished and the gross value of the interaction is 2β, where $\alpha > \beta$. When a dishonest player meets an honest player the former pockets the entire 2β whereas in an encounter between two dishonest individuals the proceeds are shared equally assuming they are equally skilled in deception. While scheming in vain is unproductive, it is not as bad as trusting the other party, only to be cheated later. Furthermore, cheating an honest agent is more profitable than sticking to what was agreed upon and sharing the proceeds, i.e. 2β is greater than α. The situation facing the interacting agents is structurally a prisoners' dilemma situation.

	H	D
H	α, α	$0, 2\beta$
D	$2\beta, 0$	β, β

Figure 1. The payoffs in the random matching game.

In an evolutionary framework the most successful types increase in frequency in the population. Hence, the composition of the population will change over time so that the type receiving the highest expected payoff smoothly increases in frequency.[3]

[3]In evolutionary biology models there are compelling genetic arguments for the frequency of a type to depend on its relative fitness. This is not necessarily the case in the social sciences since the transfer of "cultural" traits or behaviors plausibly takes place through imitation and learning. Thus it is these processes that determine the properties of the dynamic. [For treatments of dynamics see e.g. van Damme (1987), Friedman (1991), Weibull (1992) and for discussions on dynamics and cultural evolution see Boyd and Richerson (1985) and Selten (1991).]

Let z be the difference in expected payoffs of the two types, π_h-π_d, to be defined later. Then the change of the proportion of dishonest in the population, p, can be described by any continuous dynamic $\dot{p} = \varphi(z(p))p$, defined for $p \in [0,1]$, where $\varphi(z(p))$ is continuously differientiable, strictly decreasing in z and is zero for z = 0.[4] Population proportions such that the population dynamic has a fixed point constitute dynamic equilibria. Furthermore, an equilibrium is asymptotically stable if there is some neighborhood of **p** such that any trajectory of the population dynamic originating in the neighborhood converges to **p**.

In the game outlined above dishonesty dominates honesty and the only feasible equilibrium is a situation where everybody is dishonest. However, the introduction of safeguards may change this. Economic transactions differ greatly in their susceptibility to opportunistic behavior, and based on their assessment of the riskiness of the transaction honest players may find it worthwhile to take precautions like check the other party's credit history or make provisions for a wider range of contingencies than those covered in a standard contract before engaging in a business relationship. The term safeguards will be used to denote all the various efforts to reduce exposure to opportunism.[5]

Safeguards are operationalized as the fraction, 1-θ, of the maximum loss, $-\beta$, an honest agent will incur should he encounter a dishonest agent. High θs thus correspond to extensive precautions. Although prudent, writing extensive contracts and undertaking other protective measures is certainly costly. The cost of a θ level of precaution is given by a continuous, twice differentiable, cost function c(θ) defined on [0, 1], reflecting the safeguard technology. Safeguards are assumed to exhibit diminishing returns and complete protection, θ=1, is assumed to be infinitely costly. A zero level of safeguards

[4]Since the population is at most bimorphic, an expansion of one type in the population implies a contraction of the other. Thus the relative rate of change for several different types is of no concern and it suffices to use any payoff-monotone continuous time dynamic. [For a general discussion of this class of dynamics see Weibull (1992)]

[5]Carefully crafted contracts facilitate recouping losses in court following a breach of trust. In court proceedings other costs arise, such as litigation costs. Even though these arise after a defection by the other party, they correspond to safeguard costs in that increased expected litigation costs essentially weakens the effect of the precautions taken. To achieve the same level of protection as before the increase, more resources must be spent on safeguarding.

In a model featuring risk averse agents, increased uncertainty concerning the outcome of court proceedings will have a similar effect.

carries no cost. When matching is random the probability of meeting a dishonest player equals their frequency in the population, p. Thus, the payoff accruing to honest players is given by:

$$\pi_h = (1-p)\alpha + p\theta\beta - c(\theta). \qquad (1)$$

Honest individuals choose the level of safeguards to maximize π_h. For all p greater than zero honest agents wish to take some precautions and the optimal θ is given by;

$$\theta = c'^{-1}(p\beta), \quad \theta \in [0,1], \qquad (2)$$

since $c'' > 0$, c' is one-to-one and thus has an inverse. In this section untrustworthy individuals are assumed to be naïvely dishonest, that is they only know how to cheat and are incapable of behaving honestly even if it would be more profitable to do so:

$$\pi_d = (1-p)(2-\theta)\beta + p\beta. \qquad (3)$$

Both types prefer to interact with honest counterparts and, as would be expected, the payoffs for both types increase as the proportion of honest in the population increases. This is easily seen by differentiating the payoffs with respect to p, using expression (2). The payoff difference is given by

$$z(p) = \pi_h - \pi_d = (1-p)(\alpha-\beta) - (1-\theta(p))\beta - c(\theta(p)). \qquad (4)$$

In an almost entirely honest population the probability of being cheated is minuscule warranting only small safeguard expenses: preying on the honest pays off handsomely: $z(0) = \alpha - 2\beta < 0$. Thus, unless safeguards carry no cost, there can never be an equilibrium with only honest individuals. The best we can hope for is asymptotically stable equilibria containing some proportion of honest agents, participating in the interaction. Such equilibria will be referred to as "good" while equilibria featuring only dishonest types will be called "bad".

The feasibility of different equilibrium types is determined by the parameter values in the model, (α, β). Figure 2 illustrates a situation where both types of equilibria are feasible. There is a good equilibrium in p_1, where the payoff functions intersect for the first time coming from the left. There is also a dishonest equilibrium in p=1. Of course p_2 is also an equilibrium point but it is not stable. Initial p's in the interval [0, p_2) yield convergence to p_1, whereas p's greater than p_2 will result in an asymptotically stable equilibrium at p = 1.

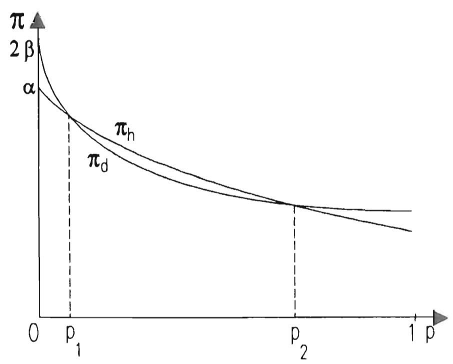

Figure 2. The payoffs of honest and dishonest types as a fuction of the proportion of dishonest types in the population.

Lemma 1: For all c(θ) there are (α ,β) s.t. there exists a "good" equilibrium which is asymptotically stable.

Proof: Let $\alpha = r\beta$, $r>1$, and consider p and β s.t. $c'^{-1}(p\beta)$ is constant, $\bar{\theta}$, and satisfies $r-1 > 1-\bar{\theta}$. Then, for a sufficiently large β (and correspondingly low p) $z(p)=[(1-p)(r-1)-(1-\bar{\theta})]\beta - c(\bar{\theta}) > 0$ implying $\dot{p}<0$. Since z(p) is continuous and $z(1) < 0$ there is at least one p, s.t. z(p)=0, constituting an asymptotically stable equilibrium. □

This means that as long as safeguards are reasonably cheap compared to the interaction payoffs "good" equilibria are feasible. However, given a sufficiently high initial proportion of dishonest agents a degenerate dishonest equilibrium will always be reached, and if safeguard cost are exorbitant dishonesty may prevail for all initial p.[6]

Lemma 2: If $c''(\theta)$ exists and is ≥ 0 then there can only be one good equilibrium.

Proof: $c''(\theta) \geq 0$ ensures that z(p) is concave.

Naturally, studying transitions between good and bad equilibria makes more sense in societies where good equilibria are feasible. Hence, throughout the remainder of the paper it is assumed that the parameters are such that both equilibrium types are feasible.

Safeguard costs and social welfare

In this section the effects of changes in safeguard costs with respect to equilibrium stability and social welfare will be discussed. The cost of safeguards can be affected directly through, for instance, subsidies for individuals seeking legal redress, lowering individual costs, or indirectly through policies increasing the uncertainty of the outcome of this process, thereby raising costs.

Apart from strengthening the protection of the honest individual in a transaction, additional safeguards also make dishonesty less attractive thus slightly reducing the proportion of dishonest people in equilibrium. This socially beneficial effect is not fully taken into account by honest individuals contemplating the appropriate level of safeguards.[7] Thus there may be a case for subsidizing safeguards from a social welfare point of view. Welfare is simply assumed to be a population-weighed average of the

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[6]Harrington (1989) remarks in a comment to Frank's model that "cooperative behavior need not arise as part of an evolutionary stable outcome" and argues that with more plausible assumptions, and given payoffs, the decisive factor in this regard is whether the initial population has a sufficiently high proportion of honest agents.

[7]In his analysis of individual precautions to prevent theft Shavell (1990) distinguishes between a diversion effect, where observable precautions make thiefs choose other victims, and a theft reduction effect induced by the reduced profitability of theft in general. The former effect, which may cause potential victims as a group to overinvest in precautions, is not considered in this paper. The theft reduction effect, loosely corresponding to a decrease in p in the evolutionary model in this paper, is not fully appropriated by individuals thus leading to underinvestment.

payoffs irrespective of whether individuals are honest or not. Social welfare is given by[8]

$$S(p,\theta,\gamma) = (1-p)\pi_h + p\pi_d = (1-p)^2\alpha + (2-p)p\beta - (1-p)c(\theta). \qquad (5)$$

Now, suppose the government contemplates subsidizing safeguards, to be financed by levying a uniform tax on all citizens. Since there is a continuum of agents they do not perceive their choice of precautions to influence the tax and treat it as a fixed cost. Let γ denote the safeguard subsidy. Honest agents thus only pay $(1-\gamma)c(\theta)$ to obtain a θ level of protection. Note that a safeguard subsidy, γ, only affects social welfare indirectly through the propensity to invest in safeguards since the full cost of safeguards, $(1-p)c(\theta)$, still burdens society's resources, leaving expression (5) unchanged.

Proposition 1: In a good equilibrium with no safeguard subsidies the introduction of subsidies (i) improves social welfare, (ii) continues to do so for $\gamma \leq 0.5$ and (iii) reduces the investments in safeguards in equilibrium.

Proof: In appendix I.

Not surprisingly, subsidizing safeguards is initially beneficial from a social point of view. However, the level of subsidies implied is quite high, partly reflecting the fact that subsidies are the only means available in the model to influence the level of honesty in society. Indeed, most societies do extend some type of safeguard subsidies. For instance, judicial systems are normally partially state funded, requiring the individuals concerned to pay only a fraction of the real litigation costs.

The third result may seem somewhat counterintuitive at first but is actually quite straightforward. The introduction of safeguard subsidies increases the payoffs of honest individuals for a given level of safeguards, thereby causing the proportion of dishonest agents to go down which in turn makes honest individuals invest less in safeguards.

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[8]Social welfare here measures both the extent to which synergies are realized and the amount of resources spent on unproductive safeguards. If α is close to β, increasing social welfare becomes a matter of minimizing safeguard costs in which case a degenerate dishonest equilibrium might well be preferable to an interior equilibrium. Furthermore, a stronger emphasis on the well-being of the honest would bias the analysis towards more subsidies.

Policies affecting the cost of safeguards may have more than just marginal effects. In fact, the social level of trust can degenerate completely when sufficiently undermined. If safeguards become so expensive that dishonest individuals do better than honest ones regardless of the level of honesty in the polpulation then a good equilibrium is no longer feasible. Let $\hat{c}(\theta)$ be a new cost function with the same properties as $c(\theta)$ such that $\hat{c}(\theta) \geq (1+\delta)c(\theta)$ for all levels of safeguards.

Proposition 2: (i) In any good equilibrium a sufficiently large increase in safeguarding costs, δ, will induce a transition to the bad equilibrium. (ii) A loss of trust is irreversible unless safeguards are free.

Proof: (i) As δ increases, the optimal θ (given by equation 2) will decrease. For a large enough δ θ becomes sufficiently small, i.e. close to zero, to make z(p) negative for all p. (ii) $z(1-\varepsilon) < 0$ for small ε if $\delta > -1$. □

It could be argued that policies aimed at instilling higher moral standards, creating a stronger capacity for remorse in individuals or upholding commendable behavior through group pressure or ostracism could restore lost trust. However, these mechanisms are likely to be most effective when deviations are rare. While mechanisms like these can be expected to increase compliance with an already widely held norm they are most likely quite ineffective when the majority challenges the "norm", i.e. they are preventive rather than corrective.

Even if policies like those mentioned above cannot reestablish a good equilibrium they can certainly be valuable in a good equilibrium. As indicated by proposition 3.1 pushing a bimorphic equilibrium towards more honesty increases social welfare.

Now, suppose that there is some cost involved in adopting the dishonest strategy, e.g. because deception is more mentally taxing than simply sticking to the agreement. Attempting to outsmart the other player is assumed to entail a small cost, $k \geq 0$.[9] Thus,

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[9] As Akerlof (1983) puts it "There is a return to appearing honest, but not to being honest. It pays parents to teach their children to be honest because the individually functional trait of appearing honest is jointly produced with the individually dysfunctional trait of being honest." The rationale for this, for "Fagans" disappointing, hypothesis is that it is costly to train children to be convincingly deceptive. Akerlof mentions

for sufficiently low safeguard costs a transition from a bad to a good equilibrium is feasible. However, this does not mean that a good equilibrium can be restored by recreating the conditions that prevailed before the loss of trust.

Proposition 3: A loss of trust in a state admitting both equilibrium types induced by a cost increase $\Delta\delta$ cannot be reversed by $-\Delta\delta$.

