A MODEL OF THE ENTRY DECISION
OF POTENTIAL RAIDERS
INTO THE BIDDING FOR A TARGET FIRM

by

Hanin I. Abdallah

Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in
Economics

APPROVED:

Jaques Cremer, Chairman

Dilip Shome
Amoz Kats

Catherine Eckel
Gerd Weinrich

August, 1991
Blacksburg, Virginia
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Committee Chair: Jacques Cremer, Ph.D.
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(ABSTRACT)

This work is in the spirit of the literature on the understanding and analysis of the
different forces that shape the takeover process. We focus on the strategic interaction
among the raiders and we study their decision to enter the bidding for a target firm in a
context of asymmetric information. Each raider incurs a fixed takeover sunk cost when she
decides to enter the bidding. Therefore she wants to avoid bidding for the firm and losing
the bid to a raider with a higher valuation. We analyze the Bayesian-Nash equilibrium in
one-period, two-period and infinite period models where each raider decides whether and
in which period to enter. This decision depends on the takeover cost, the target’s
reservation price and the distribution function of the raiders’ valuations. We also consider
the case where one of the raiders is a large shareholder and the role of management in
maximizing the shareholders’ interests.

We find that raiders delay entry into the bidding when the takeover cost or the
reservation price for the firm increase. Such an increase also implies a decrease in the
probability of a takeover. If one of the raiders is a large shareholder, he will enter the
bidding faster the bigger is the percentage of shares he owns in the target. The existence of a large shareholder will, however, discourage other raiders from entering. The shareholders of the target firm might benefit from an increase in the target's reservation price but they never profit from an increase in the takeover cost.

We conclude with an empirical section that indirectly tests some of our model's implications. The results of our empirical work indicate that raiders enter the bidding faster when the management's reaction to the bid proves to be friendly. The premiums offered by the raiders and the size of the target test insignificant in determining the pre-bidding period. Finally we find that the existence of a large shareholder discourages other raiders from entry. However, the large shareholder has on average a longer pre-bidding waiting period than a raider with no ownership in the firm.
ACKNOWLEDGMENTS

I would first like to thank my advisor, Jacques Cremer, for his optimism, encouragement, insights and guidance throughout the years of my studies.

Special thanks to Dilip Shome for many helpful and interesting conversations, and for his major help in the empirical part of my work.

I would also like to thank Gerd Weinrich for his long and tireless friendship and for many helpful discussions especially those at the Economics Department at the Universita' "G. d'Annunzio" in Pescara, Italy.

I thank Catherine Eckel for many comments on the organization of the theoretical part of the dissertation.

I would like to salute my colleagues in the department, Fahad, Farhad, Yves, Jeff, Nevedita, Bipacha and Stelios for their spirit of cooperation and camaraderie.

I have met many special people during my stay in Blacksburg: Halima, Fadi H., Jihad, Ayman, Walid, Fadi F., Jihane and Nadim. I hope to keep them in my life thereafter.

Thank you, my friend, Wafa, for long hours of coffee, love and fun. I appreciate your friendship greatly and wish you the best always.

My appreciation goes to Geer for introducing me to the Macintosh world, his genuine dutch generosity, always being there, and for his enormous support in the last period of my dissertation.

Thank you, my gwoopy pan, Pawel, for being my example of the Absolute and Unconditional in this ever compromising world.

I, finally, would like to mention Nadim Khalaf and Nabil Matar at the American University of Beirut, and Fadia Kiwane at the St Joseph de L'Apparition, I will always
remember them for their dedication to knowledge, education and peace through the very
difficult and crazy times of the war in Beirut.

My parents, Ibtissam and Ibrahim, my brother Karim and my sisters, Amal, Manal and
Hala as well as my country, Lebanon, have been the greatest source of strength, optimism
and hope in my life. I thank them for all the love they brought into my life.

I dedicate this dissertation to my parents, Ibrahim Abdallah and Ibtissam Kamhawi.
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INTRODUCTION

Our inquiry into the takeover process proceeds as follows. In the first chapter we introduce the takeover process and review the major empirical results in the literature. In the second chapter we discuss some of the theoretical papers on the leading issues surrounding takeovers. The third chapter presents and analyzes a model of the decision of the potential raiders in a takeover on whether and when to enter the bidding for the target firm. We also consider the case where one of the bidders is a large shareholder and the role of the target firm's management in maximizing the shareholders' interests. In the fourth chapter we indirectly test some of the implications of our theoretical model. Finally, in our conclusion we evaluate our results and discuss some suggestions for future research.
OVERVIEW OF THE EMPIRICAL RESULTS
OF THE TAKEOVER PROCESS

Introduction

Mergers and Acquisitions refer to four major ways of achieving a change in control, mergers, friendly or hostile takeovers and proxy fights. A merger of two firms occurs after a long period of negotiations and with the agreement of both managements. After the merger the two firms operate as one entity under one management. In a takeover the acquiring firm makes a direct offer to the target's shareholders to buy some or all of their shares. In a friendly takeover the management and the target's board of directors approve the takeover and the takeover price. The management of the target in a hostile takeover refuses to negotiate with the interested buyer; it strongly opposes the change in control and tries to stop it. In this case the raider wins if he succeeds to buy the majority of the target's outstanding shares. In a proxy fight, a dissident manager or large shareholder tries to gain control of the board of directors in order to initiate important changes in the management and in the firm.

Firms can target companies in the same business in which case the merger or takeover is called horizontal, or in a supporting industry and it is called vertical. A firm can diversify by acquiring a company in an unrelated business or it may be interested in acquiring the undervalued assets of another company.

We present an overview of the empirical findings related to the role of mergers and acquisitions and their effect on firms, workers, management and the shareholders. We base our analysis on a symposium on Takeovers in the Journal of Economic Perspectives,
winter 1988. Most of the empirical work reviewed in the symposium covers one or both waves of Mergers and Acquisitions, in the early 70's and in the late 70's until the mid 80's. The first article by Shleifer and Vishny (1988) explains the need for outside monitoring given the structure of corporate governance but insists on the superiority of inside monitoring when possible. Jensen (1988), in the second article, concentrates on takeovers involving corporations with Free Cash Flow problems. Jarrell, Brickley and Netter (1988) summarize the empirical results of the major recent studies on takeovers. Finally, Sherer (1988) questions in his article the efficiency of the financial market. Takeovers according to him are a result of market errors or what is known as the "random walk" of stock prices.

Using these articles we answer some basic questions about takeovers, discussing alternative points of view and presenting the empirical facts related to them.

We divide our presentation into five parts. We start by presenting the evidence on what could be the role of takeovers. Part two looks at who gains and who loses in a takeover, and part three on where do these gains possibly come from. Part four discusses the role of anti-takeover defensive tactics and government (State and Federal) laws. Finally, in part five we present some characteristics of the takeovers in the 80's.

**What is the role of Takeovers**

Mergers can have synergic values through either acquiring monopoly power and economies of scale or by decreasing transaction costs in vertically related industries. However, here we focus on the role of takeovers in the managerial and financial markets. Do takeovers play a role in disciplining management and do they contribute to the efficiency of the financial markets? We also discuss the FCF problem as a specific case of the agency problem and its relation to takeovers.
A. Disciplining management

Many authors argue that takeovers are crucial to the operation of the market for corporate control. When a senior manager shirks from optimizing shareholders' income, who would discipline him? This argument is based on the fact that internal control devices are limited. Since if they were completely effective, they are superior to takeovers considering the takeover costs, the disruption in the firm's operations and the breaching of implicit contracts that result from a takeover.

Incentive-based schemes of compensations do not work perfectly because of imperfect information and the problem of adverse selection. The manager of a firm, due to his insider position, will accumulate information about the actual environment in which the firm is operating that is unknown to the outside investors. Outsiders, not knowing whether weak earnings are a result of mismanagement or an adverse environment, cannot perfectly punish bad management. A raider on the other hand might have more information about the firm's environment or about how to better manage the firm and would be interested in taking over the firm when the manager is shirking.

Shleifer and Vishny discuss the reasons behind the failure of another internal control device: the board of directors. The board of directors has the "nominal power to hire and fire the chief executive officer and to block major corporate projects" (Shleifer and Vishny, 1988); theoretically it is there to monitor the management. The authors point to three reasons why this form of control can fail. First, the selection of the members of the board is done by management. It usually includes insiders loyal to the management or outsiders "with financial interest in the continuity of the management, such as lawyers or advertisers of the firm" (Shleifer and Vishny, 1988). Second, even if the board wanted to monitor management, it still faces a substantial asymmetry of information relative to the
management that has an incentive to increase this asymmetry. The cost of eliminating asymmetry of information is high and a member of the board of directors is willing to invest in such an activity only if he owns a substantial fraction of the firm's shares, which is not usually the case. The board can still choose to induce a maximizing behavior by the management by setting part of the management's salary in the form of stock ownership or stock options. The legal environment puts severe limits on such a behavior, limiting one other form of internal control. It is legally easy for shareholders to challenge a direct payment of money or stock holding as a breach of fiduciary duty. In which case the business judgment rule, a law that limits the interference of the court in a corporation's business, does not protect the CEO (Chief Executive Officer) nor the members of the board of directors. It is less risky for the board to allow the non-value maximizing behavior of the CEO than to implement extra rewards for the management and be exposed to the shareholders' accusations. It is also less risky for the CEO to enjoy secretly some non-maximizing activities than to persuade the board to give him some stock options to better align his interest with the shareholders' interest.

Empirically, results from Warner, Watts and Wruck (1988) and Weibach (1988) show that "poor stock performance is followed by higher CEO turnover" (Shleifer and Vishny, 1988) indicating that CEO's are threatened by a bad performance in the market. However the change in the number of turnovers is small and therefore the threat does not prevent CEO's from pursuing non-value-maximizing activities.

Shleifer and Vishny present some evidence on a positive relation between management's pay and stock prices. Murphy (1985) indicates that management's pay responds positively to increases in stock prices and studies, done by Brickley, Bhagat and Lease (1985) and Tehranian and Waegelian (1985), establish that the market responds positively to the announcement of incentive-based compensation schemes. Shleifer and
Vishny argue that this evidence does not necessarily mean that management is properly directed towards value maximizing (Shleifer and Vishny, 1988). They point to two statistical facts to illustrate their argument. The increase in share prices in the case of a short-term incentive scheme is higher than for a long-term scheme, and the announcement of short-term incentive contracts are followed by unusually high earnings. These contracts seem to be designed to insure that the management will reap some of the gains from an expected increase in earnings. The market recognizes the signal behind the announcement of the incentive-based schemes as an expected increase in earnings and reacts positively to it.

A positive relation between managers' pay and stock prices is not surprising but the question is whether it is enough to deter non value-maximizing behavior by the management. Jensen and Murphy (1986) estimate the increase in the lifetime wealth of a large firm's CEO to be $1.4 for each $1000 increase in the market value of the firm to illustrate the small benefit a CEO gets from increasing the firm's value. What is not clear is what would be an acceptable ratio and how it is determined. In an extreme case of asymmetry of information and agency problems this ratio should be closer to 1 to eliminate shirking by management. Finally, Mork, Shleifer and Vishny (1988) find that for 371 firms from the 1980 Fortune 500 the 40 that have been acquired between 1981 and 1985 show a lower average Tobin's q of 0.524 as compared to the average for the whole sample of 0.848 (Tobin's q is the ratio of the market value of a firm's debt and equity to the replacement cost of its physical assets). The acquired firms belong to industries with low q's, are older firms and invest a lower fraction of their corporate income than the average Fortune 500 firm. Firms that are being taken over are not performing well in the market compared to others in the same industry. The evidence highlights industries in decline or in a changing environment where conflicting interests arise the most. In such situations, the
incumbent management finds it difficult to change a policy it had previously adopted or to decrease the level of operation and employment in the firm. The manager might be reluctant to decrease the size of the corporation since it means a decrease in his power.

The evidence and the facts on the environment in which CEO's operate indicate substantial need for further monitoring. Given the limits of internal control over top management, takeovers and the threat of takeovers are important.

B. A solution for the FCF problem

The free cash flow problem occurs when a firm has a cash flow "in excess of that required to fund all of the firm's projects that have a net positive value" (Jensen, 1988). In this case, the optimal thing to do from the shareholders' point of view is to distribute the extra cash to the shareholders as dividends. The manager, however, might consider to spend the money on some non-profitable projects that would increase his value to the firm (e.g., choose to invest in a project where his expertise is highly needed). He can also opt to keep the cash for future use and avoid the possible need to raise capital in the market and therefore being subject to extra monitoring.

Jensen (1988) points to two facts that encourage the managers in pursuing a non maximizing behavior. First, managers' compensations are frequently related to growth and second, managers are often compensated through promotions that also creates an incentive for growth. Free cash flow creates the environment for future targets as well as acquirers. A firm with high FCF will be looking for potential targets. A firm that is using its FCF in non-profitable projects will also constitute a potential target. The FCF problem is another instance of agency problems. In his article, Jensen presents the evidence related to the relation of FCF to takeovers. In the oil industry where there was in the beginning of the 70's a high level of cash flow but a need to decrease capacity, oil companies continued to
expand their operations and invest in new projects. Some of these companies went into diversification while others expanded internally. When it diversifies and therefore enters into a new industry, a company had the disadvantage of unfamiliarity and inexperience with the business. Diversification programmes included retailing, manufacturing, office equipment and mining. We present some examples of takeovers made by some oil companies; in retailing: Marcor by Mobil, manufacturing: Reliance Electric by Exxon, office equipment: Vydec by Exxon, mining: Kennecot by Sohio, Anaconda Minerals by Arco, Cyprus Mines by Amoco.

It all ended in a large number of horizontal mergers and restructuring with a common objective of eliminating inefficiencies, reducing excess capacity and transferring some of the cash flow to shareholders. Diversification according to Jensen (1988) may be preferable to internal investment since it leads to an exit of some capital from the declining industry. Even if some of these diversification ventures have proven inefficient and have eventually failed, they lead to a transfer of some of the free cash flows to the shareholders of the acquired companies and to other economic activities where they may be better used.

Diversification was also popular in the tobacco business that generated large cash flows but faced a declining demand (e.g., the purchase of General Foods by Philip Morris for $5.6 millions). There was also some takeover activity in the forest product industry (St Regis by Champion International and Crown Zellerbach by Sir James Goldsmith), in the food industry (the $ 6.3 billions leveraged buy-out of Beatrice) and in the broadcasting industry (CBS restructuring as a defense against Turner's hostile bid and the purchase of American Broadcasting Company by Capital Cities Communications). The first two industries have FCF and limited growth opportunities and the broadcasting industry generates large rents on its licenses.
We must note that there could also be a rationale against shrinking a company in a declining industry. Through its years of operation the firm's management could have developed an expertise on teamwork and a specific management style that could be used in several other industries. A decision on diversification should be made after weighing the advantages and disadvantages of venturing in a new industry.

We cite some of the empirical findings supporting FCF theory that were presented by Jensen (1988). Magenheim and Muller (1985) and Bradly and Jarrell (1985) note an exceptionally good performance by the acquirer prior to the takeover, which is evidence of possible FCF in the acquiring firm. Palepu (1986) finds that firms with a mismatch of growth and resources are more likely to be taken over. Targets tend to have low market performance in the four years preceding the takeover but the return on equity is not related to the probability of a takeover (in case of FCF we expect high returns on equity).

When a firm has FCF it is more susceptible to agency problems. The manager of the firm has an incentive to continue growth in the same industry or diversify and this could be in conflict with shareholders' interests. We note that in the case where the acquiring firm has FCF, we can explain the small positive and sometime even negative impact of the takeover on the acquiring firm's stock.

C. Correcting for market myopia and market undervaluation

Market myopia refers to a belief that markets "are shortsighted and undervalue future cash value while overvaluing near-term cash flows" (Sherer, 1988). This creates a discrepancy between the market value and the true value of the present and discounted expected future cash flow of the firm. A raider recognizes this discrepancy, offers to buy the firm at a premium and still makes a profit.
Market undervaluation is based on the belief that stock prices move over time in a random walk. At times certain stocks are overvalued while others are undervalued, creating therefore opportunities for takeovers. Undervalued firms are candidates for future targets and overvalued for future acquirers.

The two hypotheses are based on some notion of market inefficiency. In his article Sherer defends this belief while both Jensen and Jarrell and Birckly and Netter reject it. If we accept that takeovers take advantage of market inefficiencies then they do not create any real positive gains. If we consider the costs of takeovers they are actually wasting resources. Sherer presents several empirical facts in support of his views.

The first evidence is the negative long-run returns for acquiring firms. Jensen and Ruback (1983) surveyed seven studies that looked at the one year after takeover returns of acquiring firms and found that they averaged -5.5%. Magenheim and Muller (1987) examined returns over the three year period after the takeover; they estimated abnormal returns at -16%. As Sherer (1988) mentions, these results should be viewed with caution since as the time span increases so does the variance of the returns and it becomes essential to take account of other factors that might be influencing the results. Further investigations are needed to determine what causes these long-run losses, and whether the performance of acquiring firms is significantly different from other firms in the same industry.

The second evidence is that the conglomerate mergers of the 60's and the 70's have proven to be inefficient and in the long-run lead to many divestitures of inefficiently run subsidiaries. These facts should not be ignored, but what they prove is that a takeover involves many risks especially if the raider does not possess the knowledge to run the target firm. As we have seen in case of FCF problems, some firms are guided by the same inefficient behavior they might be seeking to stop by taking over another firm.
We start our defense of market efficiency by the evidence presented in the article of Jarrell, Brickley and Netter (1988). They test the myopia of the market by testing the myopia of institutional investors. Institutional investors tend to imitate the preferences of the market since they also are judged by it. Therefore we expect them to undervalue future gains and insist on short term high revenues given the market myopia. According to this view, a high level of institutional holdings will lead to a higher takeover activity and to a decrease in R & D. A study by OEC in 1985 finds no connection between an increase in institutional holdings, takeover activity and R & D expenditures.

Hall (1987) shows that much takeover activity has been directed towards low R & D firms and that firms that have been taken over show no difference between pre and post takeover expenditures on R & D compared to industry levels. McConnell and Muscarella show that stock prices respond positively to announcements of increased capital expenditures except if they are for exploration and development in the oil market. Finally when a target succeeds in staying independent its market value usually returns to its pre-offer value (Bradley, Desai and Kim 1983; Easterbook and Jarrell 1984; Jarrell 1985 and Ruback 1986). If the target is a firm that has been undervalued by the market, we expect it to gain some of the value the market has miscalculated due to the amount of scrutiny it faces during the bidding period.

Jensen (1988) cites some of the same empirical facts as Jarrell, Brickley and Netter (1988) for his defense of the market efficiency and its non-myopic behavior. He adds two observations. First, the price per earnings' ratio differs widely among securities, which we do not expect if the market puts most of the weight in evaluating securities on current earnings. In this case the ratio should be close to a constant. Jensen (1988) provides the example of restructuring as an instance where short-term earnings decrease while long-term earnings are expected to increase and the market responds positively to it.
The evidence presented by Jensen (1988), and Jarrell, Birckley and Sherer (1988) in relation to the market myopia and efficiency is more convincing than Sherer's (1988). Sherer's argument points to the dangers of takeovers and their possible long-term inefficiency that can be due to factors other than the market's myopia and inefficiency and could differ among different types of takeovers. The market no doubt does make some valuation mistakes; it discounts the value of future earnings for risk under imperfect information. However to assume that these errors are on the basis of takeover activity is a strong statement that would certainly need further proof.

**Who gains from takeovers and who loses?**

It is important to understand the effect of a change in control on all the agents involved in an acquisition. Some of these effects are clear as is the positive effect on the target's shareholders. For the acquiring firm's shareholders, the results are less clear and vary with the period considered. The target's top managers lose their jobs after the takeover and the effect on the target's employees varies among different acquisitions.

**A. Shareholders of the target firm**

(the Office of the Chief Economist, 1985) finds an average premium of 53% for 225 successful tender offers between 1981 and 1984; it is 37% for the year 1985 and 33.6% for 1986. For the ten year period 1977-1986 mergers and acquisitions have produced a gain of $346 billions (in 1986 dollars) for the targets' shareholders. It is hard to argue against takeovers from the target's shareholders point of view given that their primary goal is to maximize the returns they make on their shares. Now we turn to the other parties that are affected by a takeover.

B. The shareholders of the acquiring firm

The results here are less clear. It seems that the shareholders of the acquiring firms have been accumulating positive but small increases in share value and that these gains have been decreasing. Jarrell and Poulson (1987a) find that between 1962 and 1985, 440 bidders realized on average small but statistically significant gains of about 1 to 2 percent around the public announcement of the takeover. Their evidence is consistent with Jensen and Ruback (1983) and shows an excess return of 5% in the 1960's and 2.2% for the 1970's. For the 1980's they find statistically insignificant losses for the shareholders of acquiring firms. For the long-term effect, both Jensen and Ruback (1983) and Magenheimer and Muller (1987) find losses between 5.5% and 16% for the one to three years following the takeover. These findings indicate that most gains from the takeover are transferred to the target. This is consistent with the free-rider problem where shareholders do not tender their shares unless the tender offer exceeds their expected post-takeover value. As we noted earlier the empirical facts on the post-takeover returns of the acquiring firm's shareholders support Jensen's theory of FCF. In this case the acquiring firm has FCF problems and is engaging in a non profitable transaction.
C. The bondholders of the target and of the acquiring firm

The takeover might change the level of risk undertaken by both the target and the acquiring firm. Therefore it changes the value of the issued bonds and entails a possible loss to the bondholders. Denis and McConnell (1986) report no losses to the bondholders and Lehn and Poulson (1987) "find no evidence that the shareholder value created by the leveraged buy-outs come at the expense ... of bondholders" (Jarrell, Brickly and Netter, 1988).

These findings support the view that the gains accrue from reducing inefficiencies due to mismanagement of the firm's resources rather than from redistribution. The process should effect mainly the shareholders and if any, positively the bondholders. In the case of a highly leveraged buy-out we do expect the bondholders to be more affected.

D. The target's employees

One of the most common arguments used against takeovers is the loss incurred by the employees of the target but "it has not been tested widely" (Jarrell, Brickley and Netter, 1988). Brown and Medoff (1987) study wages and employment in Michigan. Wages and employment in their study increase on average for firms involved in acquisitions. This result is not always true and many takeovers and buy-outs involve wage concessions and a decrease in employment (e.g., the management-union proposed buy-out of United where the deal involved major concessions from the employees). We also expect two different effects for the short-term and the long-term. If there is major restructuring in the company and an effort to reduce employment and spending in inefficient projects, the employees will suffer initially. Later when the company is healthy again we expect the wages and benefits of its employees to increase.
E. Target's management.

Jensen (1988) reports that, "roughly 50% of the top level managers of the target firm are gone within three years of acquisition - either hostile or voluntary." Golden Parachutes allow to decrease the management loss but they usually include a small percentage of the management.

The sources of gains from Takeovers

The source of the huge amounts of surpluses created by takeovers depends on what one believes is the role of a takeover and what it accomplishes. Depending on the particular takeover considered one or several of the sources of gains we look at apply.

A. Gains in efficiencies.

Takeovers eliminate inefficiencies due to agency problems by replacing a management that is abusing its power by a more efficient one. The takeover creates new contracts with better incentives for managers, restructures the organization cancelling any inefficient layers and changes the leadership adding new blood to the firm. The concentration of ownership that results from the takeover allows a better monitoring of the firm and agency problems decrease substantially. The high amounts of debt incurred in a takeover help monitor management by imposing on it a periodical payment of interest. However these do as well increase bankruptcy costs and should have an optimal limit that depends on the firm and on the economic conditions in which it is operating.
B. Correcting for inefficiencies resulting from FCF problems

The FCF problem is another instance of an agency problem and it involves a strong conflict between shareholders and management's interests. In this case the gains come from the high cash flows of the firm (the target or the acquiring) and from divesting any non-profitable project undergone by management. If the target has free cash flow, the acquiring firm gains it after the takeover. The acquiring firm will acquire the target with its FCF. If this acquisition is inefficient there will be a transfer from the shareholders of the acquiring firm to the shareholders of the acquired firm. The high amounts of leveraged buy-outs and going private (totalled $37.4 billions and 32% of public acquisitions) point to an effort to decrease agency costs, which is mainly what both accomplish. Jensen (1988) notes that LBO's are specifically popular in businesses with low growth prospects and high levels of cash flow.

C. Discrepancy between actual and market value of the firm

When the market is inefficient or myopic, the acquirer realizes that the market is making an error and that she or he can get the firm at a discount price. No real gains are created and there is a shift in gains from the shareholders to the raiders. We have seen that there is a lack of supporting evidence to this theory. However the manager of a firm or a large shareholder can obtain inside information that is not available to the market. Such asymmetry of information can create a discrepancy between the actual and the market value of the firm and an opportunity for making profit from a takeover.
D. Transfers from employees or bondholders to the shareholders

We have seen that the evidence does not support the view that takeovers transfer value from bondholders to shareholders. There is however little evidence on the effect of takeovers on the target's employees. Shleifer and Summers (1987) show that the premiums paid by Icahn to TWA shareholders were equal to "half the present value of wages losses to members of three TWA unions: pilots, flight attendants and machinists." Some takeovers include more wage cuts than others and often these reductions are larger in unionized industries, which are accused of setting wages above the efficient level. In these cases takeovers give back to the shareholders what is originally theirs. We should however not forget that stability in employment and employment benefits have their value in incentive schemes. When takeovers transfer some value from employees to shareholders they might be "ruining the market for implicit long-run labor contracts and forcing labor and management to use less efficient contracting devices" (Shleifer and Summers, 1987).

E. Tax gains

Tax gains are possible through tax losses and credits that are incurred by the acquiring firm after a takeover. The acquiring firm can also substitute capital gains for ordinary income when it buys a target using cash flow that is taxed as ordinary income and sells it later at a profit considered as capital gains. The evidence varies on the importance of tax gains. Auerbach and Reishus (1987) estimate tax benefits resulting from 318 mergers and acquisitions between 1968 and 1983. They find that these gains are not significant for most of the large acquisitions. However they find tax gains significant enough for some transactions to have affected the decision to takeover. Lehn and Poulsen (1987) look at leveraged buy-outs between 1980 and 1984 and find that premiums paid to shareholders are related to the potential tax gains from the buy-out. This result is not surprising given
the large amounts of debt incurred in LBO's and the lower tax on debt compared to equity. The importance of the tax gains varies among transactions but they do not explain all the premium paid in a takeover.

**What is the role of anti-takeover defensive tactics and government laws**

The role of anti-takeover tactics is often the subject of controversial debate. Some of these tactics are established by the incumbent management and do not require shareholders' approval. We will discuss each of the tactics separately presenting the empirical evidence and the theoretical arguments on its role in takeovers. We focus on the two articles by Jensen (1988) and Jarrell et. Al., (1988) and we divide the defensive tactics as does the latter article into two categories the ones that require shareholders' approval and the ones that do not.

**A. Defensive tactics that require shareholders' approval**

The defensive tactics that require shareholders' approval relate to the voting process in case of a takeover or a proxy fight, restrictions on the takeover price and the change in the state of incorporation. They are preventive measures that make taking over the firm more difficult and sometimes more expensive.

1. **Super majority amendments.** These are amendments that set the required majority vote by shareholders in the event of a merger or a serious change in control. These amendments can set the requirements anywhere from 2/3 up to the level of 9/10 of shareholders' vote. They are usually triggered by the board of directors in the case of an unfriendly takeover. Jarrell and PoulSEN (1987b) look at 104 super majority amendments
passed since 1980 and report a significant decrease of 3% in the share prices of firms that pass the amendments. They also note that the firms that passed these amendments had small institutional and large insider shareholding. They argue that these two facts explain why these amendments passed in spite of their unpopularity.

The results on super majority amendments show the importance of blockholdings. Pure super majority amendments are harmful to outsider shareholders but they still pass in institutions with high insiders' and low outsiders' stock holding. Along this line Birckley, Lease and Smith (1988) find that "no" votes on anti-takeover amendments increase with outsiders' holdings and decrease with insiders' blockholdings. The insiders must be accumulating substantial gains from the decrease in the probability of takeovers that results from the passage of this amendment to compensate for the loss in share prices.

2. Fair price amendments. It "is the super majority provision that applies only to non-uniform, two-tier takeover bids that are opposed by the target's board of directors" (Jarrell, Brickly and Netter, 1988). A two-tier takeover bid consists of two stages. In the first stage the bidder offers to buy at a first-tier price a specified maximum amount of shares and announces it will acquire the rest of the shares later, at a second-tier price, that is usually lower than the first-tier price. In a partial offer, that is also non-uniform, the bidder offers to buy part of the shares without specifying what it plans to do with the rest of the outstanding shares. In case the offer is uniform (all shares are bought at the same price) and fair then super majority is not required. In most cases an offer is fair when it is equal to the highest price paid by the raider to acquire any of the target's shares within a certain period. The super majority rule insures that an offer does not discriminate against shareholders, even though partial offers might be used to overcome the free rider problem. The fair price amendment seems to be growing in popularity. Jarrell and Poulsen (1987b)
find that 487 firms that passed the amendment between 1977 and 1985, with more than 90% of the cases occurring after 1983. This growth in popularity might stem from the perceived low deterring value of this provision. Jarrell and Poulsen (1987b) find a statistically insignificant average loss of 0.73 percent for the stock of firms that passed the amendment and that these firms have normal institutional and insiders' holdings.

3. **Dual-Class Recapitalization.** A dual-class recapitalization changes the usual one class of shares with one vote per share, into two classes of shares where one possesses a higher voting power than the other. Such recapitalization usually results in an increase in the voting power of insiders' holdings or of an outsider's blockholding. Jarrell and Poulsen (1988) and Partch (1987) find that firms that usually go through a dual-class recapitalization have high average net-of-market return and high average insider holdings (44%) before recapitalization. These common characteristics shed doubt on the belief that this kind of recapitalization is used as a defense against takeovers. The market puts positive value on voting power, and stocks with higher voting rights trade at a premium of 1 to 7 percent (Lease, McConnell and Mikkelson, 1983).

Recapitalization increases the value of insiders' holdings, therefore it is used to raise capital without diluting control. As for its effect on outsiders' shareholders, one study by Partch (1987) reports non-negative stock price changes. Jarrell and Poulsen (1988) find for a sample of 89 firms an average abnormal loss of .93% at the announcement of dual-class recapitalization between 1976 and 1987. These firms have large concentration of stocks before the recapitalization, so it is hard for small shareholders to stop the recapitalization even if they wanted to. The decrease in the outstanding stocks' value might be due to the relative decrease in the voting power of these stocks. Jarrell, Brickley and
Netter (1988) also argue that shareholders might agree to an increase in the stake of management or of a large shareholder in return for a decrease in agency problems.

4. **Changes in the State of Incorporation.** Laws governing takeovers differ among states. Therefore, when a firm decides to change its state of incorporation to a state that has tougher takeover laws it might be doing so as a defense against a possible takeover. There is however no evidence that the market perceives reincorporating as harmful to shareholders. Both Dodd and Leftwich (1980), and Romano (1985) find a statistically significant price increase around the reincorporation period. For firms that change their state of incorporation as an anti-takeover device Romano (1985) finds an insignificant positive effect around the period of reincorporation. We must note that prior to 1987 most of the state anti-takeover laws have been ruled unconstitutional when challenged. Therefore the shareholders might not perceive the decision to reincorporate as a real threat to the takeover. They might be reacting positively to the signal of a probable takeover attempt.

5. **Reduction in cumulative voting rights.** Cumulative voting rights allow for a minority number of shareholders to elect board members even when they are opposed by a majority of shareholders. These rights are often used in hostile takeovers and proxy fights to try to gain control of the board of directors. Management often tries to pass amendments to limit these rights. Baghat and Brickly (1984) look at the stock price reaction of 84 companies that passed such amendments and find statistically significant negative price reactions, which proves their harmful effect.
B. Defensive measures that do not require shareholder approval

These are measures that are taken to defend the target firm from a specific takeover threat. The fact that these measures are taken without shareholders' approval assures the abruptness of management reaction but it also prevents the shareholders from discriminating among different takeovers.

1. Litigation by the target's management. Management might decide to go to litigation against a raider when it believes that the raider is not offering a fair price for the target or that he did not respect the takeover laws. With litigation the management argues that it gains time to attract other raiders that will eventually bid higher the price offered by the initial raider. Jarrell (1985) looks at 85 cases of firms involved in a litigation against a raider and finds that litigation leads to a substantial delay in the takeover process. In most cases this delay increases the number of suitors for the target. Jarrell finds that for the 59 firms that were eventually taken over, the bidding process leads to an average increase of 17 percent in the premium paid to the shareholders. The firms that were not eventually taken over lost all the original premium offered by the initial raider.

Litigation by the management based on a false 13D filing by the raider (the rule requires from any shareholder that acquires five percent or more of the outstanding shares of a company to file a report with the SEC, within ten days after reaching the 5% limit. He must reveal his identity, the number of shares owned and his intention) seems to be harmful to shareholders. Netter (1987) finds a significant loss in share prices when management wins the litigation case and an increase in stock prices in case it loses. Here the management's argument that it wants to increase the number of raiders by delaying the takeover process is not as viable since the initial raider is already a large shareholder and will have an advantage over other raiders or will discourage them. There seems to be a fine
line between the case where management wants to bid the price higher and when it is trying to discourage bidders. This line is clearer when one looks at specific takeover cases.