Proof: Both before and after $\Delta\delta$ $z(1) < 0$, $p=1$ is an asymptotic equilibrium. Furthermore, z is monotonously decreasing in δ and thus $z(1) < 0$ for $\delta \in [\delta°, \delta°+\Delta\delta]$. □

Hence, there is an element of hysteresis in the transition making it necessary to overshoot in order to return to a good equilibrium. This feature is consonant with arguments cautioning us about the perils of becoming a people of liars and cheats. While being intuitively a quite appealing property, this is not captured in the standard evolutionary equilibrium model. The main point here is that the mere addition of the seemingly innocuous assumption that agents are allowed to undertake costly safeguards generates this feature. Moreover, it is robust in the sense that the analysis is valid for all safeguard technologies with diminishing returns.

If trustworthiness, or honesty, is thought of as a general trait, its deterioration is not easily confined to specific aspects of behavior or particular transactions. In other words, a person who behaves opportunistically in one situation is also not to be trusted in other situations either. The level of trustworthiness may thus be affected by any policy that changes the relative payoffs of different types. For instance, a tax policy relying on honesty on the part of the taxpayers, thus favoring the dishonest relatively speaking, would shift a mixed equilibrium toward increased dishonesty. In fact, "nice" systems that trust its citizens, or users, to be responsible individuals may actually pose a threat to the viability of a high level of honesty in a society and should perhaps be eschewed.

daytime TV as anecdotal evidence in support of the scarcity of talent in this area.

Sophisticated strategies

For simplicity, the payoffs have thus far been assumed to exceed the individuals' reservation level. Relaxing this assumption leaves the analysis basically unchanged but may admit an interval of bad equilibria. Suppose agents require an expected payoff of at least β, before they participate. This could be thought of as the autarcic payoff, given by,

$$\hat{\pi}_i = \max\{ \pi_p, \beta \}, \tag{6}$$

which depicted graphically would typically look as follows:

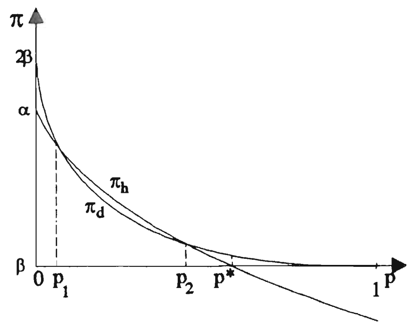

Figure 3. The payoffs of the types when honest individuals require β to participate.

The dishonest equilibrium is now to be found in p* where the honest part of the population prefers not to participate, while the dishonest find participation to be weakly dominating. If there is some small fixed cost associated with being dishonest the only behavior that is nash in the participation choice and also constitutes a dynamic equilibrium is nonparticipation on the part of both groups, for all p∈[p*,1]. [10]

[10] There are several papers examining credibility problems on the individual interaction level using a incomplete information framework, notably Sobel (1985) and Dasgupta (1988). Agents meet and interact repeatedly while updating their prior beliefs about their partner's type. To entice dishonest types to reveal themselves defecting must be at least as attractive to them as pretending to be honest and enjoying the benefits of the partner's increased trust in them. Whether it is worthwhile to try to learn more about the other party and build trust or whether it is better not to interact, or to interact only in a risk-free way, depends on the prior

Apart from the participation decision it could also be argued that it is not plausible that dishonest persons should ceat when it is contrary to their interests to do so. Allowing dishonest players to mimic honest behavior when it is profitable to do so implies that they face the following payoff function,

$$\pi_d = \max\{ \pi_h, (1-pq)(2-\theta)\beta \}. \quad (7)$$

Proposition 4: There exist good equilibria for all $p\in[p^*, 1]$ in which the individual payoffs are the same as in p^*.

Proof: Let q be the proportion of dishonest aggents actually behaving dishonestly. For $p\in[p^*, 1]$ q s.t. $pq=p^*$ yield perfect nash equilibria, in q, in the "stage game" and support an asymptotically stable equilibrium in the population game. □

As long as π_d is greater than π_h all dishonest agents will naturally prefer to behave dishonestly. Now consider a p large enough to push the dishonest payoff below that of the honest players. This will induce some dishonest agents to act as honest ones. This in turn implies that, coming from a low p, any p is compatible with a "good" equilibrium. However, if there were some cost associated with being dishonest or if there were a lexicographic preference for honesty, then p* would be the unique "good" equilibrium. A high initial proportion of dishonest individuals is of course still compatible with a degenerate dishonest equilibrium. This means that for a range of initial p's both types of equilibria are feasible.

The introduction of sophisticated dishonesty leaves the analysis basically unchanged, although one difference compared to the case involving naïve dishonesty is that while a transition to a good equilibrium in the latter case requires a substantial change in the proportion of types, a transition in the sophisticated case "merely" involves

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probability that the other party is honest. Building trust is always optimal from a social point of view and thus the prior constitutes a social capital.

If individual encounters take place randomly the prior probability corresponds to the proportion of the population being honest. The model in this paper, while being symmetric, could be interpreted as being analogous to a collapsed repeated game model endogenizing the prior within an evolutionary framework. The payoffs would then represent the total value of interacting over time with a specific type.

a coordinated change of strategy on the part of a sufficient number of dishonest agents. Even though this distinction is inconsequential in the model it is perhaps plausible that a change in the proportion of types would take considerable time whereas a coordinated change in strategies could be achieved much more quickly, and with substantially lower costs.

These remarks of course simply relate to the properties of the model under these different assumptions. But they serve to point out the fact that while a "loss of trust" is most likely a very serious matter indeed, it is perhaps not the abyss indicated by a naïve modelling approach.

Conclusions

The environment in which individual interactions take place determines the riskiness of the transactions and the relative payoffs to honest and dishonest individuals. Important environmental factors include the ease of monitoring and the efficacy of legal redress. In the present paper all activities reducing the exposure to opportunism are summarized under the term safeguards. The basic assumption about safeguards is that it gets increasingly expensive to move toward complete protection, i.e. the technology is assumed to exhibit diminishing returns.

Both the honest and the dishonest benefit from a more honest population. Private investments in safeguards promote honesty, which benefits everyone in the population. This externality is not taken into account by individuals, resulting in underinvestment in safeguards. Thus, not surprisingly, safeguard subsidies are found to increase social welfare. More interestingly, the optimal level of subsidies can be shown to be large, perhaps to some extent reflecting the fact that safeguards constitute the only means in the model by which the level of honesty can be influenced. Furthermore, investments in safeguards turn out to decrease with subsidization because of the decrease in the fraction of dishonest in the population resulting from safeguard subsidies.

Conversely, transient increases in safeguard costs may prompt a transition to a dishonest equilibrium thereby doing lasting damage to the social trust capital. A return to an honest equilibrium generally requires more than just revoking the policy that gave rise to the shift, i.e. it requires some degree of overshooting. This, is in accordance with popular view about pendulum motions in societal evolution, the swing from a lax to an austere regime, for example. Smooth adjustments are simply not enough.

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CHAPTER II

Vanity and congestion: a study of reciprocal externalities[1]

Introduction

The pleasure derived from consuming a good is sometimes affected by the consumption patterns of other people. Such consumption externalities may be of a one-way type, as when a living-room view is obstructed by neighboring houses, or it may be reciprocal, as when driving a car reduces the street space available for other drivers, making driving less enjoyable. In this chapter we study welfare aspects of negative reciprocal externalities, of which congestion is a special case.

Negative externalities have long been a favorite topic of economic inquiry, but studies have normally abstracted from strategic behavior on the production side. For many applications this is a natural assumption to make, for instance when studying optimal capacity and fee structures for publicly provided goods, like street space [See e.g. Vickrey (1969).].[2]

Reciprocal externalities are, however, likely to be important also in markets for private goods and services in that they affect the strategic interaction between firms. In the literature on clubs, Bertrand competition is shown not to ensure marginal cost pricing

[1]This chapter is written jointly with Jonas Häckner.

[2]A discussion of the more general problem of designing corrective taxes in the presence of externalities can be found in Diamond (1973) or Green and Sheshinski (1976). For the case of equal and reciprocal externalities Diamond shows that a uniform price, in excess of marginal cost by the value of the externality, permits the competitive equilibrium to be Pareto optimal.

in the presence of congestion.[3] The reason for this is that increased demand results in more congestion which, in turn, reduces consumers' willingness to pay for the good. Hence, price cuts tend to be undesirable. On the other hand, the socially efficient price ends up being higher than the marginal cost in order to compensate for the negative externality. The question is whether prices are high enough or too high. Another example of reciprocal consumption externalities is given by markets for prestigious brand-name goods where substantial output expansions may cause brand-name debasement. For instance, if everyone wore Rolex watches, wearing one yourself would do little to enhance your prestige. [See e.g. Veblen (1899) and Hirsch (1976)]

Historically, policymakers have been inclined to thoroughly regulate some congested markets. The transportation sector is perhaps the best example. In most countries practically all transportation services, (airlines, the trucking industry, railroads, taxis, etc.), have been subject to extensive regulation, both in terms of price and entry. It is easy to see that congestion is a real issue in such markets. For instance, flights are less likely to be overbooked the smaller the number of passengers. And the availability of taxis decreases, i.e. the waiting time increases, when per cab demand increases. Whether negative consumption externalities provide a rationale for regulatory intervention depends on the strength of the externalities relative to the costs of regulation. Such costs would seem to depend on the context (availability of information etc.), and optimal regulation is used only as a benchmark in the analysis.

The aim of this chapter is to study price formation and economic efficiency on oligopolistic private goods markets characterized by reciprocal consumption externalities and price competition. The chapter is organized as follows: In the next section, the basic model is presented and the price equilibrium is characterized. In the following section, we examine welfare issues. The chapter concludes with a section on endogenous entry and some final remarks.

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[3]In Scotchmer (1985a), private clubs subject to congestion, like golf courses and sports clubs, are shown to choose membership fees above marginal cost in a Bertrand game. In contrast to our framework, consumer demand is assumed to be perfectly inelastic, so the question of price efficiency cannot be addressed. This assumption is relaxed in Scotchmer (1985b) but instead firms choose a two-part tariff consisting of membership fees and user charges. In equilibrium, firms tend to set low charges in order to increase the consumer surplus captured by the membership fee. In this chapter, it will become clear that competition in linear prices have quite different implications.

The model

There are two types of goods. One type of good is available in a number of different brands of identical intrinsic quality, and the other type is a composite good representing consumption of everything else. For the brand-name good, consumer utility is assumed to be increasing in the amount consumed, but at a decreasing rate. Furthermore, brands can be differentiated in terms of exclusiveness (i.e. total sales) and utility is increasing in exclusiveness (decreasing in the volume of sales of a certain brand). The marginal utility from consuming the composite good is assumed to be approximately constant for reasonable ranges of income. The utility function of a consumer j purchasing brand name good i can be written

$$U_{j,i}=U(y_{j,i},\ q_{j,i},\ Q_i)\ , \tag{1}$$

where $y_{j,i}$ and $q_{j,i}$ denote consumption of the composite good and of the brand name good respectively and Q_i represents total sales of brand i. By assumption, U_1, $U_2>0$, $U_3<0$, $U_{11}=0$ and $U_{22}<0$.

We assume that there is a continuum of identical consumers. The demand of an individual consumer patronizing firm i is derived by maximizing (1) with respect to $y_{j,i}$ and $q_{j,i}$ given that consumers correctly anticipate the equilibrium Q_i, and subject to the budget constraint $p_iq_{j,i} + y_{j,i} \le I$, where the price of the composite good is normalized to unity. Furthermore, consumers do not perceive their own demand to influence the price-setting behavior of the firms. Nor do they take into account the effect of their own demand on exclusiveness.[4]

Let there be n firms each producing one brand-name good, possibly differentiated by exclusiveness. Consumers, being utility maximizers, would never buy from a firm unless it is the best deal around. Thus, for given prices, market shares, m_i, will adjust so that customers are indifferent between buying from different firms in equilibrium.[5]

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[4]A notable exception to this, however, is Groucho Marx's famous remark about joining clubs.

[5]Consumers being indifferent between firms of course introduces the need for some invisible hand guiding demand so that indifference actually holds. For example, if prices are equal and all "indifferent" consumers happen to patronize the same firm, they would not be indifferent any longer but rather realize that they all made a mistake.

Consequently, expressed in terms of indirect utility,

$$V(p_1, Q_1, I) = V(p_2, Q_2, I) = \dots = V(p_n, Q_n, I) \ , \tag{2}$$

which amounts to n-1 equations. The demand of a representative consumer patronizing firm i is derived using Roy's identity, yielding another n equations. Finally, the market shares add up to one, so there are 2n equations altogether. The total number of consumers being normalized to one, the aggregate demand facing a firm thus equals individual demand times the market share,

$$Q_i = q_{j,i} m_i \ , \tag{3}$$

which can be solved for explicitly using the 2n equations. For the sake of tractability consumer preferences are assumed to have the simplest possible functional form consistent with the assumptions made. Consumer j's utility function is given by

$$U_{j,i} = y_{j,i} + (1-\alpha q_{j,i})q_{j,i} - \beta Q_i q_{j,i} \ . \tag{4}$$

The first term on the right-hand side is consumer j's consumption of the composite good, $y_{j,i}$, while the second term gives the quadratic gross utility from consuming the differentiated good, $q_{j,i}$. The last term reflects individual j's disutility of the consumption of others, Q_i, which is assumed to increase in his own consumption of variety i. Hence marginal utility and individual demand depend on exclusiveness. The decrease in utility of additional consumption is parameterized by α while ß measures the impact of the negative externality.[6] The individual demand and the indirect utility function are given by

$$q_{j,i} = \frac{1-p_i-\beta Q_i}{2\alpha} \tag{5}$$

and

[6]For positive externalities, ß<0, the equal utility condition, expression (7), will not hold (or be unstable) and there is a tendency towards natural monopolies. The strategic implications of positive externalities are discussed in the literature on networks. See for example Katz and Shapiro (1985) and (1986).

$$V(p_i, Q_i, I) = \frac{(1-p_i-\beta Q_i)^2}{4\alpha} + I \ . \tag{6}$$

Hence, in this case expression (2) implies

$$p_1 + \beta Q_1 = p_2 + \beta Q_2 = \dots = p_n + \beta Q_n \ . \tag{7}$$

Let **p** be the vector of prices charged by the firms. The marginal willingness to pay for one unit is at most one so $p_i \leq 1$ and **p** is a point in the price simplex $P=[0,1]^n$. The demand facing firm i can now be expressed as a function of **p**.