2. The SEC 13D Disclosure rule. After a 13D filing and in case of a potential takeover, the shareholders will have time to react to the news and gather information on the bid. The share price quickly adjusts to the expected value of the share to the raider. Jensen (1988) argues that this rule decreases the number of potential raiders since it decreases the benefits the raider can obtain from the bid. The raider has to pay for the takeover costs but has to share the benefits with other shareholders. If the rule is abolished there will a transfer of wealth from the target's shareholders to the raider or to the acquiring firm in the event of a takeover. Therefore the probability of a takeover occurring increases. The rule protects minority shareholders and insures the transfer of some of the takeover gains to them. That is an important guarantee to the shareholders given the risks that agency problems create to their investment in the firm. If the firm is performing badly in the market because of mismanagement, the SEC 13D rule will insure that the raider will acquire the firm at a price that reflects the potential change in control. It therefore protects small uninformed shareholders. The raider should share some of the gains from the takeover since he incurs the costs and risks of a takeover, therefore we do not want all the gains to be transferred to the shareholders.

3. State anti-takeover amendments. These are amendments that affect takeovers involving firms incorporated in the specific state that issues them. They are divided into three categories. The first generation laws were passed by the states before the 1982 Supreme court decision in Edgar v. Mite where it ruled Illinois anti-takeover law as unconstitutional. The second generation laws were passed after the case Edgar v. Mite,
some of these have been ruled unconstitutional. And finally the third generation laws that were passed after the Supreme court in 1987 (CTS v. Dynamics Corp. of America) ruled the Indiana anti-takeover law constitutional. Each of these laws tried to follow guidelines that were set by the most recent Supreme court decision. Two studies find negative stock price reaction to the passage of State anti-takeover laws. Ryngaert and Netter (1987) find a significant loss in stock prices of up to 3.25 % for firms incorporated in Ohio after the passage of the Ohio anti-takeover law. Schuman (1987) finds a loss of 1% in stock prices for firms incorporated in New York after the passage of New York anti-takeover law. These numbers clearly indicate that the shareholders consider the decrease in the threat of takeovers due to the passage of these laws as a decrease in the value of the firm.

4. Targeted repurchases or Greenmail. Greenmail refers to the amount of money a firm pays to repurchase some of its shares from a potential raider. The repurchase is usually done at a high premium. The payment is often followed by a standstill agreement that forbids the large stockholder from bidding for the firm for a specified period of time. The evidence on greenmail payments is mixed. Jensen and Ruback (1983) find significant losses in stock prices of firms that are engaged in making greenmail payments suggesting that shareholders consider them as an anti-takeover device. More recent studies find that even though the effect of greenmail payments is negative the overall effect starting from the accumulation of stocks is positive (Mikkelson and Ruback, 1985, and Holderness and Sheehan, 1985). A study of the OCE (1984) finds the initial announcement of the investor's purchase of stock and interest in the firm has an average positive return of 9.7% while the greenmail transaction leads to a loss of 5.2 percent in stock prices. These results suggest that shareholders benefit in general from the existence of a large shareholder because of his high monitoring value. It is also possible that shareholders expect the firm
to still be in play after the greenmail payments. Greenmail has a positive value since it encourages accumulation of shares, which is important for any serious challenge to the management including a takeover. When the payment is made, the shareholders' expectations of a takeover decrease and so does the chance of gaining the high premiums that come with it, therefore they react negatively. But as the evidence indicates the overall effect, starting from the initial purchase of shares is still positive.

5. Poison pills. "Poison pill describes a family of shareholder rights agreements that, when triggered by an event such as a tender offer for control or the accumulation of a specified percentage of target shares by an acquirer, provide target shareholders with the rights to purchase additional shares or to sell shares to the target at very attractive prices" (Jarrell, Birckley and Netter, 1988). These provisions operate under the discretion of the board of directors that can easily alter them, and they can be very costly to any potential raider. They do not require shareholders' vote to pass and are hard to challenge in court. In most cases the court invokes the business judgment rule that is a doctrine that prohibits the court's intervention in a corporation's business unless there is an explicit evidence of fraud. This doctrine was used in a famous Delaware case Moran vs Household Intl., Inc., where the board prohibited the shareholders from selling their stocks for any premium under nearly 200 percent of the stock price. Empirically these pills have been associated with a significant loss in stock prices -0.34 % and a loss of -1.51 % for firms that were subject to takeover speculations (Ryngaert, 1988; Malatesta and Walking, 1988). Stock prices are also sensitive to court decisions in case of litigation, they react positively to a ruling against the poison pill and vice versa. Ryngaert (1988) also finds that firms that adopt poison pills have low insider and institutional stock holding. The evidence suggests that poison pills have a negative effect and occur in firms with a potential for agency
problems. As Jensen (1988) argues the business judgment rule should not apply to control problems since in this case there is a strong conflict between shareholders and management.

6. **Severance contracts.** "Golden Parachutes." Golden parachutes are pre-specified payments that are made to members of the incumbent management in case of a takeover. Golden Parachutes have two positive objectives. They decrease the conflict of interests between management and shareholders in case of a takeover. They also decrease the effect of the takeover threat on implicit contracts between shareholders and management, this is specially important when the managers need to make high industry-specific investments. Lambert and Larcker (1985) report an average gain of 3% following the adoption of Golden Parachutes plans by the management. Their result might be reflecting an increase in takeover expectations. Finally as Jensen (1988) mentions, Golden Parachutes plans can be easily used as an anti-takeover device if they assign high payments to a large number of the management (e.g., Eastman Kodak recent Golden Parachutes plan covers a large section of the employees).

**Takeovers in the 80's**

In this section we briefly comment on three major characteristics of the takeovers in the 80's.

A. **"Bust up" takeovers of the 80's**

These are takeovers that are characterized by the sell-off of some of the target company divisions. This activity divests any inefficient or non-profitable parts in the target
company. In many cases, especially in targets that face organizational problems and in conglomerates, the parts are worth more than the whole. In addition, the acquiring firms often need to raise capital to retire some of the debt incurred in the takeover process. The movement towards "Bust up" takeovers is natural after the diversification wave in the mergers of the 60's and 70's that proved to be inefficient. Sherer (1988) cites two results from Ravenscraft and Scherer (1987) that undermine the role takeovers in the 80's in divesting inefficient businesses. They show that the probability of divestiture moves from zero to nearly one with four standard deviations change in six variables that do not include any direct variable representing takeover probability. However many of these variables (e.g., line of business profitability or company-wide profitability) are related to the probability of takeovers. Even if the takeover does not actually occur, the threat of its occurrence might be affecting divestiture activity. Ravenscraft and Scherer also argue that the sell-off activity corresponds to a change in the parent's CEO who is in many cases the person responsible for the initial merger. They prove that such a change occurs every eleven year and that is according to them the principal reason why divesting the mergers of the 60's and 70's is occurring in the 80's. Their evidence, we find reinforces the view that existing management is reluctant in many cases to divest or change the course of a project it had previously initiated. This fact in turn increases the need for outside monitoring and therefore the threat of a potential takeover.

B. The use of high-yield, non-investment grade bonds ("Junk Bonds")

"Total publicly held high-yield bonds have risen from $7 billion in 1970 to $125 billion dollars in 1986" (Jensen, 1988). They constituted 23% of the total corporate bond market in 1986. Junk bonds operate as other bonds but they carry a 3 to 5 percent higher interest rates compared to government bonds with comparable maturity due to their higher risk.
Junk bonds have been used substantially in financing the takeovers of the 80's. They have made possible the high premiums paid by raiders and many of the large acquisitions that would be otherwise hard to finance. The claims of the stockholders of the acquiring firms on the merging venture are subordinate to the claims of the bondholders. Therefore there is no problem with the risk incurred by these bonds the question is whether the price and yields on these bonds reflect this risk. Jensen (1988) notes that it is hard to judge the pricing of junk bonds since they did not have enough experience in the market. Jensen wrote the article in 1988, the time there were few defaults on junk bonds. Druxell Burnham was still providing a large amount of junk bond investors including Savings and Loans Associations" whose depositors were defended from the risks of junk by the federal deposit insurance and were thus willing to accept more of it, at a lower yield" (The Economist, February 1990). This might have artificially inflated the demand for the junk bonds and increased their price. Junk bond prices have decreased due to the failure of many of the thrift associations (Savings and Loans) and the litigation case of Druxell Burnham. Default in paying creditors by some firms that were involved in takeovers had also its toll on the junk bond market. These developments are however independent of the potential benefits of creating a new financial instrument that facilitates credit. A test for the highly leveraged takeovers of the 80's will be a recession or a slow down in the economy. In this case debt financing will become a burden and companies will have to cut back financing for important projects to avoid default on debt. There is an optimal capital structure for each company that depends on the costs and benefits of each type of its financial instruments. It is not clear whether some of the acquiring firms are surpassing their limit on debt and whether the market is providing credit at cheap prices.
C. Anti-takeover defensive tactics

They have been widely developed and used in the 80's. This is partly a reaction to the deregulation wave in many industries and the expansion in the financial markets. Many corporations that were immune due to regulation or due to their size, became later susceptible to takeovers. The increase in the use of defensive tactics contributed to the increase in the premiums received by shareholders since they delay the takeover process and encourage auction type bidding. They, however discourage many raiders from bidding for the firm and as we have seen some of them seem to have a clear negative effect.

Conclusion

Takeovers have potential benefits and real costs. They clearly benefit the target's shareholders but can have harmful effects on the acquiring firm. Some corporations miscalculate the amounts of premiums they can pay for the target shareholders (as is the case in the attempted UAL's management and labor buy-out of United) and the amounts of debt they can later survive with (Campeau's bid for Federated and his filing for bankruptcy). As any business or investment a takeover is not always a good one. However, given the structure of today's organizations and their weakness in internal monitoring, takeovers and the threat of takeovers play an important role in deterring non-maximizing and inefficient behavior. There is however a need to protect the shareholders from takeovers given their information disadvantage with respect to the firm's management and the raiders. Takeover laws should concentrate on providing more information and time to the shareholders to weigh any takeover attempt and for the target's management and the raiders to provide any relevant information.
OVERVIEW OF THE THEORETICAL LITERATURE 
ON THE TAKEOVER PROCESS

Introduction

The graph below sketches the different elements involved in the takeover process. The target firm is composed of its management, its board of directors, its small and large shareholders and its employees.

The management and the board of directors have to decide whether and how to oppose the takeover. The managers are also affected by the threat of a takeover as an external monitoring device.

The small shareholders have to decide whether to tender their shares in the case of a tender offer and whether to oppose anti-takeover amendments. The employees of the target firm can be actively involved in a takeover, as is the case in labor management buy-outs.

The raiders have to decide whether and when to enter the bidding. They also have to choose the bidding price they will offer to the shareholders. In their decision they consider the actions and expectations of the shareholders, the target's management and of rival raiders. We will discuss the theoretical issues that have been studied in the literature, as they relate to the role and decisions of each of the agents involved in the takeover. We present some selected articles under general headings, although many of the articles discuss several issues at the same time. We focus on main assumptions and present the basic elements of each model, their results and implications.
Figure 1

A sketch of the agents involved in a takeover
The decision of the shareholders to tender their shares and the free rider problem

In the paper by Grossman and Hart (1980), a raider wants to gain control of a target firm through a takeover. To do so, he has to acquire the majority of the outstanding shares from a large number of small shareholders. Each shareholder considers that he has no effect on the takeover outcome and therefore makes his decision based on the price offered for his shares. The shareholder has the option of selling his shares at the price offered to him or to hold on to them, and share the benefits from the takeover. Therefore, he will not tender his shares at a price below their post-takeover value. The raider however will not offer such a price, since organizing a takeover is a costly process. The maximum bidding price he will be willing to offer for the firm is equal to his post-takeover valuation of the firm, minus the takeover costs. The takeover is similar to a public good that benefits both the raider and the shareholders, but that only the raider has to pay for organizing it. In this context, value-increasing takeovers will not occur since it is not beneficial for anyone to initiate them, due to this free rider problem.

A large shareholder that owns a substantial stake in the firm will however, benefit from buying the shares at their post-takeover value. The value of his shares will appreciate after the takeover and therefore, he can cover the takeover costs.

It is therefore, beneficial for small shareholders to cultivate large shareholders that would have an incentive in monitoring the firm, and researching value increasing improvements.

The free-rider problem can also be overcome by diluting the value of the free-riders' shares. The raider would engage in activities that decrease the post-takeover value of the shares of the minority shareholders, therefore eliminating the incentive to free-ride. A divergence in the perceived post-takeover value of the firm among the raider and the
shareholders, due to the private value to the raider from controlling the firm, will lead to the same result.

The paper by Grossman and Hart laid the basis for a game theoretical approach to takeovers, where each of the players analyses and takes in consideration the actions and strategies of the others. All the papers that have followed had to deal with the free-rider problem and provide a framework where it can be overcome.

Hirshleifer and Titman (1990) consider a framework similar to the one by Grossman and Hart. A raider that is also a large shareholder wants to takeover a firm through a tender offer to its shareholders. The raider can make only one offer and he has a private valuation for the firm, that is unknown to the shareholders. In Grossman and Hart the raider can derive the condition under which the shareholders will accept an offer. The offer has to be equal to the expected post-takeover value of their shares. Here, the reaction of the shareholders to the raider's offer is not fully predictable by the raider. Each offer has a certain probability of being accepted by the shareholders. This probability increases with the amount of the offer and the percentage of shares owned by the raider, and decreases with the amount of shares needed to gain control of the firm. The authors incorporate this uncertainty by assuming, that only a part of the shareholders indifferent to tendering their shares will actually tender them. The uncertainty can also be obtained if the shareholders make their decision in function of a factor unknown to the raiders. Both considerations assume a certain heterogeneity in the shareholders' reaction.

There are two implications to this uncertainty. First, a raider with a high valuation will have an incentive to increase the value of the bid so that the probability of its success increases (the benefits of success increase with the valuation of the raider). Second, unlike the model in Grossman and Hart where the raider can predict the outcome of a bid and therefore avoid making unsuccessful bids, here, unsuccessful bids can be justified.
The raider has to choose the amount of his bid and the shareholders have to set the probability function for accepting a bid. The authors derive the condition on the probability function of accepting a bid in a fully revealing mixed strategy equilibrium. They replace for a bid equal to the bidder's valuation in the first order conditions of the bidder's maximizing problem. When the shareholders react to the bids in the manner dictated by the derived probability function each bidder will have an incentive to make a bid equal to his true valuation.

The main result of the paper is that the probability of success for an offer at equilibrium is bigger the bigger is the bid and the initial holdings of the bidder. It is smaller the larger is the number of required shares to obtain control. The bigger are the valuation of the bidder and his ownership in the firm, the bigger are his benefits from increasing the probability of winning and therefore he would be more willing to offer a high bid. However when the number of shares required to secure control increases the raider has an incentive to decrease the bid price. Now he has to buy more shares at that price, therefore the equilibrium probability of winning must be smaller to induce him to offer a bid price equal to his valuation.

The assumption that the bidders can make only one bid plays an important role. Otherwise the bidders will offer the lowest acceptable price and then revise their bids in case of failure. The argument behind this assumption is that when a first attempt fails the management has time to revise its defensive tactics and competitive bidders to study the target and enter the bidding.

The authors also discuss the effect of several defensive tactics on the equilibrium probability function. They find that some of them are consistent with the shareholders' interests while others are not. They divide them into two categories, costs imposed on the raider only when he wins the bid and they include poison pills and value-reducing
strategies, and costs imposed on the raider independently of the outcome of the bid as litigation costs. Litigation might also affect the raider by decreasing the probability of a bid succeeding.

Poison pills impose costs on the raider that are completely redistributed to the minority shareholders. In an equilibrium with poison pills the probability of a successful bid decreases and the bidding price increases. Given a fixed valuation the raider now has to offer a higher bidding price to compensate for the extra gains to the minority shareholders.

Value-reducing strategies are strategies taken by the management to reduce the value of the target and make it unattractive to the raider. It is equivalent to a decrease in the raider’s valuation and imposes costs on both the shareholders and the raider. In this case the probability of success is higher for a given bid since shareholders take in consideration the decrease in the post-takeover value of the firm and accept a lower bid. The probabilities of success as a function of the raider’s valuation could however be higher lower or left unchanged. The raider with the same valuation was willing to make a higher bid previously but the shareholders are now willing to accept a lower bid so the result is not clear.

As for litigation, it increases the takeover costs independent of the outcome of the bid or it can block the takeover.