Lemma 1: The aggregate demand facing firm i is

$$Q_i = \frac{2\alpha(\sum_{j \neq i} p_j - (n-1)p_i) + \beta(1-p_i)}{\beta(2\alpha n + \beta)} \ .$$

Proof: In appendix II.

Firms maximize profits with respect to price while taking into account the strategic interdependence between price choices. Consequently, the appropriate equilibrium concept is the Nash equilibrium. Marginal production costs, c_i, are assumed to be constant and strictly less than one. The profit function of firm i is

$$\pi_i = (p_i - c_i)Q_i \ . \tag{8}$$

Having characterized consumer behavior and firm behavior, the next step is to characterize the market equilibrium. Substituting the demand of firm i into its profit function and maximizing with respect to p_i, while taking the other firms' prices as given, yields the best response function, φ_i, of firm i.[7]

[7]Assuming Cournot competition instead does not change the analysis much. Equilibrium prices would be somewhat higher, but qualitatively all results would hold.

$$\varphi_i(p_{-i}) = \frac{1}{2}\left[c_i + \frac{2\alpha\sum_{j \neq i} p_j + \beta}{2\alpha(n-1) + \beta}\right] . \tag{9}$$

The reaction functions are linear and upward sloping in the competitors' prices implying strategic complementarity. Furthermore, cost differences affect the intercepts, but not the slopes, i.e. the responsiveness to other firms' actions are unaffected. In figure 1, which illustrates the duopoly case, $c_1 > c_2$ making $p_1 > p_2$ in equilibrium.

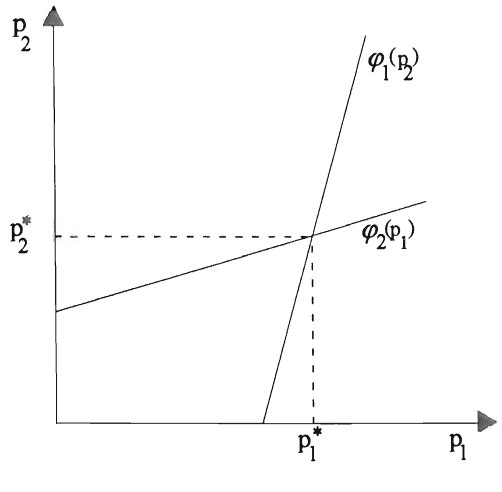

Figure 1. Examples of reaction functions in a duopoly.

If ß is large relative to α, the influence of the other firms' prices is very limited and the optimal price will be close to $(c_i + 1)/2$, i.e the price that would be chosen by a profit maximizing monopolist. Nevertheless, this does not mean that extreme congestion is likely to be desirable from the perspective of the firms. On the contrary, if ß approaches infinity, consumers' valuation of the good is reduced to such an extent that firm demand goes to zero.

For a duopoly market, the existence of a unique and symmetric price equilibrium is intuitively clear and it can easily be established also in the n-firm case.

Proposition 1: There exists a unique equilibrium.

Proof: First, the price simplex, P, is a non-empty, compact and convex set. Furthermore, the vector-valued best-response function, $\Phi(\mathbf{p})$, is linear and thus u.h.c. and convex. Finally, it can easily be shown that $\Phi(\mathbf{p}) \subset P$ and thus Kakutani's theorem guarantees a fixpoint. Uniqueness then follows directly since $\Phi(\mathbf{p})$ is a contraction. □

Corollary 1: If $c_i = c$ for all i, then the equilibrium will be symmetric with $p_1=p_2=...=p^*$.

$$p^* = \frac{2\alpha(n-1)c+\beta(c+1)}{2\alpha(n-1)+2\beta}$$

Proof: Identical costs yield symmetric reaction functions ensuring a symmetric equilibrium. Solving (9) for $p_i=p_j$ yields p^*. □

Proposition 2: The equilibrium price, p^*, is increasing in β and for $\beta = 0$, $p^* = c$. When β approaches infinity, p^* approaches the monopolistic price, $(c+1)/2$.

Proof: Follows from differentiating p^*. □

Hence, equilibrium prices are above marginal cost despite the fact that firms compete in prices and products are undifferentiated in equilibrium, costs being equal. The undercutting strategy becomes unattractive since output expansions affect quality negatively. Technically speaking, in a standard Bertrand game, firm demand and profits are discontinuous at the lowest price charged by the competitors. This discontinuity is smoothed out by reciprocal externalities allowing a price differential to be compensated for by differences in quality. Hence, it is not possible to capture the entire market by undercutting the rival slightly. If ß is small, the situation is nevertheless very similar to the standard Bertrand game with prices close to marginal cost and basically no profits.

This suggests that there may be incentives for firms to deliberately try to influence the impact of congestion on consumer utility. [8]

Proposition 3: The equilibrium price, p, is decreasing in n and it approaches c as n approaches infinity.*

Proof: Follows from differentiating p*. □

Not surprisingly, an increase in the number of firms induces a more competitive market structure leading to lower prices.

Social welfare implications

Consumers do not take into account the negative externality they inflict on their fellow consumers in the sense that buying the product makes it less exclusive and hence less desirable for others. Thus, the equilibrium consumption of exclusive items, given a certain price, can be expected to be too high from the consumers' point of view. Indeed, this can easily be demonstrated to be the case. As shown above, the externality affects the strategic interaction between producers, thereby generating an equilibrium price that is above marginal cost. But the question is whether this price is sufficiently high to compensate for the externality, or whether it is really too high from a social point of view.

To facilitate the comparative static analysis we examine a symmetric price equilibrium where individuals choose the same q. Since consumers are identical, social welfare can be measured by the utility of the representative individual minus the per capita cost of production. Letting W denote social welfare,

$$W = y + (1-\alpha q)q - \frac{\beta q^2}{n} - cq \ . \tag{10}$$

Differentiating W with respect to q gives the socially optimal individual consumption

[8] If, for example, transportation firms could commit to lower their capacity, it could be interpreted as an increase in ß, possibly leading to higher profits.These issues are discussed more thoroughly in chapter III.

$$q^{**} = \frac{n(1-c)}{2\alpha n+2\beta} \ . \tag{11}$$

Hence, the more severe the externality, the lower is the socially optimal consumption level. Moreover, this can be seen to be higher than the equilibrium quantity, derived by inserting the equilibrium price (Corollary 1) into aggregate demand. It thereby follows that the price that maximizes social welfare, p^{**}, is lower than the equilibrium price.

Proposition 4: The socially optimal consumption level can always be obtained by means of a price-ceiling, the ceiling being

$$p^{**} = \frac{2\alpha cn+\beta(c+1)}{2\alpha n+2\beta} \ .$$

Proof: Solving for the price that makes individual demand equal to q^{**} yields p^{**}. The difference between the equilibrium price, p^{*}, and p^{**}, is strictly positive for all $\beta>0$. □

Note that p^{**} approaches marginal cost as β approaches zero. This is true for p^{*} too so for an arbitrarily small β, p^{*} will be arbitrarily close to p^{**} yielding an arbitrarily small welfare loss. It is not surprising that a negative consumption externality raises optimal prices above marginal cost. The important social welfare conclusion is that the anti-competitive feature of the market, also caused by the externality, will be too strong, thus motivating a price ceiling.[9]

Another interesting conclusion concerns empirical estimates of consumer surplus in the presence of negative externalities. Comparing (11) with the actual demand function of lemma 1, it is clear that the area below the demand function will be larger than the true consumer surplus. Consequently, any conventional method to estimate consumer surplus will yield biased results.

[9]Of course, policy implications of this kind make most sense in cases of physical externalities such as those found in competing transportation systems. It seems difficult to argue convincingly for regulating the prices of Cartier and Rolex watches.

Entry

Until now, the number of firms has been exogenous. In absence of fixed costs or other entry barriers, a free entry equilibrium would be characterized by an infinite number of firms, each producing an infinitely small amount. Prices would be driven down to marginal cost, despite the externality, completely eroding firm profits. However, entry may involve substantial initial costs on many markets. For example, in the transportation sector large fixed investments in capacity, as well as in marketing, are generally required when entering the market.[10] We therefore introduce a fixed cost, K, keeping the assumption of equal marginal costs across firms.

Proposition 5: Firm profits increase in market concentration and decrease in industry cost level.

Proof: In appendix II.

Hence, the larger the fixed cost, and the larger the marginal cost, the smaller the number firms that could enter profitably.

Proposition 6: Firm profits are quasiconcave in β and increases (decreases) in β for low (high) values of β.

Proof: Follows from simple differentiation of the profit function.

Thus, given a certain K, the equilibrium number of firms will be largest for some intermediate value of ß. The explanation is that for low values of ß, the market will be fairly competitive, implying low profits and no opportunity for a large number of firms to cover their fixed costs. On the other hand, if ß is large, aggregate demand will be very low since the marginal utility from consuming the good will be reduced to a great extent. Hence, only a small number of firms would be able to enter profitably.

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[10]In markets for exclusive brand-name goods, marketing expenses are often very large when new products are introduced. If the simplifying assumption is made that marketing has only an informational value, and does not influence preferences directly, marketing may readily be thought of as a sunk cost.

We may conclude that if fixed costs are not negligible, it is reasonable to expect a small number of incumbent firms to charge prices above marginal costs without being threatened by new entrants.

Conclusions

The introduction of consumption externalities into a standard Bertrand oligopoly model has several important implications. First, as would be expected, they induce over-consumption from the consumers' perspective, at any given price. Second, they change the incentives of firms, thus dampening competition. Firms may charge prices well above marginal cost despite Bertrand competition and despite goods being homogenous in equilibrium. In fact, if the externality is substantial, equilibrium prices may be close to the monopoly level. The anti-competitive effect dominates the over-consumption effect which translates into a market price that is too high from a social point of view. Thus, welfare can be improved by means of a price-ceiling, which should be noted is commonly practiced in markets for transportation services. Furthermore, we may note that any standard estimate of consumer surplus based on observed demand functions will be positively biased in the presence of negative externalities.

These conclusions are of course based on a specific parameterization of the utility function. However, in most cases linear demand functions and linear "crowding" costs are probably good approximations of real conditions.

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CHAPTER III

Deregulating taxi services: a word of caution[1]

Introduction

This chapter studies the performance of a market for phone-ordered taxi cabs which is subject to negative waiting time externalities. Using the Bertrand oligopoly framework established in chapter II we examine the role of firm types, private vs cooperative, in determining the market outcomes.

In most countries the taxicab industry is subject to various types of regulation such as entry restrictions and price controls. A common rationale for regulating the industry has been to make transportation available at times when demand is low and in areas where population is dispersed. For example, in return for agreeing to serve relatively thin markets a firm could be granted a monopoly position. Another alleged reason for regulating the market is that a policymaker can maintain a price level that is "reasonable" in the eyes of consumers while producers are ensured a "reasonable" profit level by means of entry restrictions. Critics of regulation would argue that such arguments are thinly veiled excuses for catering to interest groups.[2]

The poor performance of regulated industries in general initiated a wave of deregulation during the 1980s. Whether deregulating a taxi market improves its performance depends on many factors. One of the most important factor is the presence or absence of inherent market failures that give rise to inefficiencies in the absence of

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[1]This chapter is written jointly with Jonas Häckner.

[2]When deciding on the appropriate number of licenses, regulators in Sweden saw fit to seek guidance from incumbent taxi firms, since they would be best informed about demand conditions. Not surprisingly this resulted in insufficient capacity and long waiting times, not unlike a monopoly situation.

regulation.[3] Essentially two types of distortions have been discussed in the literature, one arising from imperfect information about prices and the other caused by negative externalities in consumption of taxi-services. The former avenue of research, drawing on search theory, is probably best suited for analyzing the market for street-hailed cabs where price information is more likely to be incomplete.[4] In this chapter we focus on markets for telephone-ordered taxicabs, where price information is easier to come by and where waiting time presumably is an important determinant of product quality.

The externality argument was first brought up by Orr (1969)[5] who noticed that demand is likely to depend not just on prices but also on waiting time. Waiting time, in turn, depends on capacity as well as on the equilibrium demand for taxi services. Hence, there is a negative externality in the sense that one consumer's demand will increase waiting time for all other consumers making the service less valuable to them. In a perfectly competitive market this leads to an over-consumption of taxi services, or in other words, excessively low prices.

Although several authors have stressed the interdependence between demand, price and capacity, the economic implications have not been thoroughly analyzed. Prices have been assumed to be competitive, monopolistic [Foerster and Gilbert (1979)] or exogenously given by regulation [De Vany (1975) and Schroeter (1983)]. In the absence of regulation it seems reasonable to assume that prices are set by the Radio Dispatch Services (RDSs), rather than by individual cab owners [Douglas (1972) and Williams (1980b)]. The analysis requires an explicit oligopolistic framework because when they set prices, firms take into account the pricing decisions of their competitors as well as

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[3]Some evidence of excessive prices can be found in Teal and Berglund (1987). They compare the effects of deregulation in six US cities and find that rates increased after deregulation. Entry was substantial on the cab level, but few radio dispatch services were established. Furthermore, taxicab productivity declined resulting in lower earnings for taxi drivers.

[4]Using search theoretical arguments, Douglas (1972) and Schreiber (1975) claim that prices would be excessively high on an unregulated market. The reason being that unilateral price increases are relatively profitable if price information is scarce and search costs high. Williams (1980a), (1980b) and Coffman (1977) criticize Schreiber's analysis noting that it is confined to the market for cruising cabs while 70-80% of the US taxi demand consist of telephone ordered trips for which price comparisons are relatively easy. Furthermore, most taxi firms have large fleets making price advertizing worthwhile. Finally, on the cruising cab market, the presence of cabstands facilitates price comparisons, further reducing search costs.

[5]Assuming price-taking behavior, Orr characterized equilibria under various price- and entry regulations. Although he found it unlikely, he concluded that an increase in capacity might in fact stimulate demand to such extent that profits per cab increase.

the effects of the waiting time externality. The latter circumstance makes unilateral price cuts less attractive since, for a given capacity, increased demand means longer waiting time and thus a lower willingness to pay.[6] Ceteris paribus, the externality may in fact help firms sustain a higher profit level than otherwise would have been possible. This, in turn, suggests that there might be incentives to cut back on capacity in order to increase waiting time.

The chapter is organized as follows: The basic model is presented in the next section and some results concerning price-setting behavior and social welfare are derived. For the sake of expositional clarity the analysis is confined to a duopoly. The results can however be generalized to the n firm case. In the last section the model is extended to allow for entry. The chapter ends with some concluding remarks.

The model

Taxi firms, by which we mean radio dispatch services (RDSs), choose fares and decide on fees for drivers wishing to hook up to their service. Fares are assumed to be linear in the quantity of services consumed, q, and each driver can at most be hooked up to one RDS. The expected waiting time when ordering a taxi from a certain firm is assumed to depend on the demand facing that firm divided by the size of their taxi fleet. The fleets are initially assumed to be of equal size and are normalized to one.

Consumers value two things. First, their utility is assumed to be linearly increasing in the consumption of a composite good, y, representing "everything else." Second, consumer utility is assumed to increase, at a decreasing rate, in the amount of taxi services consumed, e.g. the number of (equally long) trips demanded, and decrease in waiting time. To make the welfare analysis tractable we specify a simple utility function with the above properties. Assuming a continuum of identical consumers, the utility of consumer j patronizing firm 1 is given by

[6] That such a mechanism may put an upward pressure on price has in fact been shown in a quite different context, namely in the theory of clubs [Scotchmer (1985)].

$$U_{j,1} = y_{j,1} + (w-\alpha q_{j,1})q_{j,1} - \beta Q_1 q_{j,1} \,, \tag{1}$$

where the last term reflects the disutility of waiting, caused by others' consumption, Q_1. The marginal utility of the first unit of good q consumed is denoted by w. The diminishing utility of additional consumption and waiting time is parameterized by α and ß respectively.[7] Waiting time is assumed to become more important, the more taxi trips consumed, thus affecting marginal utility and individual demand. Furthermore, consumers disregard the effect of their own demand on the price-setting behavior of firms. The demand for taxi services by a single consumer patronizing firm 1 is derived from the individual consumer's utility maximization subject to the budget constraint, $I = y_{j,1} + p_1 q_{j,i}$, where the price of the composite good is normalized to one. That is,

$$q_{j,1} = \frac{w-p_1-\beta Q_1}{2\alpha} \,. \tag{2}$$

The aggregate demand of firm 1, normalizing the number of consumers to unity, is simply $Q_1 = q_{j,1}m$, where m is firm 1's market share. Consumers will choose to ride with the firm offering the best price - waiting time tradeoff. In equilibrium customers are indifferent with respect to the different firms, i.e. in terms of their indirect utility functions, $V(p_1,Q_1,I) = V(p_2,Q_2,I)$. For our specific utility function this yields

$$p_1 + \beta Q_1 = p_2 + \beta Q_2 \,. \tag{3}$$

Solving for the market shares satisfying the above condition for given prices and letting $m_2=(1-m)$ be firm 2's market share we have

$$m = \frac{2\alpha(p_2-p_1) + \beta(w-p_1)}{\beta(2w-p_1-p_2)} \tag{4}$$

and thus the aggregate demand for firm 1's services is given by

[7] β can actually be given two structurally indistinguishable interpretations. The first, and most obvious, interpretation is that it reflects consumers' aversion toward spending time waiting. However, it may also be thought of as a technology parameter that relates capacity to waiting time.

$$Q_1 = \frac{2\alpha(p_2-p_1) + \beta(w-p_1)}{\beta(4\alpha + \beta)} . \tag{5}$$

Firm 2's demand is derived analogously. The marginal cost of producing taxi services is assumed to be constant and the profit of firm 1, given there are no fixed costs, is given by

$$\pi_1 = (p_1 - c_1)Q_1 . \tag{6}$$

The best-response function for firm 1 is obtained by differentiating profits with respect to p_1:

$$\varphi_1(p_2) = \frac{1}{2}\left[c_1 + \frac{2\alpha p_2 + \beta w}{2\alpha + \beta}\right] . \tag{7}$$

Thus, prices are strategic complements. Furthermore, the slope being less than one ensures a unique equilibrium. The symmetric case, where firms face equal marginal costs, c, not surprisingly yields a symmetric equilibrium with $p_1=p_2= p^*$, where

$$p^* = \frac{1}{2}\left[c + \frac{\alpha c+\beta w}{\alpha+\beta}\right] . \tag{8}$$

It is easy to see that the equilibrium price, p^*, is increasing in β. If consumers are infinitely patient, $\beta = 0$, firms face true Bertrand competition and prices are driven down to marginal cost. If waiting time does matter, firms will earn positive profits. In fact, as ß approaches infinity prices are close to the monopoly level, (c+w)/2. Equilibrium profits are however highest for intermediate values of ß. For low ßs, the market will be fairly competitive and for high ßs aggregate demand is greatly reduced by the impact of the negative externality.

In contrast to the standard Bertrand equilibrium, prices are above marginal cost despite price competition and homogeneous products in equilibrium, costs being equal.[8] [9]

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[8]A similar result can be found in Scotchmer (1985).

Moreover, while the socially efficient price on a market with negative externalities is higher than marginal cost it can be shown that the externality weakens competition to such an extent that the equilibrium price level is actually higher than optimal. Social welfare can thus be improved by means of a price-ceiling given by

$$p^{**} = \frac{1}{2}\left[c + \frac{2\alpha c + \beta w}{2\alpha + \beta}\right], \tag{9}$$

where p** approaches marginal cost as ß approaches zero. This holds true for p* as well. Hence, if ß can be made arbitrarily small, efficiency losses will also become arbitrarily small. As will be discussed below, an inflow of new cabs can be interpreted precisely as a reduction in ß.

Entry

The findings in the previous section suggest that price competition alone may not suffice to ensure efficient pricing on the market for taxi services. However, the results were derived under the assumption of fixed capacity. Insofar as regulated capacity is the real culprit, removing the institutional barriers to entry may go a long way in improving conditions.

The natural entry barriers on the cab level are likely to be very low. There is a reasonably efficient market for used cars and leasing may also be a viable option. The only element of sunk cost would appear to be the time and money spent in getting the taxi driving-license. Hence, high industry profits would soon attract new capacity thereby reducing waiting time. Prices would be driven towards marginal costs and industry profits dwindle but the social cost of negative consumption externalities would be negligible. However, this also suggests that RDSs have an incentive to try to restrict the inflow of new cabs.

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[9]In fact, it suffices for a fraction of all consumers to have an aversion towards waiting time for all firms to profitably charge prices above marginal cost. It is fairly easy to construct examples of asymmetric equilibria assuming two consumer groups consisting of "businessmen" with a high willingness to pay for transportation but a large queue aversion and "ordinary people" with a low willingness to pay for transportation and a moderate queue aversion.

Entry can, of course, take place on the RDS level as well. Establishing an RDS may, however, entail substantial fixed costs.[10] [11] First, office staff, marketing costs and equipment costs are more or less independent of scale. Furthermore, it is inconvenient for a consumer to memorize more than a few phone numbers to different taxi firms. There may also be returns to scale in that expected waiting time is likely to decrease with fleet size even if demand per cab is kept constant. This is because the geographical distance between a (randomly located) customer and the nearest taxi can be expected to decrease with the size of the (randomly located) taxi fleet. These effects, benefiting incumbents, may to some extent be approximated by increasing returns to scale in the operation of a service. Some empirical evidence in support of this can be found in Teal and Berglund (1987) who report that US deregulations typically have resulted in massive entry on the cab level while the market structure on the RDS level has been more or less unaffected.

Assuming that entry is most likely to occur on the cab level, we now analyze the effects of entry, keeping the number of RDSs fixed. This is done by introducing an initial stage in which RDSs decide on capacities by taking into account the effect on equilibrium prices in the subsequent stage. Technically speaking, we solve for the subgame perfect Nash equilibrium of a two-stage game. Fleet sizes, equilibrium prices and quantities are compared under two different assumptions regarding the organizational structure of the RDSs, denoted regimes I and II. These structures may be thought to reflect different regulatory regimes or market practices. For the sake of tractability the analysis is confined to a duopoly market and RDSs are assumed to be symmetric in terms of organizational structure.

Under regime I, RDSs are cooperatives controlled by the cab drivers. Only members are allowed to vote when deciding on capacities so new memberships are

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[10]The airline industry may serve as an interesting comparison. Airline business was widely held to be essentially contestable for many of the same reasons put forward in the discussion about the taxi industry. The experience following airline deregulation in the US was however somewhat disappointing in that factors like gate access and computerized booking systems tended to impede entry, or at least make entry less attractive [Levine (1987)]. There may be incumbency advantages for established radio dispatch companies that are in some respects parallel to that of the computerized booking systems.

[11]Although high fixed costs per se do not constitute entry barriers in a strict sense, they do limit the number of firms that can coexist on the market without running a loss. If prices adjust instantaneously to new market conditions (in contrast to the contestable market framework where hit and run entry is feasible) then, even in the absence of sunk costs, firms may earn positive profits in equilibrium.

refused (and old ones terminated) as benefits the majority of the members. Hence, RDSs choose fleet size to maximize per cab profits. In regime II, RDSs are privately owned enterprises choosing connection fees to maximize firm profits.

Firm capacity is modelled by making ß firm-specific letting, $\beta_i = b/f_i$, where f_i denotes the fleet size of firm i and b reflects aversion towards waiting time. Replacing β with β_1 and β_2 in expression (3) and proceeding as before, the demand facing firm 1 becomes

$$Q_1 = \frac{f_1[2\alpha f_2(p_2-p_1)+b(w-p_1)]}{b[2\alpha(f_1+f_2)+b]} . \tag{10}$$

Straightforward differentiation implies that the gross equilibrium profit of RDS 1 is

$$\pi_1 = \frac{bf_1[w-c]^2[\alpha(2f_1+f_2)+b][2\alpha^2 f_2(2f_1+f_2)+\alpha b(2f_1+3f_2)+b^2]}{4[3\alpha^2 f_1 f_2+2\alpha b(f_1+f_2)+b^2]^2[2\alpha(f_1+f_2)+b]} . \tag{11}$$

It can be checked that the waiting time facing firm 1's customers, Q_1/f_1, is decreasing and convex in f_1 at equilibrium prices, which is reasonable since the first unit of capacity is likely to reduce waiting time to a greater extent than the hundredth unit.

Let K_c denote the fixed cost of an entrant cab and let K_r denote the fixed cost of an RDS.[12] Then $\bar{K}(f_i)=K_c+K_r/f_i$ is the average fixed cost of a cab hooked up to an RDS with fleet size f_i.[13] The marginal cost of running a RDS is assumed to be zero.

The fleet size equilibria

When the RDSs maximize profits per cab, $\pi_I \equiv \pi_i/f_i - \bar{K}(f_i)$, with respect to fleet size, there is a clear incentive to keep the fleet small. A privately owned RDS maximizes total profits, i.e. connection fees times fleet size minus costs. The highest connection fee possible to extract is $Z=\pi_i/f_i-K_c$ which yields a per cab profit amounting to $\pi_i/f_i-\bar{K}(f_i)$ just as under regime I. Hence, firms maximize $\pi_{II} \equiv f_i\pi_I = f_i(\pi_i/f_i-\bar{K}(f_i))$ with respect to f_i. For a

[12] K_r could include wages, marketing costs and capital costs while K_c could include leasing fees, and the driver's opportunity cost of working in the cab industry.

[13] The net RDS profit function can be shown to be single peaked for positive fleet sizes. Using equation (11) they can be written on the form; $\pi_1(f_1) - f_1K_c - K_r = f_1[\pi_1/f_1 - K_c] - K_r$ where π_1/f_1 is decreasing in fleet size. It follows that profits per cab are also single peaked.

given size of the competitor's fleet the relation between π_I and π_{II} is illustrated in Figure 1.[14]

Lemma 1: Fleet sizes are strategic complements under regime I and strategic substitutes under regime II.

Proof: Profit per cab, π_I, is at least quasiconcave in f_i since π_i/f_i and $\bar{K}(f_i)$ are both decreasing and strictly convex in f_i and intersect twice. It is then obvious that π_{II} has the same property. Strategic complementarity (substitutability) follows from applying the implicit function theorem to the first order condition noting that the cross derivative of π_I (π_{II}) wrt fleet sizes is positive (negative). □

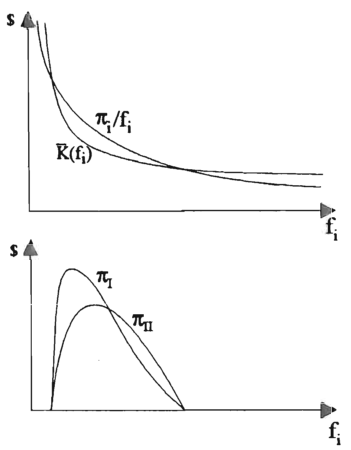

Figure 1.