The costs imposed to raiders by litigation are decreasing with the size of the bid and they result in an increase in the probability of an offer’s success. Low bids are accepted more easily since they imply a higher litigation cost. The higher litigation costs act as deterrents to lower than the true valuation bids and permit a lower decrease in the probability of acceptance to induce the fully revealing equilibrium. It is also possible to see bids higher than the raider’s valuations. A bidder might increase the bid to a value higher than his valuation if he gains sufficiently from the decrease in the litigation costs. Litigation
might be consistent with shareholders' interest since it imposes takeover costs that are decreasing with the bid and that encourage higher bids.

When litigation blocks a raider's offer, the probability schedule set by the shareholders takes in consideration the additional probability of failure due to litigation and adjusts to it. In case the probability of failure due to litigation is constant, the final probability of success decreases uniformly and the shareholders cannot fully adjust the equilibrium schedule. When the probability of failure decreases with the amount of the offer, there is no change in the final probability schedule and the shareholders can fully adjust their behavior as to have the same outcome as in the case of no litigation. In general, litigation can decrease the probability of a successful bid.

If takeovers do not affect the bondholders or labor then any action that decreases the probability of a value increasing takeover is welfare decreasing. Here anti-takeover defenses might have a different effect then just redistributing the gains from a takeover from the raider to the shareholders. Since they ensure that the bidders offer higher bids and the response of shareholders depends on the bid value, they also can increase the probability of a takeover. However there are some management's actions that are consistent with shareholders' interest but not with social welfare. The decrease in the probability of success of a bid is compensated, for the shareholders, by an increase in the expected bid price. There is however a decrease in welfare in this case.

The major contribution of this paper is introducing uncertainty in the shareholders' response to a bid, which we believe to be realistic and justifies unsuccessful bids. The equilibrium is also in this case more continuous. In nearly all the other papers we consider there is one acceptable bidding price and all the bids lower than this price are rejected. Here each bid has a certain probability of success and therefore we can explain unsuccessful bids. The authors however assume that shareholders can act as one homogeneous entity.
and set the probability function for accepting a bid to induce raiders to make bids equal to their valuations. It is difficult to imagine how such an equilibrium can be achieved when it requires coordination from a large number of shareholders.

The role of a large shareholder in the takeover process

"In a sample of 456 of the Fortune 500 firms, 354 have at least one shareholder owning at least 5% of the firm" (Shleifer and Vishny, 1986a). Shleifer and Vishny study the value of a large shareholder in a context of asymmetric information over the value of the target to the raider and costly information acquisition about possible improvements in the firm. The large shareholder has to choose a costly research effort (that might include monitoring current management) that potentially permits him to find ways to increase the value of the firm. When he chooses the intensity of his effort he also chooses the probability distribution from which the improvements will originate. So with a higher research intensity he will have a better chance in finding bigger improvements. After observing the actual improvement he found, he has to decide whether to takeover the firm and implement it. To control the firm he has to buy, through a tender offer, as many additional shares as to secure him a majority in the firm. The large shareholder will offer to takeover the firm only if he expects a non-negative payoff given the improvement he finds, the fraction he owns in the target firm, and the takeover costs. The tender offer price must also be greater than or equal to the shareholders' expectations of the post-takeover firm's value.

The shareholders do not know the true improvement that the large shareholder has found. They form their expectations of the firm's post-takeover value, considering that the large shareholder will have a positive profit from taking over the firm at the offer price.
(otherwise he would not attempt the takeover). The small shareholders will not accept a takeover price that is less than their expectations of the post-takeover firm's value.

There exists a set of possible sequential equilibria to this problem of the form: the large shareholder offers a takeover price P or does not offer to takeover the firm. P should be greater or equal to the small shareholders' expected post-takeover value of the firm as described above. The set of equilibria is reduced to the equilibrium with the lowest acceptable offer price since the raiders will always want to takeover the firm at the lowest possible price (that is the only perfect sequential equilibrium as defined by Grossman and Perry, 1986).

The large shareholder will therefore choose a research intensity that maximizes his expected payoff taking in consideration the equilibrium price at which the shareholders will tender their shares.

We will have a free-rider problem in case the raider did not own any shares in the firm. In this case and given positive takeover costs the raider must offer a price that is lower than the post-takeover value of the firm to make any profits (here there are no private benefits from the takeover). The small shareholders realizing this, will not tender their shares to any offer and there will be no successful bids.

The only profits that the small shareholders will allow to the large shareholder are the profits he makes on his shares in the firm. As a result, the bigger the large shareholder's ownership in the firm the lower is the price that the small shareholders will accept. This also implies that given a certain research effort, therefore a probability function of the possible improvements, the probability of having a takeover increases with the large shareholder's ownership in the firm. The large shareholder will then need to find a lower improvement to takeover the firm at a profit. He needs to pay a lower price and to buy a smaller number of shares to secure control.
The optimal research intensity for the large shareholder will be bigger the bigger is his ownership in the firm. We can consider that the research intensity increases the probability of finding an improvement that satisfies the conditions of a successful offer. The bigger is the ownership of the large shareholder in the firm the bigger is his expected income from a successful takeover (given that the offer is successful) therefore the bigger is the expected gains from any given research intensity.

Defining the value of the firm as its value under current management plus its expected added value under any future improvements (here assumed to be potentially implemented only by the large shareholder because of the free-rider problem), Shleifer and Vishny prove that an increase in the large shareholder's ownership leads to an increase in the value of the firm. The increase in the probability of a takeover outweighs the decrease in the expected premium paid by the large shareholder as the large shareholder's ownership in the firm increases. An increase in the takeover costs has the opposite effect on the value of the firm.

The existence of the large shareholder will allow some of the value increasing takeovers to occur. However the asymmetry in information and costly information acquisition by the large shareholder combined with the free-rider problem imply that not all value-maximizing takeovers will occur. It however follows from the perfect sequential equilibrium that the larger is the shareholdings of the large shareholder and the smaller are the takeover costs the bigger is the value of the firm and the probability of a value-increasing takeover.

The effect of takeovers on management and the role of the management in the takeover process

One of the advocated roles of takeovers is its role in disciplining management. What is not clear is why does this role go beyond incentive compatible contracts? Sharfstein (1988)
presents a model where there is asymmetric information about the environment in which the firm is operating and the effort of the management in running the firm. The management, M, can observe a variable that signals the state of nature and that the shareholders cannot observe. In the model there can be two states of nature, a good state and a bad state. The firm's value is observable by all the agents. It depends on the state of nature (with a higher value in the good state) and on the effort of the management in managing the firm that only M observes. M gets a disutility from effort and is compensated by the shareholders according to the observable value of the firm. In such a situation and when the good state of nature occurs, M is tempted to report the bad state of nature and a high level of effort while effectively exerting a minimum effort.

The possibility of a takeover is represented by the existence of a raider, R, that can observe the state of nature and therefore knows when the value of the firm can be improved by a better management. In addition, R finds an improvement to the firm's value that is drawn from a known distribution function.

The shareholders design a contract where they specify the payment for the manager and the price at which they would tender their shares in the event of a takeover attempt, given the observed value of the firm, the declared state of nature and the distribution function of the possible improvements found by the raider. The second component of the contract solves the free-rider problem since the shareholders commit themselves to a price before obtaining full information on the possible value of the firm to the raider. The shareholders use the fact that the raider can discriminate between the case where the manager is shirking and when the state of nature is bad and want to facilitate a takeover in the first case. However when they set a small takeover price therefore increasing the probability of a takeover they also decrease their expected gains from the takeover.
The optimal contract maximizes the expected shareholders' income given the probability of occurrence of each state of nature and the improvements that R is expected to find, therefore the probability of a takeover.

When the raider finds with certainty an improvement big enough to takeover the firm when M shirks (i.e., declares that the low value of the firm is a result of the bad state of nature while in reality (as the raider can observe) it results from the low effort by M), then a first-best contract is feasible. The shareholders set the income of the manager and the price at which they tender their shares such that the manager always reports the true state of nature and is paid exactly the compensation for his disutility from work. The first best outcome is possible only because of the threat of takeovers. When the raider does not exist the shareholders, for insurance purposes, cannot punish the manager whenever they observe a low firm value. The raider on the other hand observes the state of nature and therefore realizes the potential of the firm. When M shirks, the value of the firm increases with a higher level of effort, in addition R would have to pay a lower price for the firm. If the parameters' values are such that in the case of shirking the raider always takeovers the firm then M has no incentive to shirk.

If the raider does not takeover the firm with certainty when the manager shirks, then with a positive probability (the probability that there would be no takeover) M still can shirk and gain from a lower disutility of effort. When the good state of nature occurs the shareholders have to pay the manager, in addition of a compensation to his effort, his expected gain from shirking to induce him to announce the true state of nature. The payment for the manager is therefore, set over the first-best solution.

When the shareholders maximize their expected payoff under these conditions the resulting takeover price, effort by the management and firm value are at the first-best level in case the good state of nature occurs and below the first-best level in case the bad state of
nature occurs. Setting a lower income for M (which implies a lower effort) in the bad state of nature is optimal because it permits the shareholders to decrease the extra payments needed to prevent the manager from shirking in the good state of nature. A lower takeover price in the bad state of nature, in this second-best solution, encourages R to takeover the firm in case M is shirking and therefore decreases the expected benefits of shirking to M and the income the shareholders have to pay him to induce him to truth telling. A lower effort level and takeover price imply a lower firm value in the bad state of nature in the second-best solution. The shareholders suffer from the asymmetry of information. However, the level of effort by the management and the value of the firm in the bad state of nature as well as the expected value of the firm are higher when there is the threat of a takeover. Under asymmetric information the shareholders cannot discriminate against shirking, while the raider can.

When the raider is uninformed, takeovers lose their positive effect on managerial incentives and may have a negative one. The raider does not discriminate against the manager that shirks and since he is not bound by the original contract signed by the shareholders, he might deprive the manager from some promised payments. Given this possibility the shareholders will find it harder to induce the management to reveal the true state of nature. Facing an uninformed raider, it might not be optimal to the manager to reveal the true state of nature when it is the good state of nature even when the shareholders compensate him for his expected gains from shirking. This compensation is uncertain in case the firm is taken over in contrast to the gains from shirking that are certain.

Management resistance in this context has a negative effect since it increases the price at which the raider can acquire the firm when the manager is shirking. It therefore decreases the disciplinary effect of takeovers. It can still however increase shareholders' expected payoff by extracting more surplus from the raider.
The model shows clearly the disciplining value of takeovers in a context of asymmetry of information between the manager and the raider at one side and the shareholders at the other. When there is less asymmetry of information or possible resistance by the management the monitoring value of takeovers decreases. Finally, an important policy implication is that increasing the information to the shareholders after a bid is made, increases the price a raider has to pay to takeover the target firm but decreases the probability of a takeover when the manager shirks.

Shleifer and Vishny (1986b) unlike Scharfstein assume that there are no agency problems and that the manager acts in the shareholders' interests. They then, study the role of the incumbent management and its use of greenmail payments in a takeover.

The model consists of a target firm (T) that is represented by its management, and three potential acquirerers interested in the target but that need to invest some money to find information on the value of the firm to them. The acquirerers have a feature that distinguishes them. Two of them (H1 and H2) are of a high type, which means that they can potentially implement greater improvement if they find the right information. The third acquirerer (L) is of a low type and can potentially make only small improvements in the firm.

The potential acquirerer, L, owns a certain fraction of shares in the firm. The management can have information about sources of gains from one of the high type acquirerers and it is called strong or it has no such information and it is weak. When the management signals that it is weak by paying greenmail, it encourages the H's to gather costly information of possible gains from a takeover since the probability of facing competition decreases.
The game evolves in three stages. In the first stage the management decides whether to pay greenmail. In the second stage each of the raiders chooses the level of information he wants to acquire and in the third stage the bidding for the firm takes place.

Paying greenmail does not only encourage the H's to gather information because it signals that T is weak but because it also eliminates L from the bidding contest. In an extreme case the H's might have a negative expected payoff from gathering information when L stays in the race and therefore decide not to gather information. Both weak and strong targets benefit from signalling that they are weak and at a perfect Bayesian sequential equilibrium, the payment of greenmail will have a signalling value only in the case that this equilibrium is separating. There are however two other possible equilibria. One is a standstill equilibrium where T pays a greenmail whether it is strong or weak. And the second, a no-standstill equilibrium where T does not pay a greenmail independent of its type.

The authors illustrate the value of greenmail payment in eliminating a weak contestant from the takeover and signalling that the target is weak by considering two specific cases. In the first all the targets are weak and they all pay greenmail at equilibrium. The second example illustrates the case where a separating sequential equilibrium is possible.

In the first example T cannot have information about the existence of a white knight and there are only two raiders L and H (that differ in their costs in finding information and the improvements they find after their information gathering). The numerical values of the parameters are such that the expected benefits for L from finding information are greater than zero in both cases whether H invests in information gathering or not. However, H has a negative expected payoff from gathering information when L also does so. The shareholders' expected payoff is greater if they can get into a standstill agreement with L by
paying her, her expected payoff from information acquisition and therefore creating the incentive for H to invest in information gathering.

In the second example we have again three potential raiders but L has already found a certain source of improvement. The parameters' values (costs and possible valuations) are such that the H's expect a loss if they invest in information when L is not removed from the takeover bid. The strong and weak targets will have different benefits from paying a greenmail. They will both pay the same amount of greenmail to persuade L not to attempt a takeover. However the gains from such a payment are different. For a weak target, removing L secures an expected payoff equal to the high valuation, with the probability that both H's find a way of improving T. Otherwise the only bidder is L and shareholders get zero expected payoff. When T is strong, paying the greenmail increases the expected payoff of the shareholders, from the valuation of the firm to L (that payoff is certain for a strong target since at least L and one H will bid for the target) to the valuation of the firm to H with the probability that one of the H's finds this valuation when he invests in finding it.

In example 2 the values of the parameters are such that only for a weak T the gains from paying the greenmail are bigger than the costs of the greenmail. It follows that the perfect sequential equilibrium is separating and is of the form, the weak T pays a greenmail equal or greater than the valuation of L and the strong T does not pay a greenmail or pays a greenmail less than the valuation of L. In this case H's and L believe T is weak when it pays greenmail and L accepts the greenmail.

It follows from the analysis of the equilibrium that there exists for all parameter values a no-standstill equilibrium supported by the beliefs that when a greenmail is paid the target is believed to be strong with certainty and if no greenmail is paid the target is believed to be strong with a certain probability. For some parameter values and beliefs there exists a
pooling standstill equilibrium. And finally for some parameter values and beliefs there exists a separating equilibrium where only weak targets pay greenmail.

The major implication of the analysis of this model is that payment of greenmail may in some cases be used by the management to signal that it has no white knight. Therefore inducing other raiders to acquire information on the target and possibly enter the bid and raise the takeover price the shareholders get. Shleifer and Vishny suggest that in some cases shareholders might choose to restrain their management from using greenmail so that restraining from using it in a takeover does not have a signalling value.

We note that greenmail payment is not only useful in case a separating equilibrium exists. When the management pays greenmail it does not only send a signal about its type but it also removes a weak competitor from the bidding, which might by itself encourage further information gathering by other rivals. That was the case in the first example where H has a positive net expected payoff from gathering information only in the case that L is eliminated from the bidding.

The authors rightly note that their findings do not mean that greenmail could not be used against shareholders' interest when resisting a takeover. With the existence of agency costs, the benefits from allowing greenmail payments should be weighed against the losses incurred by the shareholders in case the management abuses this anti-takeover defense.

**Bidding strategies of the raiders and the signalling value of bids in a takeover**

Fishman (1988) studies the strategic interaction among bidders during the bidding process. When the value of the target to the bidders is unknown and can only be obtained from costly information acquisition, each bidder has an incentive to signal that he has a high valuation and discourage other bidders from attempting to gather information about the
target. In this way the bidder will eliminate other bidders from the race and avoid a bidding war that would result in the loss of the bid or the payment of a higher price for the target. Such a strategic behavior might explain the empirical evidence on the high premiums paid by the raiders at an initial bid. It also reflects the length of the bidding period that gives time for bidders to conduct further investigation of the target (the author cites a period of over six weeks between the initial and the successful offer for multi-bidder tender offers in a study done by Bradly, Desai, and Kim (1986).

Fishman's model has two bidders that can acquire costly information about the value of the target to them. These valuations constitute private information and can only be observed at a cost by the corresponding raiders. They are however drawn from a commonly known distribution function. There is also a variable that indicates whether the state of nature is favorable for a takeover or not. The two bidders profit from information acquisition only when the state of nature is favorable.

The takeover proceeds as follows. One initial bidder, B1, obtains the information on the state of nature freely. When it is positive he invests in finding information on the value of the target to him. He then has to decide whether to make a bid and the amount of the bid he wants to make.