If firm 2 increases its capacity, firm 1 will lose some customers to firm 2, reducing Q_1 and hence waiting time. When demand is reduced, waiting time becomes less sensitive to changes in f_1 which also makes firm demand less sensitive. In turn, gross profits, π_1 and gross profits per cab, π_1/f_1 , become more robust to changes in f_1. Under regime I,

[14] In figure 1 maximal profit per cab is higher than maximal profits per RDS. This is simply due to the optimal fleet sizes being smaller than one which, in turn, follows from normalizing the total number of consumers to one.

firm 1 can therefore increase its fleet size, spreading the fixed cost, K_r , over a larger number of cabs, incurring only a small loss in terms of π_1/f_1. Conversely, under regime II, firm 1 can reduce its fixed cost payments, $f_1K_c+K_r$, by reducing its fleet size, without affecting π_1 very much.

Proposition 1: Under both regimes, there exists a unique and symmetric equilibrium in fleet sizes.[15]

Proof: The reaction-functions, $f_i(f_j)$, are identical. Under regime I they are concave and upward sloping (by strategic complementarity) and under regime II they are downward sloping (by strategic substitutability). □

Proposition 2: (i) Under regime I, the equilibrium fleet size decreases in consumers' valuation of taxi services, w, and increases in marginal cost, c. (ii) Increases in w raise prices while the effect on quantity is ambiguous. Increased costs, c, have indeterminate effects on prices and quantities. (iii) Increased RDS fixed cost, K_r, increases f_i given any f_j, resulting in lower prices and larger equilibrium quantities. The fixed cost per cab, K_c, does not affect fleet sizes.

Proof: In appendix III.

As consumers' valuation of taxi services increases, (or marginal cost decreases,) the firm will want to trade off some of this for a reduction in fleet size in order to increase per cab profits.

The direct effect of an increases in w is a rise in both price and quantity. However, firms benefit from cutting back on capacity, which increases prices and reduces quantities. Hence, only the effect on price is clear. Similarly, when c increases, the direct effect is a rise in price and a reduction in quantity. As capacity increases, prices go

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[15]Since equilibrium taxi fleets are symmetric under all regimes, the assumption of identical RDSs, made in the section introducing the model, can in fact be rationalized.

down, and quantities go up, so the net effect is unclear. Finally, when the fixed cost of an RDS, K_r, increases, there is a tendency to spread it among a greater number of members, which lowers prices and increases equilibrium quantities. A policymaker could therefore induce lower prices through imposing a lump sum tax on RDSs which is a somewhat paradoxical result. Raising the fixed cost per cab, K_c, does not affect the maximization problem.

Proposition 3: (i) Under regime II, if consumers are patient, i.e. when b is small, the equilibrium fleet size decreases in consumers' valuation of taxi services, w, and increases in marginal cost, c. If consumers are impatient, i.e. when b is large, the opposite is true. (ii) For small b, increases in w raise prices while the effect on quantity is ambiguous. Increased costs, c, have indeterminate effects on price and quantity. When b is large, w has a positive effect on quantity while the effect on price is ambiguous. Increases in marginal cost raise prices and reduce quantity. (iii) Increased per cab fixed costs, K_c, reduces f_i given any f_j. This raises prices and reduces quantity. The RDS fixed cost, K_r, has no effect on capacities.

Proof: In appendix III

If consumers have a large aversion towards waiting, the willingness to pay for a reduction in waiting time will increase greatly when w increases, in which case, it is profitable to expand capacity. When consumers are patient, waiting time is not a major issue and increases in w are immediately traded off for reductions in capacity in order to reduce the fixed cost payments.

When b is small, price and quantity derivatives with respect to w and c are the same as in regime I and for the same reasons. Therefore, let us assume that b is large. The direct effect of an increase in w is a rise in both price and quantity. But since firms increase capacity, which tends to reduce price and increase quantity, the only clear effect is on quantity. When c increases, on the other hand, the direct effect is a rise price and a reduction in quantity. In this case, firms cut back on capacity, which tends to raise prices and reduce quantity so the effect in this case is unambiguous.

Finally, when the fixed cost of taxicabs, K_c, increases, firms naturally cut back on capacity which raises prices and reduces equilibrium quantities. Consequently, one way for a policymaker to induce lower prices is to subsidize the fixed cost of entrant cabs. Raising the fixed cost of an RDS, K_r, does not affect the maximization problem.

From a welfare perspective, it is interesting to compare the equilibrium fleet sizes. In figure 1, which is drawn for an arbitrary f_j, we can see that the equilibrium fleet size in regime II, f_{II}, is larger than that of regime I, f_I. Indeed, given any f_j it will be optimal to choose a higher f_i under regime II than under regime I. In terms of equilibrium prices and quantities, $p_I > p_{II}$ and $Q_I < Q_{II}$.

Of course one could also imagine a situation where a regime I firm competes with a regime II firm.[16] Assume that the market initially is in a regime I equilibrium. Then one firm, say firm 2, is reorganized as a regime II firm. Since the best response to a given f_1 is larger for a regime II firm than for a regime I firm its reaction function shifts out. Firm 1's reaction function is increasing in f_2 so at the new intersection both firms will have larger fleet sizes but firm 2 will have the largest one. Compared to a symmetric regime II equilibrium, firm 2 will have a larger fleet size in the hybrid equilibrium and firm 1 a smaller one. All drivers would of course prefer to belong to the cooperative firm but only a limited number of members are accepted.

Policy implications

The main conclusion from the last section is that market profits will be positive despite "free" entry of taxicabs. The reason is the endogenous entry barrier, in the form of high connection fees and exclusion, created by the RDSs.

If the fixed cost of entrant cabs, K_c, is low, it would be socially desirable to reduce entry barriers to a minimum since a large number of new cabs would drive ß towards zero, without incurring a great cost on society. Consumers' valuation of taxi services would increase and market prices be driven towards marginal cost. In other words, the market would become more and more similar to the standard Bertrand market with constant marginal cost pricing and almost no externalities. Clearly, the market outcome

[16]The two major firms on the Stockholm taxicab market are organized in this manner.

will not be efficient in this case, but regime II will be relatively more efficient than regime I. If the industry could be costlessly re-regulated, one therefore might want to prevent the RDSs from refusing to hook up new entrants. If costs are observable, the fees could also be subject to regulation.

However, if the fixed cost of entrant cabs is substantial, some entry barrier may be needed to prevent the positive price-cost margin from attracting too many cabs from the social point of view. More specifically, when a cab enters on the margin, the consumers' valuation of the price decrease and the waiting-time reduction may be smaller than the fixed cost. Regime I might then be relatively efficient since equilibrium fleet sizes are small.

Conclusions

The sunk cost of an entrant cab is likely to be small since cabs can be leased and there exist well-functioning markets for second hand taxi equipment. Also, the fixed costs are likely to be moderate, consisting mainly of a leasing fee and perhaps the opportunity cost of working in the industry. All this put together makes for a strong case for deregulation. However, price competition alone does not ensure efficiency. Cooperatively-run RDSs will be relatively less efficient compared to privately-owned RDSs. Since firms will not voluntarily choose large capacities, one could even argue for a regulation of the RDSs guaranteeing free access and, if costs are observable, low connection fees. Thus, a case could be made for stimulating competition between independent taxi firms, but to separate the production of the services from the ordering system which could be run as a regulated monopoly or be publicly operated. In such case, the costs of regulation must of course be taken explicitly into account. Specifically, information asymmetries may make it difficult to induce cost efficiency.

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CHAPTER IV

Reciprocal shareholding and takeover deterrence

Introduction

In recent years there has been a growing interest in ownership issues. Corporate control, takeovers and, in particular, agency problems stemming from managerial interests not fully coinciding with those of the shareholders have attracted considerable attention.

Large corporations with dispersed ownership structures are claimed to be especially prone to agency problems manifesting themselves in low performance and conspicuous executive perquisites. The existence of a well-functioning market for corporate control has been argued to be an important safeguard against managerial malpractice. [See e.g. Jensen (1986).] Furthermore, the market for corporate control is a means for allocating capital to its most efficient use and replacing well-meaning but mediocre management teams with more competent ones when competence is not observable.[1]

In markets where reciprocal shareholding between firms is a prominent feature, as is the case in Sweden and Japan, there has been some concern that the takeover mechanism is impeded by reciprocal shareholding.[2] According to folklore, reciprocal

[1]This strand of the agency literature differs from the "formal principal agent literature" in Williamson's (1988) terminology, which focuses on the risk sharing problem. In the latter context, takeovers enhance efficiency only to the extent that raiders contribute information that can be used to more accurately evaluate risk averse managers' performance thus reducing their risk exposure. Hence, provided that information is more cheaply available to raiders than to owners, takeovers may economize on resources spent on monitoring managerial performance. [See Scharfstein (1988).]

[2]In Japan, like in Sweden, intercorporate stockholdings are often concentrated within a group of companies, often referred to as keiretsus. In many groups mutual stockholdings are so sizable that Aoki (1988) concludes that "...outsiders would have little hope of taking over a member of those corporate groups through open market bids if the members acted against such a move in concert."

ownership structures increase managerial power, diminishing the chance of a takeover occurring, to the detriment of the shareholders. Nevertheless, reciprocal ownership has its proponents, some of whom do not seem to dispute the folklore logic but instead view a strengthened defense against takeovers, in particular against foreign ones, as beneficial. Industrialists and officials in Sweden have expressed concern over the increased exposure to the European market for corporate control that may follow an accommodation to European legislation concerning foreign ownership.

In many parts of western Europe reciprocal ownership is severely restricted or prohibited by law. Although this is not true to the same degree for the U.S., reciprocal ownership is not very common in the U.S. either.[3]

In this chapter, reciprocal shareholding is assumed to give managers indirect control over a fraction of the voting rights in their firm. Since managers most often stand to lose from a takeover, the shares controlled by managers are not tendered. In a model with normal, non-intertwined shareholding Stultz (1988) shows that, assuming an upward sloping supply curve for shares, shareholder welfare is increasing in the fraction of votes controlled by management when the fraction is low and decreasing when it is high. Here, all shares are valued according to their expected payoff. Managerial resistance to a takeover attempt may however increase the premium paid, and thus benefit shareholders, if a takeover actually takes place, but it also reduces the probability of such an event occurring.[4]

In a special study on reciprocal stock ownership between Swedish public firms, DsI 1986 (in Swedish), the Swedish Parliamentary Commission on Stock Ownership and Efficiency reports that by the end of 1985, close to one third of the firms with equity exceeding ten million Swedish kronor were involved in reciprocal ownership relations. To be considered a reciprocal relation the value of the stock holdings or the voting power in the relationship must exceed 2%. [See Skog and Isaksson (1989) for a succinct account of ownership in Sweden]

[3]A wide variety of other means to deter takeovers are available in the U.S., and in contrast to Sweden share-repurchases are legal, except for the purpose of tax evasion. The significance of the latter observation has to do with the potential gains from transforming dividends to capital gains in face of asymmetric taxation schemes. It is easy to see that there are close similarities between reciprocal purchases of shares and share-repurchases in this respect. [See e.g. Auerbach (1979).] The mechanisms are not entirely analogous however, since reciprocal share purchases do alter the composition of assets underlying a specific share.

[4]The tradeoff between the size of the premiums and the probability of a takeover is analogous to the price setting problem in sequential search models where sellers choose what price to charge when facing a distribution of reservation prices.

Previous research on reciprocal shareholding has focused primarily on the product market repercussions in oligopolistic industries. Mutual shareholdings align the interests of competing firms leading to less output and higher prices in Cournot oligopolies. Moreover, collusion can be expected to be facilitated, further reinforcing the effect. [See Reynolds and Snapp (1986).] However, acquisition of shares in rivals is not a subgame perfect equilibrium in a Cournot setting even though it might be under Bertrand competition [Flath (1991)]. Furthermore, Flath (1989) shows that the effect on output in vertically related Cournot-oligopolists depends on the dominating direction of these bonds. The takeover deterrence aspect of reciprocal ownership is, however, equally important between firms in unrelated industries. Product market implications are therefore left aside in this analysis in order to focus on the corporate control issues.

The purpose of the present chapter is to shed some light on when reciprocal ownership is likely to have a deterring effect on takeovers, under what circumstances it can be expected to have beneficial or detrimental effects on shareholder wealth, and how managerial compensation is affected by reciprocal shareholding.

In the next section a simple two-firm, two-period model is presented. Managerial compensation contracts are negotiated in the first period and in the second period shareholders either divide firm profits between themselves in accordance with the intertwined claims, or they tender their shares to a corporate raider. The relationships between optimal managerial compensation, the takeover premiums and the degree of reciprocal shareholding are derived. Finally in following section, managerial influence on board decisions is taken into account and the effect on shareholder wealth is discussed in the symmetric case.

The model

The analysis is set in a two-firm, two-period framework. The firms, that we can call A and B, have a large number of small shareholders but may also own shares in one another. Let α be the proportion of A's shares held by firm B and β the corresponding fraction of B's shares held by A. The pair (α,β) defines an ownership structure. This type of intertwined ownership relation will henceforth be referred to as reciprocal shareholding.

The presumption is that reciprocal sharholding adds leverage to managerial efforts to fend off hostile tender offers. How much effort, or resources, the incumbent management is willing to spend to avoid a takeover is assumed to be proportional to the level of present compensation, serving as a proxy for the desirability of maintaining status quo. Incentive problems of the type arising in principal agent models are not addressed here. The important aspect in this analysis is the managers' valuation of incumbency, regardless of whether it is mainly derived from on the job consumption, prestige or plain compensation. The opportunity cost determines the intensity of managerial resistance. Compensation contracts may be thought of as structurally optimal in the sense that managerial incentives concerning the operation of the firm are aligned with those of the shareholders.

In the first period the shareholders, via the board of directors, decide on the level of managerial compensation, I_a. Unless a tender offer appears, dividends and managerial compensation are paid in the second period. To attract suitable candidates to managerial positions, the level of compensation must meet the individual rationality, or participation, constraint which, for simplicity, just requires compensation to be positive. Furthermore, it is assumed that the compensation cannot be made contingent on the occurrence of a tender offer in the second period.

Let the gross profit that the incumbent management is able to turn be denoted r_a. This, net of managerial remuneration, yields the profit to be divided between the shareholders in the form of dividends:

$$\pi_a = r_a - I_a \,. \tag{1}$$

Reciprocal shareholding complicates matters slightly in that a share in firm A is not only a claim on the returns generated by the productive assets originally associated with firm A, but rather a composite claim on the proceeds from both firms. Let Π_a be the total value of shares held by individual shareholders in firm A. The value of all shares is then

$\Pi_a/(1-\alpha)$ which equals $\pi_a + \beta\Pi_b/(1-\beta)$, i.e. profits in firm A plus claims on the proceeds in firm B. Deriving the corresponding equation for firm B and solving for Π_a and Π_b yields[5]

$$\Pi_a = \frac{1-\alpha}{1-\alpha\beta}(\pi_a+\beta\pi_b) \ . \qquad (2)$$

In the absence of a market for corporate control it is optimal for the shareholders to offer managers the lowest level of compensation they will accept, that is zero.

Now, suppose there are external entrepreneurs, some of whom are capable of turning a gross profit in excess of r_a. These entrepreneurs, or raiders, may present shareholders with a tender offer in the second period. If at least fifty percent of the shares are tendered, firm A becomes a subsidiary to the raider and the offer is "successful", materializing into a takeover. If less than half the shares are tendered the incumbent management retains control, e.g. through a MBO, and the offer fails.

The probability of the appearance of a raider knowing more profitable ways of using the firm's resources, e.g. by restructuring, selling off parts of the firm or finding potential synergies, is given by a distribution function, $G_i(r_i)$, where r is the gross revenue of the firm after implementation of the raider's new business strategy. $G_i(r_i)$ is assumed to be twice continuously differentiable, having a density function $g_i(r_i)$, and $G_a(\cdot)$ and $G_b(\cdot)$ are assumed to be independent. The minimum post-takeover profit a raider must be able to turn in order to make a takeover viable, assuming that takeovers are not merely reflections of managerial hubris, depends on the size of the takeover premium needed to make the offer successful. The premium in turn is determined by the bargaining power of the shareholders vis-à-vis the raider and the effect of managerial resistance. First, these issues are briefly discussed and then the threshold gross profit level is derived.

According to the Grossman and Hart (1980) argument, shareholders have incentives to free ride on each other and not tender their shares at any price below the

[5]Note that while $\Pi_a + \Pi_b$ is equal to $\pi_a + \pi_b$ the "market value" of firms with reciprocal ownership ties, i.e. the value of all shares, will be inflated.

post-takeover share value. Since the capital gains on the acquired shares must exceed the value of the offer if it is to be profitable for the raider to launch a tender offer in the first place, tender offers cannot succeed. The raider could of course have some initial holdings in the target firm and thereby earn capital gains in addition to any profit on the purchased shares. If the share value increases following a successful tender offer it is clearly advantageous to acquire as large a holding as possible before making the offer.[6] This complication is disregarded in the model because the intuitive effect of initial holdings is straightforward.

Shareholders may however perceive a very real pressure to tender their shares at a price substantially below their share of the expected post-takeover value of the firm. The value of post-takeover minority holdings can be significantly reduced if shareholders suspect that the raider will engage in dilution, e.g. divert profits from the firm through a biased price setting in transactions with other firms wholly owned by the raider. Furthermore, if the acquirer presents shareholders with a two-tier offer, stipulating a premium on 50% of the shares and the pre-takeover price for the rest, then the individual shareholder benefits from tendering even if the premium is small. [See Ryngaert (1988)][7]

The approach followed here, is to assume: that bidders are required to make only uniform "any and all" offers, that there is some scope for improving the bargaining power of the shareholders, and that managerial defensive tactics induce higher premiums instead of merely imposing costs on an acquirer.[8]

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[6]There is usually a limit to how much stock a raider can purchase before having to disclose the purchases. In the U.S. the limit is set to 5% by the Williams act of 1967 as compared to 10% for Sweden. These limits may not constitute relevant constraints since it might not be possible to acquire holdings of such magnitude without the information leaking out and becoming common knowledge. [See Shleifer and Vishny (1986) for a discussion of pretakeover trading by a large shareholder.]

[7]In the U.S., an acquirer generally has the option of effecting a takeout-merger, i.e. to purchase the remaining minority shares, after the takeover. The best price the shareholders who chose not to tender in the first instance can hope to get is only bounded from below by their "appraisal rights". These are, as Bebchuk (1988) puts it "not designed to give a target's shareholders any share of the gains from the target's acquisition, for such statutes generally exclude from the required compensation any element of value arising from the accomplishment of a merger." Thus, the shareholders may choose to tender their shares even in cases where this is not a collectively value maximizing strategy. [Also, see Bebchuk (1988) for a comprehensive discussion of the pressure to tender and undistorted choice.]

[8]The model can easily be augmented to encompass two-tier offers.

All takeovers are assumed to involve a replacement of the incumbent management, which for simplicity is assumed to mean that management gets a payoff of zero.[9] If the firm B is taken over, managers at firm A still receive their contractual compensation. Furthermore, since A's managers are unaffected by offers directed at the firm B they are indifferent to tendering firm A's holdings in firm B. They are however assumed not to sell unless a takeover is inevitable. This assumption is important and can be argued to be plausible since if the model were extended to encompass more than two periods, selling would always be at least weakly dominated by not selling. As long as there is a slight probability that the own firm will not be taken over, not-selling is better than selling. The reason for not pursuing the multiperiod analysis is simply tractability.

Now, let z be the raider's bid for all shares in A. To be successful the bid has to be high enough to prevent the incumbent management from making a successful counter offer on (50-α)% of the outstanding shares, i.e., $z_a(y_b) \geq (\pi_a+\beta y_b)/(1-\alpha\beta) + I_a/(0.5-\alpha)$, where $y_b = \pi_b$, if firm B is not being taken over, or $y_b = k_b^*$, the threshold profitability of firm B, if it is. On the other hand, z must be small enough to leave the raider with a non-negative profit. If k_a is the raider's gross from operation of firm A then it must hold that $z_a(y_b) \leq k_a + \beta(y_b + \alpha z)$ where $\alpha\beta z$ is firm A's claim on the assets firm B received as payment for its share in A. Thus takeover bids are profitable for all k_a such that z satisfies both inequalities. Consequently, the threshold gross profit is given by

$$k_a^* = \pi_a + \frac{1-\alpha\beta}{0.5-\alpha}I_a, \tag{3}$$

which can be seen to be increasing in I_a. If k_a^* is high, only entrepreneurs anticipating substantial synergies will find it worthwhile to attempt a takeover. The probability that firm A is not going to be the target of a successful takeover is given by $G_a(k_a^*)$. The expected value of managing firm A, H_a, is thus

[9] The magnitude of the loss depends on factors such as the importance of undesirable reputation effects following removal from top management and the size of any "golden parachute".

$$H_a = G_a(k_a)I_a\,, \tag{4}$$

which is clearly increasing in I_a. Henceforth the arguments of $G_i(k_i^*)$ and its derivatives will be omitted for the sake of notational brevity. The expected value of all shares in firm A is a probability-weighed average of the shareholder payoffs from the four different outcomes in the second period. If firm A receives no tender offer shareholders get either Π_a or $\pi_a+\beta z(k_b)$, depending on whether firm B is taken over. Similarly, if firm A is being taken over the payment received when tendering the shares depends on what happens to firm B. The value of the fraction held by individual shareholders is thus

$$V_a = \frac{1-\alpha}{1-\alpha\beta}(\pi_a+\beta\pi_b) + \frac{1-\alpha}{0.5-\alpha}(1-G_a)I_a + \beta\frac{1-\alpha}{0.5-\beta}(1-G_b)I_b\,. \tag{5}$$

Naturally, introducing the possibility of value increasing takeovers can only enhance the value of the shares. The last two terms reflect the value of the option to improve the bargaining position if the chance of receiving an offer is big enough to warrant the expense.

Shareholders in firm A maximize the value of their shares subject to managers' expected compensation satisfying the participation constraint. Managers are awarded a strictly positive compensation only if the marginal revenue of raised compensation, via an increased premium, outweighs marginal cost, i.e.,

$$\frac{\partial V_a}{\partial I_a} = \frac{1-\alpha}{0.5-\alpha}\left[1 - G_a - g_a I_a\frac{\partial k_a^*}{\partial I_a}\right] - \frac{1-\alpha}{1-\alpha\beta} \leq 0\,. \tag{6}$$

If expression (6) is positive at $I_a = 0$ then compensation is increased until the derivative equals zero. If not, I_a equals zero by complementary slackness. The optimality of an interior solution candidate hinges on the properties of the probability distribution, G_a. However, it is sufficient that the distribution makes the maximand concave. The requirement, discussed further in the appendix, is essentially that $g'(k)$ must not be too negative. This is trivially true for a uniform distribution. It may however seem reasonable that good restructuring ideas or golden opportunities are more scarce than are mediocre ones. To capture this feature the acquirers' restructuring ideas are assumed to be exponentially distributed with respect to their implied post-takeover firm value, k. This can easily be verified to always yield a unique compensation level, $I_a \geq 0$, that maximizes shareholder wealth, V_a. (See appendix IV)

Insofar as the optimal compensation is zero, reciprocal shareholding is inconsequential to shareholder wealth. The fraction of the own firm that is controlled by the other firm is the most important factor in determining the optimal compensation level. Examining the effect of α on the compensation decision yields that there are always αs such that it is optimal to award executives a strictly positive compensation.

Proposition 1: If the distribution is nondegenerate then there is always a sufficiently large $\alpha < 0.5$ to generate an interior solution.

Proof: A corner solution requires (6) to be negative when evaluated at I_a=0, implying that

$$e^{-\frac{k_a^*}{m}} - \frac{0.5-\alpha}{1-\alpha\beta} \leq 0 ,$$

where m is a parameter determining the width of the distribution. Thus, for m > 0, there is always an $\alpha < 0.5$ sufficiently large to render this expression strictly positive. □

Considering that reciprocal ownership may be the only reason for awarding managers a higher than minimum remuneration in the first place, it may at first seem plausible that executives would always benefit from increases in reciprocal shareholding. However, this need not be the case. The reason for this is that shareholders face a trade off between their bargaining power and the probability of receiving a tender offer. Increased reciprocal shareholding means better leverage in managerial resistance but it can also reduce the probability of receiving an offer by such a degree that it would be compensated for by lowering executive remuneration. Thus, managers may sometimes be better off if they were somewhat less able to contest takeover attempts.

Proposition 2. (i) The compensation for managers in firm A is strictly quasiconcave in α and symmetric changes in reciprocal shareholding, γ, but is quasiconvex in β. (ii) I_a is initially increasing in α and γ unless G(r/m) is very small. (iii) As α, or γ, approaches 0.5 I_a approaches zero.

Proof: In appendix IV.

Part (ii) of the proposition states that unless the management is very inefficient or incompetent, (there being an 80 % chance or better of receiving a tender offer in absence of resistance,) they initially benefit from the other firm's equity position in their firm.

Even though the remuneration may eventually decrease as reciprocal equity interests grow stronger, it does not seem likely that the deterring effect would weaken. Intuitively, intensified reciprocal shareholding reduces the cost of bargaining power and thus shareholders would be expected to consume somewhat more of it.

Proposition 3. The threshold profitability that an acquirer's improvements must surpass, k_a, is increasing in α and γ but decreasing in β, and strictly so for interior solutions.*

Proof: In appendix IV.

Thus far, managers have been assumed to exert no influence over compensation decisions and consequently reciprocal minority equity interests cannot be harmful to shareholders. Reciprocal shareholding allows shareholders to improve their bargaining power in a tender offer situation at a lower cost compared to a situation without reciprocal ownership.

Managerial influence

In this section the effect of allowing for some degree of managerial influence over compensation decisions is illustrated by means of a symmetric example with identical firms that have, equal reciprocal shareholdings, ($\gamma = \alpha = \beta$), and equal probabilities of receiving tender offers, ($G_a(x) = G_b(x)$). Furthermore, the importance of the quite strong defense capability that executives have been assumed to possess is also discussed.

Managers are assumed to represent their firm on the board of other firms in which their firm holds equity positions. This endows managers with some control over the remuneration of executives in other firms and creates strong incentives for collusion between executives in firms entangled in a reciprocal ownership structure. For simplicity, managers are assumed to take full advantage of the opportunity to collude.