The other bidder, B2, observing the bid of the first one will know that the state of nature is favorable and will review her beliefs on the valuation of the target to B1. She now believes that the valuation of B1 is greater or equal to a certain threshold value that depends on B1's initial offer. She then has to decide whether to acquire further information about her valuation of the target. Given her expectation of B1's valuation and the cost of information gathering, B2 might decide not to find out the valuation of the target to her.
When B2 decides to obtain information on her valuation of the target and when it is higher than B1's first bid, the two bidders enter in a bidding contest and the bidder with the highest valuation wins the firm. Since the target will accept any offer that is higher than the market price, bidding for the target occurs only when the state of nature is favorable and when the valuation that B1 finds is higher than the target's market price.

A sequential equilibrium is defined by a triple, the bidding price by B1, the decision of B2 of whether to seek information on her valuation and the beliefs of B2 over the valuation of B1. It is a sequential equilibrium when B1's first offer maximizes his expected payoff given the decision of B2, B2's decision maximizes her expected payoff given her beliefs on B1's valuation, and the beliefs of B2 are consistent with the initial offer made by B1.

For an initial offer to deter B2 it must be at least equal to an initial bidding price that would make B2's expected payoff equal or less than zero. We define R to be the initial bid that makes B2's expected payoff equal to zero and G the corresponding threshold value in B2's beliefs when it observes R. When the initial bid is greater than R the expected payoff of B2 is negative and she believes that B1's valuation is greater than G.

For B1 to offer a bidding price that would preempt B2 from information gathering, the difference between his expected payoff when he makes that offer and B2 drops out of the bidding, and his payoff when he makes a bid equal to the firm's market price and B2 stays in the race must be positive. The higher is the valuation of B1 the bigger is his expected loss from the entry of B2 into the bidding and the more he would be willing to eliminate her.

There exists a multiplicity of equilibria defined by initial bidding prices that make the expected payoff for B2 negative or equal to zero. In these equilibria B1 offers an initial bid equal or greater than R whenever he has a valuation equal or greater than the corresponding threshold G. When observing such a bid B2 expects B1's valuation to be greater than G
and a negative payoff from competing. When B2 observes any other offer she is not preempted from competing.

After applying refinements to the equilibria as defined by Grossman and Perry (1986), the set of equilibria is reduced to one perfect sequential equilibrium with the lowest deterring initial bid R and the corresponding beliefs represented by G. We can reduce the set of equilibria by restricting out of equilibrium beliefs to be credible. The condition of credible beliefs in this context is explained as follows. When B1's that belong to a certain subset (represented by a subset of their valuations) have a higher expected payoff when they deviate from the equilibrium and offer an initial bid that is different from the equilibrium initial bid, then B2 believes that any B1's that behave as such belong to that subset. In all the equilibria where the first offer is greater than R, when B2 observes an initial offer equal to R, B2 believes that the valuation of B1 is higher than G (by definition of R and G) and therefore should be preempted by the offer, which is a contradiction to the equilibrium.

The signalling equilibrium is not equivalent to the outcome in a complete information setup. In some instances B2 is deterred from competing while it has a valuation that is bigger than the one B1 has. Incomplete information introduces some social inefficiency.

It is however true that the signalling equilibrium welfare dominates the no-signalling outcome. The social costs of incomplete information in a signalling equilibrium (B2 is preempted too much) and in an equilibrium with no signalling (B2 is not preempted enough) are equivalent, however in a signalling equilibrium B2 makes her decision of competing or not with a larger available information set.

A direct result of the model is that the expected payoff for the target decreases as the cost of information gathering for B2 increases. That is a result of an increase in the number of preemptive bids and a decrease in the value of these bids as B2's costs increase. The
target has therefore an incentive to decrease the costs of information gathering to its bidders.

A result with a surprising empirical implication follows from the signalling value of initial bids. The target's and B1's expected payoffs conditional on the occurrence of a high deterrent initial bid are higher than when they are made conditional on a low non preemptive bid. Since B2 is less likely to compete when the initial bid is high, the expected profits for the target and B1 are higher for single bidder contests than for contests with multiple bidders.

Testing for the model's predictions incorporates several difficulties. We must distinguish among differences in information costs and differences in the distributions of the bidders' valuations. It is also difficult to recognize a multi-bidder contest when the second bidder decides to invest in information gathering but finds a valuation that is lower than the initial bid.

The main idea of the article is that a raider signals his high valuation when he offers a high initial bid. The timing of the entry into the bidding is predetermined by observing a good or a bad state of nature. The state of nature in the model represents variables that affect both raiders in the same way. When the information on the state of nature includes private information on R1's valuation then the entry into the bidding might have a signal value by itself.

The effect of security design on corporate control

Most of the public securities have a one vote per share structure where the control value of each share equals one vote. Theoretically we could have different classes of shares with a different vote value attached to each class.
Grossman and Hart (1988) analyze the optimal vote per share structure from the shareholders' point of view in a context of complete information and no uncertainty. In their model we have one raider, R, that is competing against the incumbent management, I for the control of the firm. Controlling the target firm has some public and private benefits. A raider does not accumulate any gains from an increase in the public benefits that his control of the target incurs (free-rider problems). In the first period the private and public values of the target under the control of I and R are observed. In the second period, the raider decides whether to make an offer for the firm or not. And finally in the third period, I chooses whether to resist the bid and to make a competing offer to the shareholders. The firm has two classes of shares with different vote per share ratio. The shareholders will accept the highest bid as long as it is greater than the public valuation of the winner.

The authors study the equilibrium outcome for the relative values of I's and R's private and public values and analyze whether setting different share per vote ratios affect the shareholders expected payoff. The objective of the model is to design the optimal vote per share structure, averaging on all possible combinations of the values of private and public values of I and R.

Considering unrestricted offers we present a brief analysis of all the possible cases.

A. The private benefits of I are relatively insignificant

1. When R has public benefits greater than the one for I. The raider bids for the two classes of shares offering a bid equal to his public value and the security design does not affect the outcome.

2. When the public benefits of R are smaller than the ones for I, R wins the bid only if his private value is big enough to cover one of the two classes
of shares (in case that gives him enough votes to win the bid) or both classes of shares (in case he needs the votes from both classes of shares to win control). In the first instance the value of the shares in the class that constitutes a minority vote will be the public benefits of R divided by the number of shares in that class. However the shareholders that tender their shares receive a price just above the public benefit of I. When R has to buy all the shares to obtain control, all the shareholders obtain a price equal to the value of the public benefits of I for their shares.

In this case it is optimal for the target to have one class of shares.

B. The private benefits of R are insignificant

1. If the public benefits of I are bigger than the ones for R, I retains control of the target.

2. If the public benefits for R are greater than the ones for I, R wins the bid only if the private value for I is under a certain value. This value is the difference between the public value of R and that of I, multiplied by the number of shares in the class with the majority votes when this class exists. In case R needs to buy all the shares to win the bid then the minimum value is equal to the difference multiplied by the number of shares in the class with the smallest number of shares. That is because it is sufficient for I to block the bidding (in the case R needs all the shares to gain control) by offering a higher price than R for one class of shares. Under this condition a one class of shares with one vote per share is optimal.
C. The private benefits of both I and R are insignificant

The one with the higher public benefits wins the bid. The vote per share structure does not make a difference.

D. The private benefits of both I and R are significant

This is the only case where a one per share structure may not be optimal. Grossman and Hart illustrate by an example how the shareholders might be able to extract more of the private benefits of I and R by letting them compete on the votes. The example considered has both private and public values of R dominant over I. If there is only one class of shares then R will win the target by offering a price equal to the public value of R. The sum of the public and private values for I are smaller than the public value of R, therefore, I, cannot challenge the offer. If on the other hand we had two classes of equities, one that consists of pure votes and no claim on the cash flows of the target and the other of pure shares and no voting power, the value of the non-votes shares will be equal to the public value to R. In order to win the votes and gain control over the target, R now has to offer the shares with pure votes a price equal to the private value of I. The raider will still win the firm but he has to pay a higher price for it. Grossman and Hart note that in more general cases where both I and R have significant private values, the optimal structure is somewhere between pure votes and a one vote per share.

The case of restricted offers gives the same result where a one vote per share structure is optimal in all the cases except in the case where both I and R have significant private values.
When we have different classes of shares the shareholders will have differing interests. In the extreme case of pure votes a raider might gain control because of a high private value when the shares with no vote would have a higher value under the control of the management. It is in general optimal for the shareholders to set the security design as to increase the relation of the outcome of a takeover to the public value of the shares and that is equivalent to one class with one vote per share. The only case where a one vote per share is not optimal is when we want two contestants to compete over their private valuations. In this instance, pure votes (or a class of shares that is between pure votes and the one vote per share) represent the value of control and can sometimes insure such a competition.

The relation of capital structure, manager's equity and corporate control

Harris and Raviv (1988) explore the relationship between the incumbent management's ownership of equity in the target firm and the outcome of a takeover attempt and explain how this ownership is optimally set by the manager. The model consists of the incumbent manager, I, that owns a certain fraction, $\beta$, in an all-equity financed firm, small investors that own the rest of the shares and a raider R that is interested in taking over the firm. Both I and R have the same private benefit from controlling the firm but could have a low or a high ability in managing the firm that correspond respectively to a low and high firm value. Each of I and R can exclusively have one level of ability or the other. We can calculate the expected value of the firm under the control of each of I and R depending on the pre-determined probabilities of the type of their ability to control.

When the firm is subject to a takeover I chooses a new level of $\beta$. The manager can change the fraction of her ownership by buying back equity from the small shareholders.
She finances this acquisition by issuing debt. This operation changes the fraction of ownership of the incumbent since it changes the number of outstanding shares. However, as debt increases the benefit of control decreases due to an increase in bankruptcy cost and monitoring.

The takeover attempt proceeds as follows, the raider offers to acquire equity from the passive shareholders at a certain price. The passive investors decide on whether to tender their shares by individually observing some i.i.d. signals that favour one of the candidates and the takeover contest is decided by a majority vote. The raider obtains the votes of the shares she owns and I obtains the votes of the $\beta$ shares and of the shares of the passive investors that did not tender to $R$.

There are three possible outcomes from the takeover that depend on the initial equity position of the incumbent relative to the wealth available to $R$ for purchasing outstanding shares. In the first case the incumbent's ownership is so small that $R$ will win even if she has a lower ability. The incumbent's ownership could be so high that $R$ will lose even if she has the high ability. For intermediate values of $\beta$, I ($R$) will win only if she has a higher ability to manage the firm (the authors refer to this case as the proxy fight case). Therefore the outcome of the takeover and the value of the firm depend on $\beta$.

In the absence of agency costs the manager would choose an intermediate level of ownership that leads to the third outcome. However, the manager chooses $\beta$ by maximizing her expected payoff. In the first case I obtains income only from the shares she owns in the firm that is under the control of $R$. In the second she obtains income from the shares she owns in the firm that is under her control and the benefits of control. And in the last case she gains on the shares she owns in the firm that is under the control of the more competent competitor and with the probability that she is the most competent she gains the benefits of control. Given that the expected payoffs of the shareholders and I are
not perfectly correlated, the manager will not always choose the level of debt (therefore the level of β) that maximizes shareholders' expected income. We note that a high level of debt is harmful to the incumbent, I, since it decreases the benefit of control. The debt level will affect the value of the firm through its effect on the result of possible control contests.

The implications of the model are that on average takeover targets will increase their debt level. Targets of unsuccessful bids will increase their debt levels more than targets of successful bids or proxy fights since it takes on average a higher increase in debt to defeat a takeover. Debt issues are accompanied by an increase in stock prices due to higher expectations of a takeover attempt.

**The role of the medium of exchange in takeovers**

All the models we have looked at so far consider that bids are made in the form of cash. In reality the bidders have the choice between cash, debt and equity or any combination of the three. Fishman (1989) considers a model with asymmetric and incomplete information. The model has two bidders, R1 and R2 competing for one target. Each bidder observes at a cost a private signal about his valuation and the target observes costlessly a signal about its value to the two raiders. All signals are mutually independent.

The problem unfolds as follows. One of the raiders, R1, obtains costless information about a firm being a possible target. The raider can then observe a signal about her valuation at a cost. In case R1 has a positive expected payoff from bidding after observing the signal, she bids for the target. The expected payoff of R1 from bidding depends on her expected valuation, the reservation price of the target and the expected reaction of R2 to the bid. When R1's expected payoff is negative no bidding occurs and the story ends. When R1 makes a bid, the firm is recognized as a potential target and R2 has to decide whether
compete against R1's offer given her beliefs over R1's valuation. Finally the target observes a signal about its value under the control of each raider. If R2 decides to compete then the raiders keep bidding the price higher until one of the raiders drops out of the competition. The target is acquired by the raider that offers the highest bid under the condition that it is higher than the target's given reservation price.

So far the context is similar to the one in the article by Fishman (1988). But the choice of the medium of exchange is now introduced. The raider has a choice between cash and debt. When the raider offers a cash price her gain from the bid is equal to her valuation minus the bid price she had to pay. When the raider makes an offer financed by debt, the raider receives the difference between her valuation and the bid price when this difference is greater than zero and zero if the difference is negative. The target in turn receives the debt face value in the first case and the valuation of the raider in case the raider defaults on her debt and her assets are seized. The assets of the raider will be equal to the value of the target under her control, which is equal to the raider's valuation.

The decision of the target when a cash offer is made depends only on whether that offer exceeds the reservation price of the target. However when a debt offer is made, the value of the offer depends on the valuation of the raider. In this case the decision of the target depends on the signal it receives concerning the valuation of the raider. When the signal is positive it will accept the offer and will reject it when the signal is negative. Therefore R1 has an incentive to make a debt offer since she can profit from the target's information over her own valuation. R1 however also wants to preempt R2 from entering the competition and therefore wants to signal that she has a high valuation by paying cash.

The winning offer in case of competition will have a face value equal to the minimum [maximum { debt offer, the expected valuation of the first raider}]; the expected valuation of
the second raider]. In case of competition the target only accepts a cash offer when it observes a negative signal (in this case the target expects the valuations of both raiders to be less than its reservation price and has no incentive in accepting a debt offer) and awaits for the outcome of the competition in case it observes a positive signal. Once there is competition, the two bidders have an incentive to offer a debt offer.

A perfect sequential equilibrium is defined by the first bidder strategy, consisting of the type of offer she makes and its face value, the second bidder's strategy, consisting of the second bidder response as a function of the first bidder's actions, and a density function that represents the second bidder's beliefs over the first bidder's valuation conditional on the initial offer made by R1.

There exists a perfect sequential equilibrium and it is of the following form:

The first bidder offers a bid in the form of debt and equal to the target's reservation price when her expected valuation is less than the threshold that would deter the second raider from bidding (offering the threshold will signal to R2 that R1 has a high valuation and the expected payoff of R2 is negative under this condition by the definition of the threshold) and a cash offer with a face value equal to the threshold otherwise. The second bidder will compete against the first bidder when the initial offer is a debt offer or a cash offer smaller than the threshold, and will not compete when she observes a cash offer that is greater than the threshold.

The above described equilibrium satisfies three conditions:

1. Each bidder's strategy maximizes her expected payoff given the strategy of the other bidder.
2. The beliefs that bidder 2 has over the valuation of bidder L1 are credible. That is the equilibrium outcome is consistent with these beliefs.
3. Beliefs that are contingent on out of equilibrium offers must be credible.

Equilibria where the first raider offers a cash offer for an amount above the threshold and preempt bidding only in this case do not satisfy the third condition. In this case the second raider's beliefs are not consistent with the fact that first bidders that have valuations greater than the threshold find it more profitable to bid a price equal to the threshold when the second raider believes they belong to a subset of raiders that have valuations greater than the threshold.

The following results follow from the analysis of the equilibrium. As the probability of the target being profitable, represented here by the probability of the target observing a positive signal, increases it becomes harder to deter the second bidder. As a result there are fewer preemptive bids and a higher number of securities offers, even though these offers now present an insurance against a lower probability of a non-profitable acquisition. A decrease in the cost to the second bidder of obtaining a signal makes the price of competing lower to R2. The bid that R1 has to offer to preempt the second bidder from competing is therefore higher. In this case the first bidder offers securities more often and the expected payoff for the target is now higher, since the second bidder is preempted less often and the preemptive bid is higher. This is true as long as the expected payoff of the first bidder stays positive.

When the target observes its signal and releases truthful information about the profitability of the acquisition before the initial bid occurs the author obtains the following results:

1. Bids are observed only when the target's signal is positive and it is therefore more difficult to deter the second bidder.
2. The expected payoff of the first bidder decreases since the preemptive bid she has to pay is higher and the benefits of offering a debt offer and therefore also the signalling effect of the choice of the type of offer do not exist anymore.