Disregarding the intricate issue of how to most appropriately model the relative influence of different groups on the board of directors it is here simply assumed that the objective function of the board is a vote-weighed average of the boardmembers' preferences. Thus, while payoffs are entirely divided among final owners this is not the case when it comes to control. As reciprocal shareholding become more pronounced, voting rights are gradually transferred from shareholders to managers. Thus, taking managerial collusion into account, I is now chosen to maximize:

$$W_a = (1-\gamma)V_a + \gamma H_a \,. \tag{7}$$

As before, the level of managerial compensation is governed by the first derivative of the maximand wrt I: [10]

$$\frac{\partial W_a}{\partial I_a} = \frac{1}{0.5-\gamma}\left[(1-\gamma)\frac{0.5+\gamma(1-\gamma)}{1+\gamma} - (1-2.5\gamma+2\gamma^2)\left(g_a I_a \frac{\partial k_a}{\partial I_a} + G_a\right)\right]. \tag{8}$$

Consider points {γ, r/m} such that expression (8) equals zero given that $I_a = 0$. Tracing out the pairs γ and G(r/m) that will satisfy this condition results in a graph partitioning the γ-G space in a "left-region" where $I_a = 0$ and a "right-region" with higher compensation. (See Figure 1)

The effect on shareholder wealth can be expressed as V-V^0 where V^0 denotes shareholder wealth in the absence of reciprocal shareholding. The symmetry implies that the extent of reciprocal shareholding does not affect the value of the sum of outstanding

[10]The condition for obtaining a unique maximum remains the same in this slightly modified problem.

shares in either of the firms. Noting that $V^0 = r$, which is the profitability of the underlying assets when $I_a = 0$, the potential benefits of reciprocal shareholding can be expressed as

$$V_a - V_a^0 = \pi_a - \pi_a^0 + \frac{1-\gamma^2}{0.5-\gamma}(1-G_a)I_a = \left[\frac{0.5+\gamma(1-\gamma)}{1-\gamma^2} - G_a\right]\frac{1-\gamma^2}{0.5-\gamma}I_a . \tag{9}$$

Tracing out the points in the γ-G plane that make the bracketed factor equal to zero yields a curve representing the shareholders' points of indifference with respect to ownership structure below which shareholders benefit from reciprocal shareholding and above which they would do equally well or better without it.

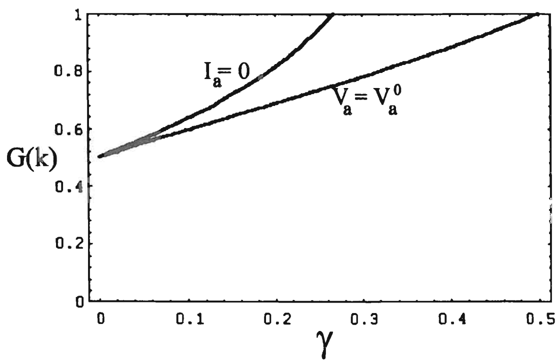

Figure 1.

Above the $I_a = 0$ graph shareholder wealth is not affected by reciprocal shareholding. Below this region, but above the $V=V^0$ graph, compensation is positive and shareholder wealth is reduced. Finally, in the bottom region shareholders benefit from reciprocal shareholding.

An important factor in the analysis is the strength of managerial resistance relative to the outside raider. Managers perhaps have access to more sophisticated defense strategies, involving poison pills, for instance. Conversely, bidders might use a two-tier offer. Within the model this could be parameterized as follows:

$$k_a = \pi_a + \theta \frac{1-\alpha\beta}{0.5-\alpha} I_a \,, \tag{10}$$

where θ denotes the relative strength of managerial resistance. For example, a two-tier offer with a minimal premium on 50% of the shares and the pretakeover price for the remaining shares can be seen to correspond to θ = 0.5. The effect on compensation of changes in θ can be shown to be similar to that of changes in α, and. increases in θ make takeovers more difficult. Furthermore, resistance is also weakened if managers are not able to concentrate their efforts of persuasion on a subset of the shareholders, which means replacing 0.5-γ with 1-γ. Finally, the degree of influence on their board managers obtain from reciprocal shareholding, in equation (7) assumed to be equal to the degree of reciprocity, may be weaker or stronger than γ, e.g. by a factor λ.

The effect of less concentrated resistance and different degrees of influence on the own board is illustrated in Figure 2 where the counterparts of equation (8) and (9) are derived and plotted.

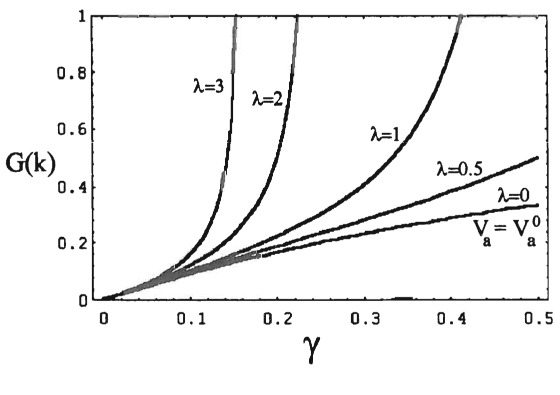

Figure 2.

The decreased efficiency of managerial defence makes resistance detrimental to shareholder wealth unless the firm is extremely likely to get an offer. The size of the region with strictly positive compensation is determined by the influence wielded by managers.

Generally speaking, reciprocal shareholding may be beneficial to shareholders when the probability of receiving a tender offer is very high, otherwise it is probably not a particularly good ownership structure from a shareholder point of view.

Conclusions

The present chapter is based on the premise that reciprocal shareholding gives the incumbent management an edge on an outside raider in the battle over the firm. How hard management is actually prepared to fight depends on the attractiveness of incumbency, which is determined by the level of managerial compensation. The threat of managerial resistance may benefit shareholders by improving their bargaining power in a takeover situation.

If managers can influence their compensation, then reciprocal shareholding can be detrimental to shareholder wealth. The effect on shareholders is determined by the performance, or competence, of the incumbent management relative to that of external entrepreneurs. If the firm is poorly managed, hence making a takeover imminent, reciprocal shareholding, which lowers the cost of eliciting managerial resistance, benefit shareholders. Conversely, since it is less likely that an outsider can significantly boost profits in an already efficient firm, the probability of receiving a tender offer is low and reciprocal equity interests may prove to be a burden.

While the deterring effect unambiguously becomes stronger with symmetric increases in reciprocal shareholdings this is not true for managerial compensation. If managers are "too effective" in fending off hostile takeover attempts, further increases in reciprocal stockholdings which strengthen the managerial fortress may result in a lower compensation to managers. Finally, given some degree of managerial influence, the less powerful the defensive tactics available to managers for any given ownership structure and compensation level, the fewer are the situations where reciprocal equity interests could be expected to benefit shareholders.

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Appendices I-IV

Appendix I

The marginal effect of subsidizing safeguards in a good equilibrium is given by

$$\frac{dS(\cdot)}{d\gamma} = \frac{\partial S(\cdot)}{\partial p}\frac{\partial p(\cdot)}{\partial \gamma} + \frac{\partial S(\cdot)}{\partial \theta}\frac{\partial \theta(\cdot)}{\partial \gamma} \tag{I.1}$$

where

$$\frac{\partial S(\cdot)}{\partial p} = -2(1-p)(\alpha-\beta) + c(\theta) \tag{I.2}$$

and

$$\frac{\partial S(\cdot)}{\partial \theta} = -(1-p)c'(\theta) = -(1-p)p\frac{\beta}{1-\gamma} < 0\,. \tag{I.3}$$

The first order condition on investments in safeguards, $G(p,\theta,\gamma) = c'(\theta)-p\beta/(1-\gamma) = 0$, and the equal profit condition, satisfied in a dynamic equilibrium, $F(p,\theta,\gamma) = (1-p)(\alpha-\beta)-(1-\theta)\beta-(1-\gamma)c(\theta) = 0$ implicitly define p and θ in terms of γ. Substituting $\theta = c'^{-1}(p\beta)$ into $F(p,\theta,\gamma)$, thus making it a function of p and γ alone, and applying the implicit function theorem yields

$$\frac{dp}{d\gamma} = -\frac{c(\cdot) + (\beta-(1-\gamma)c'(\cdot))\frac{\partial\theta}{\partial\gamma}}{-(\alpha-\beta) + (\beta-(1-\gamma)c'(\cdot))\frac{\partial\theta}{\partial p}} = -\frac{c(\cdot) + \beta(1-p)\frac{\partial\theta}{\partial\gamma}}{-(\alpha-\beta) + \beta(1-p)\frac{\partial\theta}{\partial p}}\,. \tag{I.4}$$

The last equality follows from $c'(\theta) = p\beta/(1-\gamma)$. The partial derivatives in expression (I.4) are derived from $G(p,\theta,\gamma) = 0$ using the implicit function theorem

$$\left.\frac{\partial\theta}{\partial\gamma}\right|_{p=\bar{p}} = \frac{1}{c''(\cdot)}\frac{p\beta}{(1-\gamma)^2} > 0$$

$$\left.\frac{\partial\theta}{\partial p}\right|_{\gamma=\bar{\gamma}} = \frac{1}{c''(\cdot)}\frac{\beta}{1-\gamma} > 0\,.$$

Thus, the numerator of (I.4) is clearly positive. The denominator can also be demonstrated to be positive by utilizing that in a stable equilibrium it must be true that

$$\frac{\partial \pi_h}{\partial p} > \frac{\partial \pi_d}{\partial p},$$

that is,

$$-\alpha + \theta\beta > -(1-\theta)\beta + (1-p)\beta\frac{\partial\theta}{\partial p}.$$

Hence, expression (I.4) is strictly negative and subsidies can thus be seen to reduce the proportion of dishonest individuals in the population.

Similarly, differentiating G(p,θ,γ), letting p be given implicitly by F(p,θ,γ), gives us

$$\frac{d\theta}{d\gamma} = -\frac{-\frac{p\beta}{(1-\gamma)^2} - \frac{\beta}{1-\gamma}\frac{\partial p}{\partial\gamma}}{c''(\theta) - \frac{\beta}{1-\gamma}\frac{\partial p}{\partial\theta}}, \tag{I.5}$$

where the partial derivative of p with respect to γ is positive, making the numerator negative:

$$\left.\frac{\partial p}{\partial\gamma}\right|_{\theta=\bar\theta} = \frac{c(\theta)}{\alpha-\beta} > 0$$

$$\left.\frac{\partial p}{\partial\theta}\right|_{\gamma=\bar\gamma} = \frac{\beta-(1-\gamma)c'(\theta)}{\alpha-\beta} = \frac{(1-p)\beta}{\alpha-\beta} > 0 .$$

The denominator of expression (I.5) can be shown to be proportional, with the reverse sign, to the denominator in expression (I.4) and is thus negative. Consequently, expression (I.5) is negative, that is, subsidization of safeguards will reduce the investments in safeguards in equilibrium.

Insertion of the derivatives in expressions (I.2)-(I.5) into expression (I.1) yields that social welfare increases with subsidization of safeguards up to the point where (I.2) reverses sign and becomes sufficiently positive to dominate expression (I.1). Using F(p,θ,γ) expression (I.2) can be written

$$\frac{\partial S(\cdot)}{\partial p} = -2(1-\theta)\beta - (1-2\gamma)c(\theta) .$$

For that to happen the degree of subsidization, γ, must exceed 0.5.

Appendix II

Proof of Lemma 1: In equilibrium, equation (7) must hold. Using (3) and (5) we then have

$$p_1 + \frac{\beta m_1(1-p_1)}{2\alpha+\beta m_1} = p_2 + \frac{\beta m_2(1-p_2)}{2\alpha+\beta m_2} = \ldots = p_n + \frac{\beta m_n(1-p_n)}{2\alpha+\beta m_n} \ ,$$

which implies that,

$$\frac{2\alpha p_1+\beta m_1}{2\alpha+\beta m_1} = \frac{2\alpha p_2+\beta m_2}{2\alpha+\beta m_2} = \ldots = \frac{2\alpha p_n+\beta m_n}{2\alpha+\beta m_n} = k \ .$$

Thus, the number of customers buying from i can be written in the form

$$m_i = \frac{2\alpha(k-p_i)}{\beta(1-k)} \ ,$$

which summing over all i yields an expression for k. Substituting for k results in

$$m_i = \frac{\beta(1-p_i)-2\alpha(np_i-\sum_{j=1}^{n} p_j)}{\beta(n-\sum_{j=1}^{n} p_j)} \ .$$

Recalling equations (3) and (5) and substituting for m_i yields the desired result. □

Proof of Proposition 5: Differentiating the profit function yields

$$\frac{\partial\pi}{\partial n} = \frac{-\alpha\beta(1-c)^2[2\alpha^2(n(2n-3)+1)+4\alpha\beta(n-1)+\beta^2]}{2(2\alpha n+\beta)^2(\alpha(n-1)+\beta)^3)} < 0$$

and

$$\frac{\partial\pi}{\partial c} = \frac{-\beta(1-c)(2\alpha(n-1)+\beta)}{2(2\alpha n+\beta)(\alpha(n-1)+\beta)^2} < 0 \ ,$$

which establishes the proposition. □

Appendix III

$$p_1^* = \frac{6\alpha^2 c f_1 f_2 + \alpha b(c(2f_1+3f_2)+w(2f_1+f_2))+b^2(c+w)}{2(3\alpha^2 f_1 f_2 + 2\alpha b(f_1+f_2)+b^2)} \tag{III.1}$$

$$Q_1^* = \frac{f_1(w-c)(2\alpha^2 f_2(2f_1+f_2)+\alpha b(2f_1+3f_2)+b^2)}{2(3\alpha^2 f_1 f_2+2\alpha b(f_1+f_2)+b^2)(2\alpha(f_1+f_2)+b)} \tag{III.2}$$

Proof of Proposition 2: (i) Follows from applying the implicit function theorem on the first order condition, noting that

$$\frac{\partial^2 \pi_I}{\partial f_i \partial w} < 0, \; \frac{\partial^2 \pi_I}{\partial f_i \partial c} > 0 .$$

(ii) Differentiating equilibrium price, equation (III.1), wrt w yields

$$\frac{dp^*}{dw} = \frac{\partial p}{\partial f_1}\frac{\partial f_1}{\partial w} + \frac{\partial p}{\partial f_2}\frac{\partial f_2}{\partial w} + \frac{\partial p}{\partial w},$$

where fleet size affects price negatively. As w has a negative effect on fleet size and the direct effect of w is to increase prices, the total effect must be positive.