3. The expected payoffs of both the second raider and the target increase. The second raider now does not consider non-profitable acquisitions and there are less preemptive bids and they require a higher bid price.

The last result suggests that the target should release information about the acquisition, which contradicts the actual behavior of targets that usually increase the cost of information acquisition for the raiders.

The model predicts a higher expected payoff for the first bidder in case of a cash offer but the expected payoff for the target contingent on the type of offer is not clear and depends on the model’s parameter values.

The paper also suggests that targets will reject securities offers more often than cash offers and that rejecting these offers is done to protect shareholders’ interests. To study such a hypothesis a comparison of the target’s share reaction to the rejection of an offer contingent on the type of offer should be made. Such studies show that the price increase of the shares of the target and the first bidder is higher for cash offers as opposed to a combined cash and securities offer (The author cites several of which: Asquith, Burner and Mullins, 1986 and Franks, Harris and Mayer, 1988).
Conclusion

The major papers we have looked at focus on a game theoretical approach to study the interaction among the players in a takeover. The asymmetry of information is crucial in all of these models. Most of the papers are analytical and help us understand the diverse forces that shape a takeover. They also indicate the diversity in the roles and rationale of takeovers. We now summarize the basic results of the papers we have looked at. In Grossman and Hart (1980), the free-rider problem can be solved either by introducing private valuations to the raiders, by the existence of a large shareholder in the target or by permitting the raider to discriminate against minority shareholders. The bids in the model by Hirshleifer and Titman (1990) can be perfectly revealing of the valuation of the bidders when the shareholders' reaction to bids is uncertain. In this context the higher is the bid the higher is the probability of its success. Shleifer and Vishny (1986a) argue that the existence of a large shareholder is beneficial to the small shareholders since he will be willing to invest in costly information gathering. Takeovers in the model by Scharfstein (1988) help decrease agency problems since the probability of a takeover increases when the target's management shirks. The management can then use anti-takeover defenses to protect itself from losing the private benefits of control. However, in the model by Shleifer and Vishny (1986b) the management acts in the shareholders' interest and uses greenmail payments to encourage more raiders to bid for the firm and secure a higher bid for the shareholders. Fishman (1988 and 1989) proves that bidders will try to discourage competition by the choice of their bid amount and of the type of their offer. Grossman and Hart (1988) find that the one share one vote design is optimal except in the case where private benefits of all the raiders are high. Finally, in the paper by Harris and Raviv
(1988), the management might change the capital structure of the firm to manipulate its ownership in the target and affect the takeover outcome.

There has been no theoretical paper that we know of, that studies the role of the employees in a takeover or the effect of takeovers on the employees and the bondholders. A paper by Shleifer and Summers (1987) has an analytical discussion of the importance of the role of takeovers in transferring surplus from the employees (the stakeholders) to the shareholders of the target firm. The paper discusses the way these transfers may be affecting the implicit contracts between the stakeholders and the target and conducts a case study of this issue. The paper, however does not model the transfer argument and does not incorporate it with the other important factors that govern the takeover process. There is no theoretical work on the effect of takeovers especially leverage buy-outs, on the bondholders of the target firm.
A MODEL OF THE ENTRY DECISION OF POTENTIAL RAIDERS INTO
THE BIDDING FOR A TARGET FIRM

Introduction

A corporate takeover is the result of a fight over the control of a firm. A raider identifies a potential target firm. The raider could be a large shareholder, a group of investors or the management of another firm that we call the acquiring firm. A target firm is a firm that the raider can potentially acquire at a price that is less than its value to him. The takeover process typically starts with the raider accumulating some of the target's shares. These shares will win him voting power and facilitate negotiation with management. The target firm's shares are more valuable to the raider than their market price, so he will gain by accumulating some of them at the pre-takeover market price. The raider will then need to recruit the right team for legal, financial and economic advice. He will need a researched study of the target firm and of the alternative ways to finance the deal. The costs associated with these services could be quite high. The raider then contacts the management of the target firm and tries to work out a deal with it. In case the management reacts negatively, the raider turns directly to the shareholders and offers to buy their shares at a specific price. At this point, other interested bidders might bid for the firm's shares, and the one offering the highest price will win control over the firm. Even though the costs of preparing the bid and researching the target firm might seem small, compared to the size of the expected benefits, there is always a chance the bid will be lost to another raider and all the defeated bidders incur a net loss.

Entering a bidding contest requires a certain cost that will be lost whatever is the outcome of the bidding, and therefore it is a sunk cost. The decision to become active in a takeover is a strategic decision. It will depend on the raider's expectations of winning the
bid, the price he has to pay to acquire the target firm and the sunk cost of entering. In the following, we would like to study how potential acquirers make the decision to enter into the bidding.

The setup we use is similar to the framework used by Bolton and Farrell (1989) in their paper, "Decentralization, Duplication and Delay." They draw a comparison between centralization and decentralization in an industry where decentralization has the advantage of using private information. They concentrate on entry decisions in a natural monopoly industry with a fixed cost for entry. Their basic model has two firms that are identical except for their fixed entry cost. Each firm possesses private information on its cost. Both firms want to avoid dual entry, since in this case they enter a Bertrand competition where they both earn zero profits. (They both have the same constant variable cost.) The firms have to decide when to enter the market, given that the only information they have on their rival's cost is that it belongs to a known fixed distribution. Given that the firm with a higher entry cost will incur a higher loss in case of dual entry, it will decide to postpone the entry decision to a later period, in a Bayesian Nash equilibrium. So in equilibrium, the firms with lower costs decide to enter first. Bolton and Farrell conclude that when the decision of entry is decentralized, so that each firm decides whether or not to enter, the firms can use their private information on costs. Therefore, the outcome is more efficient than when a central authority that has no information on costs decides which firm must enter.

The complication, that arises from using the framework of Bolton and Farrell in our context, is that the expected payoff to potential bidders in a takeover depends on the actual value of the target to the rival bidder. In case of dual entry in a takeover, the two entrants bid against one another and the one with the highest bid wins but has to pay the reservation price of his rival. The expected payoff of the entrant in a natural monopoly industry
depends on whether there is dual entry or not; it does not depend on the actual cost of entry
to the other entrant. Let us now look at the model in more detail.

The general model

We are looking at a model with two raiders, R1 and R2, interested in acquiring one
target firm. The firm is valued differently by each raider \( (v_1, v_2) \), and these values are
private information. Each raider knows the value of the firm to himself but does not know
the value of the firm to his rival. These valuations represent the difference between the
value of the firm to the raider and the market price of the firm. We assume that the raiders'
valuations are drawn from a common fixed and uniform distribution function \( F(v) \), defined
over a range \([v_{\min}, v_{\max}]\), that we normalize to be \([0,1]\). The distribution function is
common knowledge to all the raiders and to the management of the target.

As a raider decides to enter into the bidding, he incurs an entry fee that will be lost if the
raider loses the bid. A raider loses a bid, when another raider with a higher valuation
decides to enter at the same time. Potential bidders know perfectly the cost, \( s \), of entering
the bidding process, and the reservation price, \( x \), that is the minimum premium that the
management or the shareholders will accept to sell the firm (the management would be
ready to buy the firm at a premium \( x \)).

The model has \( n \) periods, and each bidder has to make a decision whether to enter into
the bidding and in which period to enter. Agents are risk neutral, so that the entry decision
of each raider will maximize his expected payoff given, his expectations of the valuation
and the action of the other raider. The decision to enter in a specific period is made at the
beginning of the period and cannot be reversed. After a bidder decides to enter, he
immediately incurs the cost \( s \), and then bids for the firm. If he is the only bidder, he wins
the firm for any bid with a premium that is greater than or equal to $x$. If there is another bidder, the two enter a bidding war and the one offering the highest price for the firm wins and ends up paying a bidding price equal to his rival's valuation of the firm (a first price ascending auction).

Any one bidder, depending on his valuation of the firm and his expectation of the other bidder's valuation, might choose to wait some time before deciding to enter the bidding since there is a chance that a bidder with a higher valuation would enter at the same time. He would want to avoid entering, paying $s$, and then being outbid. We assume for simplicity no discount rate. The introduction of a discount rate will favor a faster entry for both shareholders and bidders.

*The equilibrium of the game*

We want to prove the existence and analyze the properties of a set of cutoff points $(V_1, V_2, \ldots, V_n)$ over the range of the distribution function $(V_{\text{min}}, V_{\text{max}})$ that would have the following properties:

If $V_1 < v < V_{\text{max}}$, a raider with valuation $v$ will enter in the first period;

If $V_2 < v < V_1$, a raider with valuation $v$ will enter in the second period;

... Etc.;

If $V_n < v < V_{n-1}$, a raider with valuation $v$ will enter in period $n$ with $V_1 > V_2 > V_3$

This is depicted in Figure 2. Each raider, by following the above rule, should be maximizing his expected payoff given his beliefs and the strategy of the other player. We consider a symmetric equilibrium where both raiders will have the same decision rule.
The general model with the cutoff points for the entry decision

Figure 2 reflects the passage of time from left to right, where we start with period 1 and end with period \( n \).

These cutoff points will determine a Bayesian Nash equilibrium. The equilibrium is Bayesian since it incorporates the raiders' beliefs, which are then confirmed by the equilibrium outcome. It is a Nash equilibrium since each raider, with a valuation between any two cutoff points, would want enter in the period determined by the two cutoff points, assuming all the other raiders would respect the equilibrium structure (See Appendix 1 for proof).

We consider first the case where we have two raiders that have no ownership in the firm and look at the cases where \( n \) is equal to 1, 2 and \( \infty \). Next we turn to consider the case where one of the raiders is a large shareholder. And finally we look at welfare implications and the role of management.
The case of two raiders

A. A one period model

Let us first, discuss the situation where we have only one period and the raiders have to decide whether or not to enter that period. We want to determine which raiders would decide to enter the bidding and bid for the firm and which ones would decide not to. The bidding will proceed as follows. Each raider will start by bidding $x$ for the firm. If he has no rival, then he will get the firm for $x$. If there is another bidder who decides to enter, then the second bidder will bid the price higher, and the bidding will go on until one of the bidders reaches his actual valuation. At this point, it will not be profitable for him to bid a higher price. The other bidder acquires the firm, and pays for it the valuation of the loser.

Figure 3 represents the range for the raiders' valuations. We want to determine the valuations of the raiders that would enter and the ones that would not.

![Diagram](image-url)

Figure 3

The one period model

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**Proposition 1.** There exists a Bayesian Nash Equilibrium for the one-period game defined by the cutoff point z, where only the raiders with valuation greater than z decide to bid for the firm.

Let us determine the valuation of a raider that would be indifferent between entering and not entering. For such a raider the expected payoff from entering into the bidding should be equal to his expected payoff if he does not enter.

We set the valuation of such a raider to be z and we discuss how z is determined. The valuation of such a raider will be greater than (to the left of) x+s. That is because if his valuation was equal to x+s, his expected payoff if he enters would be less than zero and equal to:

\[(1-x-s) (-s) + (x+s) (x+s-x-s) = (1-x-s) (-s) < 0\]

The expression for the expected payoff can be explained as follows:

(1-x-s): the probability that the rival raider has a valuation greater than x+s, in which case such a raider would enter the bidding and win the bid.

(-s): The raider's payoff in this case. When a rival with a valuation higher than x+s enters the bidding, the raider with valuation x+s loses the sunk cost, s, that he paid to enter the bidding and does not gain anything from the bid.

(x+s): the probability of having a rival raider with valuation less than x+s. In this case no other raider enters and the raider with valuation x+s gains the firm.

(x+s-x-s): The raider's payoff when the raider with valuation x+s wins the firm, since he pays x to the shareholders to
acquire the firm and he had to pay \( s \) when he entered the bidding.

The expected payoff to entry is less than zero. Zero is the expected payoff of any raider, in particular of a raider with valuation \( x+s \), when he decides not to enter.

Since the expected payoff of a raider with valuation \( x+s \) is less than zero when he decides to enter, we expect the cutoff point between valuations of raiders that decide to enter and those that decide not to enter, \( z \), to be larger than \( x+s \).

The expected payoff of a raider with valuation \( z \) if he decides to enter is:

\[
(1 - z) (-s) + z (z-x-s),
\]

and \( z \) is determined by setting this expression equal to zero.

\[
(1 - z) (-s) + z (z-x-s) = 0
\]

Developing and simplifying we get:

\[
z^2 - xz - s = 0.
\]

Solving for \( z > 0 \), we get:

\[
z = \frac{x + \sqrt{x^2 + 4s}}{2}.
\]

The cutoff point, \( z \), where raiders with a valuation greater (smaller) than \( z \) enter (do not enter), defines a Bayesian Nash equilibrium. Each raider, given his beliefs and given that the other raider will follow the equilibrium rule defined by \( z \), will have an incentive to follow the equilibrium rule.
Proof:

Let us consider a raider with a valuation $z+y$, $y > 0$. The expected payoff for such a player if he decides to enter is:

$$(1-z-y)(-s)+y(z+y - \frac{z+y+z}{2})-s) + z(z+y-x-s)$$

This expected payoff is greater than the expected payoff of the player with valuation $z+y$ if he does not enter. That is because we already know that $(1-z)(-s) + z(z-x-s) = 0$.

Appendix 1 has a general proof where for any n-period model, a raider that has a valuation between two cutoff points, maximizes his expected payoff by entering the period defined by the two cutoff points.

Proposition 2. $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial s}$ are positive.

$$\frac{\partial z}{\partial x} = \frac{1}{2} + (x^2 + 4s)^{-1/2}(x)$$

$$\frac{\partial z}{\partial s} = 2(x^2 + 4s)^{-1/2}$$

The two derivatives are both positive. With bigger $x$ or $s$ we get a larger $z$, which indicates that fewer raiders will choose to enter.
B. A two-period model

We consider next a two period model. A raider must decide whether to enter the first period, enter the second period or not bid for the firm at all. The equilibrium has two cutoff points, \(z\) and \(w\), where a raider of type \(v\) (who has a valuation equal to \(v\)) decides to enter in the first period if \(v < z < 1\), in the second period if \(w < v < z\) and no one has entered in the first period, and not to enter at all if \(v < w\). The two cutoff points characterize a Bayesian Nash equilibrium, since each of the players will act according to the rule described above as long as he knows the other will do so, and the beliefs of the raiders are consistent with the equilibrium outcome. (Proof similar to the one for the general case in Appendix 1.)

We prove the existence and characterize the two points \(z\) and \(w\) that would satisfy the properties given above.

![Diagram](image)

Figure 5

The two-period model

We note again that the graphs representing the cutoff points are drawn in a decreasing order from left to right and that is to reflect the fact that the raiders with higher valuations will be the first to enter.
Claim 1: Both cutoff points are greater than \( x+s \)

Proof:

A bidder with valuation \( v \), with \( v < x+s \) will never want to enter since his expected payoff would always be negative. We want to prove that \( w > x+s \), so that a type with \( v=x+s+\mu \), \( \mu \) small enough, would have a negative expected payoff if he decides to enter. Suppose that \( x+s \) is the last cutoff point. A bidder with valuation \( x+s+\mu \) (\( \mu > 0 \), but small) will always choose to enter the second period. His expected payoff if he enters the second period, given that the distribution function for the valuations is uniform, is:

\[
f(\mu) = (z-(x+s+\mu))(-s) + ((x+s+\mu)-x-s)(x+s+\mu - \frac{(x+s+\mu)+(s+x)}{2}-s)+(s+x)(\mu),
\]

where:

- \((z-(x+s+\mu))\): the probability that the rival raider will enter in period 2 and that he will have a valuation higher than \( x+s+\mu \).
- \((x+s+\mu)-(s+x))\): the probability that the rival raider will enter in period 2 and that he will have a valuation lower than \( x+s+\mu \), given that \( x+s \) is the second cutoff point.
- \(\frac{(x+s+\mu)+(s+x)}{2}\): the expected valuation of the rival raider given that he will not enter in the second period, hence, by the definition of the equilibrium, that he will have a lower value than \( x+s+\mu \).
- \((s+x)\): the probability that no one enters in the second period

Simplifying we get:

\[
f(\mu) = (z-(x+s+\mu))(-s) + \mu(\frac{\mu}{2}-s)+(s+x)\mu
\]
As we approach $x+s$ from above, so that $\mu$ tends to zero, the expected value from entering becomes negative and equal to $(z-(x+s))(-s)$. The two cutoff points must therefore be both greater than $x+s$.

Next we prove the existence of such cutoff points and see how they relate to the takeover cost and to the reservation price. A raider with valuation $z$, is indifferent between entering the first or second period. The expected payoff for bidder of type $z$ if he enters the first period is:

$$(1-z)(-s) + z(z-s-x)$$

The expected payoff for bidder of type $z$ if he decides to enter the second period:

$$(1-z) 0 + (z-w)(z-\frac{z+w}{2} + s) + w(z-s-x)$$

$$(1-z):$$ the probability that his rival enters in period 1. In this case the bidding is over in period 1, and the payoff in period 2 is zero.

$(z-w):$ the probability that his rival decides to enter in the second period. He then wins the bid but expects to pay the valuation of his rival.

$w:$ the probability that his rival decides not to enter. He then wins the bid and pays $x$ for it.

Both expected payoffs should be equal at the cutoff point $z$.

A raider with valuation $w$, is indifferent between entering the second period or not entering at all (which gives him an expected payoff equal to zero). The expected payoff for $w$ if he enters the second period is:

$$(z-w)(s) + w(w-s-x).$$

So we obtain $z$ and $w$ by solving the following equations:

$$(1-z)(-s) + z(z-s-x) = (z-w)(z-\frac{z+w}{2} - s) + w(z-s-x) \tag{1}$$
and \[(z-w)(-s) + w(w-x-s) = 0\] (2)

Equation 2 implies:
\[z = \frac{w^2 - xw}{s}\] (3)

We note that the partial derivative of \(z\) with respect to \(w\) is equal to \(\frac{2w-s}{s}\) and it is greater than 1 for equilibrium values of \(w\). This implies that when both \(w\) and \(z\) increase due to an increase in one of the model's parameter values, the increase in \(z\) will be greater than the increase in \(w\). Therefore, the probability of having a raider that decides to enter the second period increases.

Equation 1 implies:
\[(z-w)(z-x-s)-(z-w)(z-s-\frac{z+w}{2})-s(1-z) = 0\]

Replacing for the value of \(z\) given in (3) we get:
\[\left(\frac{z^2-xw}{s} - w\right) \left(\frac{w^2-xw}{s} \right) - x) - s(1-\frac{w^2-xw}{s}) = 0\]

Developing we get:
\[(w^2-xw-s)(w^2+(s-xw-2xs)-2s^2(s-w^2+xw) = 0\]

Developing and then simplifying, we get:
\[w^4+w^2(-2x)+w^2(x^2-2xs+s^2)+w(2x^2s)-2s^3 = 0\] (4)

To obtain \(w\), we solve for it in (4) and then we replace \(w\) by its value in (3) to obtain \(z\).

Analysis of equations (3) & (4) and of the existence of the equilibrium

We first, want to check that our solution gives a \(z\) greater than \(w\). We have, \(w > x+s\) which implies that \(w^2-w(x+s) > 0\); therefore \(w^2-wx > ws\) and \(z = \frac{w^2-xw}{s} > \frac{ws}{s} = w\).
If both \( x \) and \( s \) go to 0, by equation (4) we have \( w^4 = 0 \), implying \( w = 0 \). When we have no takeover cost and no reservation price, any raider with a positive valuation for the firm will try to bid for it. If \( s \) goes to 0, we get:

\[
\begin{align*}
    w^4 - 2xw^3 + w^2x^2 &= 0 \\
    w^2(w^2 - 2xw + x^2) &= 0 \\
    w^2(w-x)^2 &= 0; \ w=0, \text{ or, } w=x.
\end{align*}
\]

As shown above \( w > x+s \), here \( w=x \) is the correct limit. Any raider with valuation smaller than \( x \), knows that he cannot take over the firm. Such a raider will not bid for the firm when the bidding cost is negligible but greater than zero, therefore we consider the solution \( w=x \) to be the relevant one here. All the bidders with valuations higher than \( x \) choose to enter, even if their chance of winning is small.

When \( x \) goes to zero, equation (4) becomes:

\[
w^4 + w^2s^2 - 2s^3 = 0.
\]

Solving for \( w^2 \) positive, we get:

\[
w^2 = \frac{s^2 + \sqrt{s^4 + 8s^3}}{2} > s^2.
\]

Intuitively, it is clear that a raider needs at least a valuation high enough to cover takeover costs. However, given the danger of being outbid and losing the takeover cost, \( w \) has to be bigger than \( s \), which implies that for any raider of value \( v \) to have an incentive to enter the bid at all \( v \), has to be strictly greater than \( s \). We also note that:

\[
\frac{w^2}{s^2} = \frac{-1 + \sqrt{1 + \frac{8}{s}}}{2}.
\]

Therefore \( \frac{w}{s} \) tends to infinity when \( s \) tends to zero. This implies that \( w \) will go to zero at a slower rate than \( s \).
**Proposition 3:** There exists a unique Bayesian Nash Equilibrium for the two period game with two raiders, the equilibrium is characterized by the two cutoff points, \( z \) and \( w \) where \( 1 > z > w > x+s \).

**Proof:**

We set \( g(w) \) as the expression in (4):

\[
g(w) = w^4 + w^3(-2x) + w(2x^2 - 2xs + s^2) + w(2x^2s) - 2s^3.
\]

Therefore \( g(w) = 0 \) is equivalent to (4).

From (4) we solve for \( w \) as a function \( \Delta \) of \( x \) and \( s \):

\[ w = \Delta(x,s). \]

Next we note that:

\[
g'(w) = 4w^3 - 6xw^2 + 2(x-s)^2w + 2x^2s
\]

\[
g''(w) = 12w^2 - 12xw + 2(x-s)^2
\]

We next study the three functions, \( g \), \( g' \) and \( g'' \), to check that equation (4) has a solution that is greater than \( x+s \).

\[ g''(w) \text{ is equal to zero for the two values,} \]

\[ w' = \frac{12x + [144x^2 - 96(x-s)^2]^{1/2}}{24} \]

and,

\[ w'' = \frac{12x - [144x^2 - 96(x-s)^2]^{1/2}}{24}. \]

Both solutions are smaller than \( x \) and \( g''(w) \) is convex, therefore \( g''(w) \) is positive for \( w > x+s \) (Figure 7). The function \( g'(w) \) starts at \( 2x^2s \) and increases until \( w = w' \), then it decreases until \( w = w'' \). For \( w > w' \), \( g'(w) \) is increasing but we do not know its sign. However, \( g'(x+s) = 6s^2(x+s) - 2s^2x \) and it is positive, therefore \( g'(w) \) will be positive for \( w > x+s \), since \( g''(w) \) is positive for \( w > x+s \).

\[
g(0) = -2s^3
\]

\[
g(x+s) = (x+s)^4 + (x+s)^3(-2x) + (x+s)^2(2x^2 - 2xs + s^2) + (x+s)2x^2s - 2s^3
\]

\[
= (x+s)^3(x+s - 2x) + (x+s)(s-x)^2 + 2s[(x+s)x^2 - s^2]
\]
\[\begin{align*}
    &= (x+s)^2 (s-x)(x+s+s-x) + 2s[(x+s)x^2-s^2] \\
    &= 2s[(x+s)^2(s-x) + (x+s)x^2-s^2] \\
    &= 2s[s^2x+s^3-s^2] = 2s^3(x+s-1) < 0
\end{align*}\]

g(w) starts by increasing until \(g'(w)\) becomes negative. We do not know the precise value of \(w\) at which \(g(w)\) starts decreasing, but it is a value between \(w'\) and \(w''\). When \(g'(w)\) becomes positive, \(g(w)\) starts increasing again. We are not sure of the value of \(w\) at this point either, but we know that at \(w = x+s\), \(g(w)\) is still negative, and we will prove that \(g(w)\) will be positive for \(w=1\). Figures 6 and 7 depict how \(g(w)\) and \(g''(w)\) vary over \(w\).

Figure 6

Illustration of the function \(g(w)\)
Figure 7

Illustration of the function $g''(w)$

Table 1: Topology of the functions $g$, $g'$, $g''$

<table>
<thead>
<tr>
<th>$w$</th>
<th>$X + S$</th>
<th>$h(x) = 1 - \frac{2x + (x - s)^2 + 2x^2s - 2s^3}{(x-s)^2 + 2x^2s - 2s^3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$g(w)$</td>
<td>$2S^3(X + S - 1)$</td>
<td>NEGATIVE</td>
</tr>
<tr>
<td>$g'(w)$</td>
<td>$6S^2(X + S) - 2S^2x$</td>
<td>POSITIVE</td>
</tr>
<tr>
<td>$g''(w)$</td>
<td>POSITIVE</td>
<td>POSITIVE</td>
</tr>
<tr>
<td>$g'''(w)$</td>
<td>POSITIVE</td>
<td>POSITIVE</td>
</tr>
</tbody>
</table>
If \( w=1 \), \( g(1) = 1-2x+(x-s)^2+2x^2s-2s^3 \). Table 1 depicts the changes in the sign of the functions \( g, g', g'' \) within the range \([x+s, 1]\), since it is the range we are interested in. We have just seen that \( g''(w) \) is positive for \( w>w'' \), and we know that \( w'' < x+s \). \( g'(x+s) \) is positive, therefore \( g(w) \) is increasing for \( w>x+s \). \( g(x+s) \) is negative, therefore solution for \( g(w) = 0 \) exists only if \( g(1) \) is greater than or equal to zero. We call the expression \( g(1), h(x) \), and we study the sign of this expression for \( x \) between 0 and 1-s. We are assuming that \( x+s \) is smaller than 1, since otherwise no raider would be interested in bidding for the firm.

**Claim 2:** \( h(x) \) is always positive for values of \( x \) and \( s \) where \( x+s < 1 \).

**Proof:**

\[
\begin{align*}
g(1) &= h(x) = 1-2x+(x-s)^2+2x^2s-2s^3 \\
h'(x) &= -2+2(x-s)+4xs \\
h''(x) &= 2+4s > 0. \\
h(0) &= 1+s^2-2s^3 > 0 \text{ and, } h(1-s)=0. \\
h'(0) &= -2-2s< 0 \text{ and, } h'(1-s)=-4s^2 < 0 .
\end{align*}
\]

Table 2 explains how we expect the sign for \( h(x), h'(x) \) and \( h''(x) \) to vary over the range of \( x \) (0, 1-s), and Figure 8 illustrates how \( h(x) \) is positive for \( x<1-s \). For the relevant values of \( x \), \( h(x) \) will always be positive implying that \( g(w) \) will always be equal to zero for some \( w \). For every given value of \( x \) and \( s \) with \( x+s <1 \), we find a unique solution for the Bayesian Nash equilibrium in the two period game.
Table 2: Topology of the functions $h, h', h''$

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>$1-s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h(x)$</td>
<td>POSITIVE</td>
<td>$0$</td>
</tr>
<tr>
<td>$h'(x)$</td>
<td>$-2-2S$</td>
<td>NEGATIVE</td>
</tr>
<tr>
<td>$h''(x)$</td>
<td>POSITIVE</td>
<td>$2 + 4s &gt; 0$</td>
</tr>
</tbody>
</table>

Figure 8

Illustration of the function $h(x)$
Properties of the equilibrium in the two period game

Having an implicit function for \( w \), we calculate next the partial derivatives of \( w \) with respect to \( s \) and \( x \) in order to study the variation of the cutoff points as we vary the value of \( x \) and \( s \). We define \( \Delta(x,s) \) and \( f(x,s) \) as the solutions for \( w \) and \( z \) in (3) and (4). Implicit partial differentiation of (4) with respect to \( x \) yields the following expression:

\[
\frac{d\Delta}{dx} = \frac{2w^3 - 2w^2(x-s) - 4wx}{4w^3 - 6w^2x + 2(x-s)^2w + 2x^2s}
\]  \( (4a) \)

**Proposition 4**: \( \frac{d\Delta}{dx} > 0 \).

As the fixed cost for entering into the bidding for the target increases, the probability that a raider will enter increases.

**Proof**: We prove that both the numerator and the denominator of (4a) are positive for the relevant values of \( w \).

Let \( L(w) = 2w^3 - 2w^2(x-s) - 4wx = 2w^2(w-x) + 2ws(w-2x) \).

We have proved that \( w \) is greater than \( x+s \) and now we show that \( L(w) \) is greater than zero for \( w>x+s \) (which implies it is positive at the values that solve for (4)). When \( w=x+s \), we substitute for \( x \) and get:

\[
L(w) = 2w^2(w-w+s)+2ws(w-2w+2s) = 4ws^2,
\]

a positive value. Since \( L(w) \) is increasing in \( w \), \( L(w) \) will be positive for any \( w \), with \( w>x+s \). Now we set

\[
P(w) = 4w^3 - 6w^2x + 2(x-s)^2w + 2x^2s, \text{ then}
\]

\[
P'(w) = 12w^2 - 12wx + 2(x-s)^2, \text{ so } P'(w) \text{ is positive}
\]
For \( w=0 \), \( P(w) = 2x^2s \) and it is positive. Given that \( P(w) \) is increasing in \( w \), \( P(w) \) will take on only positive values.

**Proposition 5:** \( \frac{d\Delta}{ds} > 0 \), for \( 1 > x > s > 0 \). As the fixed cost for entering into the bidding for the target increases, the probability of entry decreases.

**Proof:** The implicit partial differentiation of equation (4) with respect to \( s \) yields:

\[
\frac{d\Delta}{ds} = \frac{2w^2(x-s)+6s^2-2x^2w}{4w^3-6w^2x+2(x-s)^2w+2x^2s} \quad (4b)
\]

We prove that the numerator of (4b) is positive.

We set \( K(w) = 2w^2(x-s)+6s^2-2x^2w \), therefore

\[K'(w) = 4w(x-s)-2x^2\]

and

\[K''(w) = 4(x-s) \text{ positive for } x > s.\]

**Claim 3 :** \( K(w) \) is positive for all the values of \( x \) and \( s \) where \( x>s \).

**Proof:** We can prove that \( K(w,x,s) \) will be positive for the values of \( w \) at equilibrium and \( x>s \) or \( s>1/3>x \). We study the polynomial \( K(w/x,s) \). When \( x>s \) the polynomial can be represented by a convex curve with two roots (Figure 9). In the case where \( s=0 \), \( K(w/x,0)=w^2x-x^2w \) therefore the function will be equal to zero for the values \( w=x,0 \) and the curve is as represented in (Figure 10). We next calculate \( K(x+s) \) and \( \frac{dK(x+s)}{ds} \).
Illustration of the function $K(w/x,s)$, for $x>s$

$$K(x+s) = 2(x+s)^2(x-s) + 6s^2 - 2x^2(x+s) = 2s^2(-x-s+3)$$

$$\frac{dK(x+s)}{ds} = 4s(-x-s+3) - 2s^2 = -6s^2 - 4xs + 12s$$

Both $K(x+s)$ and $\frac{dK(x+s)}{ds}$ are positive whatever the values of $x$ and $s$. It follows that

$K(w/x,s) > K(x+s/x,s)$ for $w>x+s$ and $x>s>0$, and

$K(x+s/x,s) > K(x/x,0)$ for $s>0$ (see Figure 10).

Therefore $K(w/x,s)>0$ for $w>x+s$ (which is the range for our solution at the equilibrium) and $x>s$. We consider the condition $x>s$ to be consistent with the economic meaning of the two parameters $x$ and $s$. However we would like to note that we can include the range of $s>x>1/3$ for the following reason. In the case $s>x$, $K(w)$ will represent a family of curves that are convex and with the general shape represented in (Figure 11). The maximum value that $w$ can take in our context is 1. The function $K(w=1) = 3s^2 - s + (x-x^2)$ is greater than 0.
Figure 10

Illustration of the function $K(w)$, for $s$ less than, bigger than, and equal to 0, and $x>s$

Figure 11

Illustration of the function $K(w)$, for $s>x$
for the values of s >1/3, (3s^2-s>0). Since w will be smaller than 1 and we know that K(w=0) is greater than zero, the condition s>x>1/3 will insure a positive K(w) for 0<w<1.

We now study what happens to the first cutoff point. Are we going to have more or less raiders entering in the first period as x or s increases?

**Proposition 6:** When f is the solution for the first cutoff point in the two periods game, \( \frac{df}{dx} > 0 \). As the reservation price for the target increases, some raiders that used to enter in the first period will now wait for the second period to enter.

**Proof:** At equilibrium, \( z = f(x,s) = \frac{w^2-xw}{s} \) therefore,

\[
\frac{df}{dx} = \frac{1}{s} \left[ 2w \frac{d\Delta}{dx} - x \frac{d\Delta}{dx} - w \right].
\]

To prove that \( \frac{df}{dx} \) is positive we need to check whether \( \frac{d\Delta}{dx} > \frac{w}{2w-x} \).