Differentiating equilibrium price, equation (III.1), wrt c yields

$$\frac{dp^*}{dc} = \frac{\partial p}{\partial f_1}\frac{\partial f_1}{\partial c} + \frac{\partial p}{\partial f_2}\frac{\partial f_2}{\partial c} + \frac{\partial p}{\partial c},$$

where fleet size affects price negatively. As c has a positive effect on fleet size and the direct effect of c is to increase prices, the total effect is indeterminate.

Differentiating equilibrium quantity, equation (III.2), wrt w yields

$$\frac{dQ^*}{dw} = \frac{\partial Q}{\partial f_1}\frac{\partial f_1}{\partial w} + \frac{\partial Q}{\partial f_2}\frac{\partial f_2}{\partial w} + \frac{\partial Q}{\partial w},$$

where fleet size affects quantity positively. As w has a negative effect on fleet size and the direct effect of w is to increase prices, the total effect is indeterminate.

Differentiating equilibrium quantity, equation (III.2), wrt c yields

$$\frac{dQ^*}{dc} = \frac{\partial Q}{\partial f_1}\frac{\partial f_1}{\partial c} + \frac{\partial Q}{\partial f_2}\frac{\partial f_2}{\partial c} + \frac{\partial Q}{\partial c},$$

where fleet size affects quantity positively. As c has a positive effect on fleet size and the direct effect of c is to reduce quantity, the total effect is indeterminate.

(iii) The effect of fixed costs on fleet size is derived applying the implicit function theorem to the first order condition, noting that

$$\frac{\partial^2 \pi_I}{\partial f_i \partial K_c} = 0, \frac{\partial^2 \pi_I}{\partial f_i \partial K_r} > 0 .$$

Fleet size, in turn, affects equilibrium prices negatively and equilibrium quantities positively. This follows trivially from differentiating (III.1) and (III.2). □

Proof of Proposition 3: (i) Follows from applying the implicit function theorem on the first order condition, noting that

$$\frac{\partial^2 \pi_{II}}{\partial f_i \partial w} < 0, \frac{\partial^2 \pi_{II}}{\partial f_i \partial c} > 0 ,$$

when b is small and

$$\frac{\partial^2 \pi_{II}}{\partial f_i \partial w} > 0, \frac{\partial^2 \pi_{II}}{\partial f_i \partial c} < 0 ,$$

when b is large. In the first case price and quantity derivatives with respect to w and c are the same as under regime I, and for the same reasons. Therefore. assume b is large.

(ii) Differentiating equilibrium price, equation (III.1), with respect to w yields

$$\frac{dp^*}{dw} = \frac{\partial p}{\partial f_1}\frac{\partial f_1}{\partial w} + \frac{\partial p}{\partial f_2}\frac{\partial f_2}{\partial w} + \frac{\partial p}{\partial w},$$

where fleet size affects price negatively. As w has a positive effect on fleet size and the direct effect of w is to increase prices, the total effect is indeterminate.

Differentiating equilibrium price, equation (III.1), wrt c yields

$$\frac{dp^*}{dc} = \frac{\partial p}{\partial f_1}\frac{\partial f_1}{\partial c} + \frac{\partial p}{\partial f_2}\frac{\partial f_2}{\partial c} + \frac{\partial p}{\partial c},$$

where fleet size affects price negatively. As c has a negative effect on fleet size and the direct effect of c is to increase prices, the total effect must be positive.

Differentiating equilibrium quantity, equation (III.2), wrt w yields

$$\frac{dQ^*}{dw} = \frac{\partial Q}{\partial f_1}\frac{\partial f_1}{\partial w} + \frac{\partial Q}{\partial f_2}\frac{\partial f_2}{\partial w} + \frac{\partial Q}{\partial w},$$

where fleet size affects quantity positively. As w has a positive effect on fleet size and the direct effect of w is to increase prices, the total effect is must be positive.

Differentiating equilibrium quantity, equation (III.2), wrt c yields

$$\frac{dQ^*}{dc} = \frac{\partial Q}{\partial f_1}\frac{\partial f_1}{\partial c} + \frac{\partial Q}{\partial f_2}\frac{\partial f_2}{\partial c} + \frac{\partial Q}{\partial c},$$

where fleet size affects quantity positively. As c has a negative effect on fleet size and the direct effect of c is to reduce quantity, the total effect is must be negative.

(iii) The effect of fixed costs on fleet size is derived by applying the implicit function theorem to the first order condition, noting that

$$\frac{\partial^2 \pi_{II}}{\partial f_i \partial K_c} < 0, \quad \frac{\partial^2 \pi_{II}}{\partial f_i \partial K_r} = 0.$$

Fleet size, in turn, affects the equilibrium price negatively and the equilibrium quantity positively. This follows trivially from differentiating (III.1) and (III.2). □

Appendix IV

It suffices to show that an exponential distribution makes the maximand concave. The second derivative of the maximand wrt I_a is given by

$$\frac{\partial^2 V_a}{\partial I_a^2} = -\frac{1-\alpha}{0.5-\alpha}\left[g' I_a \frac{\partial k_a^*}{\partial I_a} + 2g\right]\frac{\partial k_a^*}{\partial I_a}. \tag{IV.1}$$

Suppressing the firm index, let

$$g_a = \frac{1}{m} e^{\frac{-k_a^*}{m}}, \tag{IV.2}$$

where m is a parameter determining the width of the distribution. First, note that if the derivative of the maximand with respect to I_a is strictly negative, i.e. a boundary solution, then (IV.1) is negative. Thus, it suffices to show that (IV.1) greater than or equal to zero implies a strictly negative first derivative. Second, inserting (IV.2) into (IV.1) yields

$$\frac{e^{\frac{-k_a^*}{m}}}{m}\left[\frac{I_a}{m}\frac{\partial k_a^*}{\partial I_a} - 2\right]\frac{\partial k_a^*}{\partial I_a}, \tag{IV.3}$$

where the first term within the brackets must be greater than two to violate concavity. Third, analogous insertion into the derivative of the maximand gives us

$$\frac{\partial V_a}{\partial I_a} = \frac{1-\alpha}{0.5-\alpha}\left[-e^{\frac{-k_a^*}{m}}\left[\frac{I_a}{m}\frac{\partial k_a^*}{\partial I_a} - 1\right] - \frac{0.5-\alpha}{1-\alpha\beta}\right], \tag{IV.4}$$

which must be negative if (IV.3) is to be positive , which concludes the verification. □

Proof of Proposition 2: First, note that no term in the derivative of the maximand for firm A, expression (7), contains the choice variable of the other firm, I_b. Hence, when examining the comparative statics of the compensation in one firm with respect to changes in α and β, the effect on the other firm's decision need not be considered. The statements about γ can easily be verified following the reasoning in the proofs for α.

(i) In an interior solution the derivative of the maximand, (IV.4), is equal to zero and thus by taking the total differential and using the implicit-function theorem we arrive at:

$$\frac{dI_a}{d\alpha} = -\frac{\dfrac{\partial^2 V_a}{\partial\alpha\partial I_a}}{\dfrac{\partial^2 V_a}{\partial^2 I_a}} = \frac{\dfrac{1-0.5\beta}{(1-\alpha\beta)^2} - \dfrac{1-0.5\beta}{(0.5-\alpha)^2}I_a\left(g'I_a\dfrac{\partial k_a^*}{\partial I_a} + 2g\right)}{\left(g'I_a\dfrac{\partial k_a^*}{\partial I_a} + 2g\right)\dfrac{\partial k_a^*}{\partial I_a}}, \tag{IV.5}$$

where the denominator is strictly positive given Assumption 1.To verify quasiconcavity we examine the sign of the 2nd derivative in critical points, i.e. where the 1st derivative (IV.4) is zero.

$$\frac{d^2I}{d\alpha^2} \propto -\frac{2}{1-\alpha\beta}\left[g'\frac{I}{m}\frac{\partial k}{\partial I} + 2g\right] - \frac{I}{0.5-\alpha}\left[g''\frac{I}{m}\frac{\partial k}{\partial I} + 3g'\right] =$$
$$\left[\frac{1}{0.5-\alpha}\frac{I}{m} - \frac{2}{1-\alpha\beta}\right]\left[g'I\frac{\partial k}{\partial I} + 2g\right] + \frac{1}{0.5-\alpha}\frac{I}{m}g\,, \tag{IV.6}$$

where $\propto$ means "proportional to". The first order condition may be rewritten as

$$1 - \frac{0.5+\alpha(1-\beta)}{0.5-\alpha}\frac{I}{m} = \frac{0.5-\alpha}{1-\alpha\beta}\frac{e}{m}^{\left[\frac{r}{m}+\frac{0.5+\alpha(1-\beta)}{0.5-\alpha}\frac{I}{m}\right]}, \tag{IV.7}$$

where the lhs is decreasing and the rhs is increasing in I. Suppose that $I/m \geq (0.5-\alpha)/(1-\alpha\beta)$. Then the lhs becomes $(0.5-\alpha)/(1-\alpha\beta)$ or smaller which is clearly less than the rhs. Hence, in equilibrium, $I/m < (0.5-\alpha)/(1-\alpha\beta)$. Finally, using that $[g'I\,\partial k/\partial I + 2g] > e^{-k/m}/m$ (IV.12) can be seen to be strictly less than

$$-\frac{1}{1-\alpha\beta}\frac{e}{m}^{-k/m} + \frac{1}{1-\alpha\beta}\frac{e}{m}^{-k/m} = 0\,,$$

thus establishing strict quasiconcavity. Furthermore as α approaches 0.5 I/m must go to zero for the lhs of (IV.7) to remain positive. □

Proceeding in the same way the comparative static with respect to β is given by

$$\frac{dI_a}{d\beta} = -\frac{\dfrac{\partial^2 V_a}{\partial\beta\partial I_a}}{\dfrac{\partial^2 V_a}{\partial^2 I_a}} = -\frac{\dfrac{\alpha(0.5-\alpha)}{(1-\alpha\beta)^2} - \dfrac{\alpha}{(0.5-\alpha)^2}I_a\left(g'I_a\dfrac{\partial k_a^*}{\partial I_a} + 2g\right)}{\left(g'I_a\dfrac{\partial k_a^*}{\partial I_a} + 2g\right)\dfrac{\partial k_a^*}{\partial I_a}}. \tag{IV.8}$$

The 2nd derivative with respect to β in critical points is proportional to

$$\left.\frac{\partial^2 I}{\partial\beta^2}\right|_{\frac{\partial I}{\partial\beta}=0} \propto -\left[2\alpha\frac{0.5-\alpha}{(1-\alpha\beta)^3} - \frac{1}{(0.5-\alpha)^2}\frac{I_a}{m}\left[g''I\frac{\partial k}{\partial I} + 3g'\right]\frac{\partial k}{\partial\beta}\right] =$$
$$= -\frac{1}{1-\alpha\beta}\left[2\frac{\alpha(0.5-\alpha)}{(1-\alpha\beta)^2} + \frac{1-\alpha\beta}{0.5-\alpha}I_a\frac{\alpha}{(0.5-\alpha)^2}\frac{I_a}{m}\left[g'I\frac{\partial k}{\partial I} + 3g\right]\right], \tag{IV.9}$$

which, again using that the numerator of (IV.8) is zero, can be written as

$$\frac{1-\alpha\beta}{0.5-\alpha}I_a\left[\frac{2}{1-\alpha\beta}\left[g'\frac{I}{m}\frac{\partial k}{\partial I} + 2g\right] - \frac{I_a}{0.5-\alpha}\left[g''\frac{I}{m}\frac{\partial k}{\partial I} + 3g'\right]\right],$$

which must clearly have the opposite sign of (IV.6). □

(ii) For $r/m \geq \ln 2$ $I_a = 0$ when $\alpha = 0$. When increasing α until (IV.4) starts to bind, I_a remains equal to 0 up to that point and then begins increasing in α. If $r/m < \ln 2$ then the first order condition binds at $\alpha = 0$ and I_a can be seen to be a decreasing function of r/m,

$$e^{-(r/m+I_a)} = \frac{1}{2[1-I_a]}. \tag{IV.10}$$

Evaluating (IV.5) at $\alpha = 0$ and using (IV.10) to obtain an expression in I_a we get

$$\varphi\left[1 - 2I_a\frac{2-I_a}{1-I_a}\right], \tag{IV.11}$$

where φ is a positive factor. This is strictly decreasing in $I_a \in [0, 1)$ and equals 0 for $I_a = (5-\sqrt{17})/4 \approx 0.22$, implying that $r/m \approx 0.23$, which translates into a 0.80 probability of a takeover if $I_a = 0$. Thus, for $r/m \geq 0.23$ I_a will increase initially in α. □

(iii) As α approaches 0.5 I/m must approach zero for the lhs of (IV.7) to remain positive. □

Proof of Proposition 3: First, in equilibria with $I_a = 0$ there is no effect on k_a^*. To determine the effect of α on k_a^* in interior solutions expression (3) is differentiated:

$$\frac{dk_a^*}{d\alpha} = \frac{\partial k_a^*}{\partial I_a}\frac{\partial I_a}{\partial \alpha} + \frac{\partial k_a^*}{\partial \alpha}, \tag{IV.12}$$

which after insertion of the partial derivatives yields

$$\frac{dk_a^*}{d\alpha} = \frac{1-0.5\beta}{(1-\alpha\beta)^2\left[g'I_a\frac{\partial k_a}{\partial I_a} + 2g\right]}, \tag{IV.13}$$

which is positive. The impact of γ is derived in the same way. Similarly, examining changes in β we get

$$\frac{dk_a^*}{d\beta} = -\frac{\alpha(0.5-\alpha)}{(1-\alpha\beta)^2\left[g'I_a\frac{\partial k_a}{\partial I_a} + 2g\right]} \qquad \text{(IV.14)}$$

and is thus negative. □

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