The condition \( \frac{d\Delta}{dx} > \frac{w}{2w-x} \) is equivalent to:

\[
(2w-x)(2w^3-2w^2(x-s)-4wx) > w(4w^3-6w^2x+2(x-s)^2w+2x^2s).
\]

Developing and simplifying we get:

\[
4w^3s-w^2(6xs+2s^2)+2wxs^2 > 0,
\]

which is equivalent to

\[
w(2w^2-w(3x+s)+x^2) > 0,
\]

a condition that is true since

\[
2w^2-w(3x+s)+x^2 = (w-x)^2 + w(w-x-s)
\]

which is a positive expression for w>x+s.

**Proposition 7:** \( \frac{df}{dx} > 0 \). As the reservation price for the target increases, the probability of a raider entering in the first period decreases.

The derivative of f with respect to s, \( \frac{df}{ds} \), is equal to:

\[
\frac{1}{s^2} \left[ 2w \frac{d\Delta}{ds} - x \frac{d\Delta}{ds} \right] s - (w^2-xw)
\]
Therefore we need to check that \( \frac{d\Delta}{ds} \) is greater than \( \frac{w^2-xw}{2ws-xs} \).

\[
\frac{d\Delta}{ds} > \frac{w^2-xw}{2ws-xs} \quad \text{implies that} \quad \frac{2w^2(x-s)+6s^2-2x^2w}{4w^3-6w^2x+2(x-s)^2w+2x^2s} > \frac{w^2-xw}{2ws-xs}
\]

We therefore study the sign of the following expression:

\[
(4w^3-6w^2x+2(x-s)^2w+2x^2s) (w^2-xw) \cdot (2w^2(x-s)+6s^2-2x^2w) \cdot (2wx-xs) = -2w^5 + 3w^4 + 2w^3x^4 - 4w^3x^2 - 6w^2x^2s + 2w^2xs^2 + 2w^2x^3s + 6ws^3 + 2wx^3s - 3xs^3.
\]

(4c)

We could not sign the expression (4c) since we have no explicit expression for \( w \).

However when \( s \) becomes very small and approaches 0, \( w \) approaches \( x \), and the expression in (4c) is equal to:

\[
-2x^5 + 3x^4 + 2x^5 - 4x^5 + x^5 = 0
\]

When \( x \) approaches zero (4c) is equal to:

\[
-2w^5 + 3w^4 - 3w^3s^2 + 6ws^3
\]

and \( w \) at equilibrium is greater than \( s \) but close to it, therefore we expect the expression to be positive. As both \( x \) and \( s \) approach zero, so will \( w \) but at a slower rate and the expression (4c) is equal to:

\[
-2w^5 + 3w^4
\]

and it is positive.

An infinite horizon Model

Here we study the equilibrium in the case of an infinite number of periods as it is depicted in Figure 12.
In the two-period model, we proved that a type with a valuation (x+s) would always choose not to enter, so that the last cutoff point is w, with w>x+s. Here we show that for a large number of periods, a raider with a valuation greater than or equal to x+s would eventually choose to enter the bidding, so that the cutoff points converge to x+s. The probability of a rival entering, as well as his expected valuation, become very small as the number of periods increases given that there has been no previous entry. At the limit the expected payoff from entering for a raider of type (x+s) is 0. It is clear that any bidder with a smaller value than x+s will not choose to enter. What we need to prove is that a type with a value greater than x+s will eventually choose to enter as time passes, if no other raider has already entered in previous periods.

Proposition 8: In an infinite period model, all the raiders with valuations greater than x+s will eventually decide to enter.

Proof: Assume that V*, with V*> x+s, is the lower bound of the decreasing series of the V_n's that are the cutoff points of an \( \infty \)-periods model. V* is therefore the cutoff point between the valuations of the raiders that enter and those that do not enter. A raider with valuation V* should be, as the number of periods increases, indifferent between entering
and not entering. The expected payoff for such a raider from entering in period \( T \) is equal to:

\[
(V_{T-1} - V_T)(-s) + V_T(V^*-x-s).
\]

As \( T \) approaches \( \infty \), \( \lim_{T \to \infty} V_T = V^* \) and this expected payoff is equal to \( V^*(V^*-x-s) \) and should be equal to 0. Therefore \( V^* \) is equal to \( x+s \).

**Determining the equation for the cutoff points in an \( \infty \) period model**

Any cutoff point \( V_n \) must satisfy the following equality: a raider with valuation \( V_n \) must be indifferent between entering in period \( n \) and entering in period \( n+1 \).

\[
(V_{n-1} - V_n)(-s) + V_n(V_n-x-s) = V_{n+1}(V_n-x-s) + (V_n-V_{n+1})(V_n - \frac{V_n+V_{n+1}}{2})(-s)
\]

(5)

Equation 5 is the general equation that links any cutoff point \( V_n \) to \( V_{n-1} \) and \( V_{n+1} \) in order for these points to satisfy the properties of the equilibrium. In addition we have \( V_0 = 1 \) and the limit of \( V_T \) as the number of periods approaches infinity is \( x+s \). We should be able to determine the values of all the cutoff points. We develop equation 5 to get:

\[
\frac{V_n^2}{2} - \frac{V_{n+1}^2}{2} - s(V_{n-1}-V_n)x(V_n-V_{n+1}) = 0
\]

(6)

Equation 6 is true for every \( V_n, V_{n+1}, \ldots, \text{etc...} \)

For \( V_n \):

\[
\frac{V_n^2}{2} - \frac{V_{n+1}^2}{2} - s(V_{n-1}-V_n)x(V_n-V_{n+1}) = 0
\]

For \( V_{n+1} \):

\[
\frac{V_{n+1}^2}{2} - \frac{V_{n+2}^2}{2} - s(V_n-V_{n+1})x(V_{n+1}-V_{n+2}) = 0
\]

For \( V_{n+2} \):

\[
\frac{V_{n+2}^2}{2} - \frac{V_{n+3}^2}{2} - s(V_{n+1}-V_{n+2})x(V_{n+2}-V_{n+3}) = 0
\]

For \( V_{n+m} \):

\[
\frac{V_{n+m}^2}{2} - \frac{V_{n+m+1}^2}{2} - s(V_{n+m-1}-V_{n+m})x(V_{n+m}-V_{n+m+1}) = 0
\]

Summing all equations 6 for all \( V_{n+i} \), \( i \) between 0 and \( m \), we get the following equation:
\[ \frac{V_n^2}{2} - \frac{V_{n+m+1}^2}{2} - s(V_n-V_{n+m}+x(V_n-V_{n+m+1})) = 0 \] (7)

We now want to use our two border conditions. Equation (7) is true for any value of \( m \) and \( n \). When \( m \) tends to infinity, \( \lim(V_{n+m}) = x+s = \lim(V_{m+n+1}) \), and the limits of both sides of (7) become:

\[ \frac{V_n^2}{2} - \frac{(x+s)^2}{2} - s(V_n-x-s) - x(V_n-x-s) = 0 \] (8)

Equation (8) represents a relation between any \( V_n \) and \( V_{n-1} \) and it is true for all \( n \)'s.

**Determining an explicit solution for the first cutoff point**

We can now get an equation for \( V_1 \) given that \( V_0=1 \).

\[ \frac{V_1^2}{2} - \frac{(x+s)^2}{2} - s(1-x-s) - x(V_1-x-s) = 0 \] (9)

Solving for \( V_1 \) greater than \( x+s \), we will get

\[ V_1 = x + \sqrt{2s-2xs-s^2} \]

As an illustration, for \( x = 0.4 \) and \( s = 0.1 \) we get \( V_1 = 0.7316 \).

**Proposition 9:** \( \frac{dV_1}{dx} \) and \( \frac{dV_1}{ds} \) are positive.

**Proof:** We can study the effect of \( x \) and \( s \) on \( V_1 \) by calculating the partial derivatives.

First with respect to \( x \), the reservation price:

\[ \frac{dV_1}{dx} = \frac{(V_1-x-s)}{(V_1-x)} \cdot \]

This derivative is positive because \( V_1 > x+s \).
With respect to s, the takeover cost: \( \frac{dV_1}{ds} = \frac{1-x-s}{V_1-x} \), and this is also positive for \( V_1 > x+s \).

As \( x \) or \( s \) increases, the first cutoff point increases. The probability that a raider enters in the first period decreases but the expected valuation of such a raider increases.

**Proposition 10:** \( \frac{dV_n}{dx} > 0 \)

**Proof:** To study the effect of \( x \) on any general cutoff point \( V_n = f(V_{n-1}, x, s) \), we look at the derivative of \( V_n \) with respect to \( x \):

\[
\frac{dV_n}{dx} = \frac{\partial V_n}{\partial V_{n-1}} \cdot \frac{\partial V_{n-1}}{\partial x} + \frac{\partial V_n}{\partial x}.
\]

keeping \( x \) and \( s \) constant and using (8) we have: \( \frac{\partial V_n}{\partial V_{n-1}} = \frac{s}{V_n-x} \). We know \( V_n \) is greater than \( x+s \), so this derivative will be positive. The partial derivative of \( V_n \) with respect to \( x \), \( \frac{\partial V_n}{\partial x} = \frac{V_n - x - s}{V_n - x} \) is greater than 0 for \( V_n > x+s \). Given that \( \frac{dV_1}{dx} \), \( \frac{\partial V_n}{\partial V_{n-1}} \) and \( \frac{\partial V_n}{\partial x} \) give positive values, \( \frac{dV_n}{dx} \) will be positive.

With an increase in \( x \), the cutoff points increase and we would expect more waiting on average.

**Proposition 11:** \( \frac{\partial V_n}{\partial s} > 0 \)

**Proof:** \( \frac{dV_n}{ds} = \frac{\partial V_n}{\partial V_{n-1}} \cdot \frac{\partial V_{n-1}}{\partial s} + \frac{\partial V_n}{\partial s} \) and we have seen that \( \frac{\partial V_n}{\partial V_{n-1}} \) is positive. The partial derivative of \( V_n \) with respect to \( s \), keeping \( V_{n-1} \) and \( x \) constant is equal to:

\[
\frac{\partial V_n}{\partial s} = \frac{V_{n-1} - x - s}{V_n - x} > 0.
\]

Given that:

\[
\frac{dV_1}{ds}, \frac{\partial V_n}{\partial V_{n-1}}, \frac{\partial V_n}{\partial s} \]

are positive, \( \frac{dV_n}{ds} \) will be positive.
As the takeover cost increases the cutoff points increase. We expect more delay and the probability of entry decreases.
THE LARGE SHAREHOLDER AS A RAIDER

Introduction

Most companies have large shareholders that could be potential raiders, and most raiders accumulate a certain percentage of the target's shares before bidding for it. In the following section, we study the role of a large share ownership by a potential raider in our framework.

When a large shareholder/raider who has a valuation greater than \( x \) decides to enter, he will obtain a payment at least equal to his valuation times the percentage of shares he owns in the target. Therefore his loss in case he loses the bid is equal to \( s \) minus the value of these payments, and it is less than the loss of a raider that owns no shares in the firm. A large shareholder will also need to accumulate fewer shares in order to win the bid. He would profit from competition among other raiders when he does not enter the bidding, but would want to discourage raiders from entering otherwise.

A raider, knowing that he might be competing against a large shareholder, takes into consideration the fact that his rival will be willing to enter faster on average. The large shareholder's loss from dual entry is smaller than the loss of a raider with no ownership in the firm.

We now address the problem formally. We look at a situation where we have two potential raiders: \( R \), the raider with no ownership in the target firm and; \( L \), a large shareholder in the firm. The raider knows of the existence of the large shareholder and knows \( \beta \), the percentage of ownership she has in the firm. There is an asymmetry among the two potential bidders. Since \( L \) owns some shares in the target firm, we expect her to have different cutoff points from \( R \). When making the decision of entry, \( L \) takes account
of her ownership in the firm. When she bids for the firm, she needs to acquire less shares than R to win. If she loses the bid to R, L still receives some premium on the shares she owns.

A one period model

We consider the case of two raiders, R and L(β), where L is a large shareholder that owns a fraction β of the firm, in a one period model, where L and R have to decide whether or not to enter. We expect L and R to have different cutoff points.

Proposition 12: The cutoff point for R will be greater than the cutoff point for L in the one period case.

Proof: We can see that if L has a valuation equal to the cutoff point for R, L would enter the bidding. Let us consider that R has a cutoff point equal to z. If L has a valuation equal to z, then L's expected payoff if she decides to enter will be:

\[(1-z)(-s+βz) + z(z-(1-β)x-s),\]

where:

\[(1-z): \text{ the probability that R will enter and in this case he will have a valuation greater than } z,\]

\[(-s+βz): \text{ the payoff for L when there is double entry, the probability that R does not enter is equal to } z \text{ and the payoff for L in this case is equal to } (z-(1-β)x-s).\]

Her expected payoff if she decides not to enter will be equal to \((1-z)βx\), where \((1-z)\) is the probability that R enters and in this case L gets a payoff equal to βx. Given that:
(1-z)(-s) + z(x-s) = 0 by the definition of z, the expected payoff for L if she enters will be greater than her expected payoff if she does not enter. Therefore, the cutoff point for the large shareholder will be bigger than (to the right of) the one for the raider.

We now determine the equations for the two cutoff points $z_R$ and $z_L$ respectively for R and L. These cutoff points are illustrated below, in Figure 13.

![Diagram](image)

Figure 13

A one period model with a large shareholder

$z_L$ is the valuation of a raider/shareholder that is indifferent between entering and not entering. Therefore it should satisfy the following equation:

$$ (1-z_R)(-s+\beta z_L) + z_R(z_L-(1-\beta)x-s) = (1-z_R)\beta x $$ (10)

where:

$(1-z_R)$: the probability that R enters. In this case he will have a higher valuation than L.

$(-s+\beta z_L)$: the payoff for L in case R enters.

$z_R$: the probability that R does not enter.
\[(z_L - (1 - \beta) x - s): \text{ the payoff for } L \text{ in case } R \text{ does not enter.}\]

\[(1 - z_R): \text{ the probability that } R \text{ makes a bid.}\]

\[\beta x: \text{ the expected payoff for } L \text{ when } R \text{ enters.}\]

\[z_R \text{ is the valuation of a raider that is indifferent between entering and not entering.}\]

Therefore the following equation must hold:

\[(1 - z_R)(s) + (z_R - z_L)(z_R - \frac{z_R + z_L}{2})(s) + z_L(z_R - x)(s) = 0 \quad (11)\]

\[(1 - z_R)(s): \text{ the probability that } L \text{ enters and that she has a valuation}\]

\[\text{higher than } z_R, \text{ multiplied by the loss for } R \text{ in this case.}\]

\[(z_R - z_L)(z_R - \frac{z_R + z_L}{2})(s): \text{ the probability that } L \text{ enters and that she has a valuation}\]

\[\text{smaller than } z_R, \text{ multiplied by the payoff for } R \text{ in this case}\]

\[z_L(z_R - x)(s): \text{ the probability that } L \text{ does not enter, multiplied by the payoff}\]

\[\text{for } R \text{ from entering. In this case, the expected payoff for } R \text{ when he decides not to enter is equal to } 0.\]

Developing and simplifying the equations we get:

\[z_L = x + \sqrt{x^2 + 2s - z_R^2} \quad (12)\]

\[z_L = \frac{s + \beta x - x(2\beta x - 1)z_R}{\beta + (1 - \beta)z_R} \quad (13)\]

We note that the derivatives for \(z_R\) and \(z_L\) with respect to \(\beta\) will have opposite signs and that we must have \(1 > z_R^2 > x^2 + 2s - z_R^2 > 0\) since \(z_R > z_L\). Therefore \(x^2 + 2s < 2z_R^2\).

Equating (12) and (13) we get equation (14):

\[\beta x z_R^s + (\sqrt{x^2 + 2s - z_R^2})(\beta + (1 - \beta)z_R) = 0 \quad (14)\]
If we set $\beta=0$, the solution we obtained in the case of two raiders would solve equation (14).

**Proposition 13**: $\frac{\partial z_R}{\partial \beta}$ and $\frac{\partial z_L}{\partial \beta}$ will have opposite signs. $\frac{\partial z_R}{\partial \beta}$ is positive and $\frac{\partial z_L}{\partial \beta}$ is negative, when $\beta$ tends to 0 or 1. We expect that $\frac{\partial z_R}{\partial \beta} > 0$ and $\frac{\partial z_L}{\partial \beta} < 0$, for $1 > \beta > 0$.

**Proof**: We partially differentiate equation (14) with respect to $\beta$ and we obtain the following expression for $\frac{\partial z_R}{\partial \beta}$:

\[
\frac{\partial z_R}{\partial \beta} = \frac{-xz_R - (x^2+2s-z_R^2)^{1/2} + z_R (x^2+2s+z_R^2)^{1/2}}{\beta x - 2 \beta z_R (x^2+2s+z_R^2)^{1/2} + (1-\beta)(x^2+2s-z_R^2)^{1/2} - 2(1-\beta)z_R^2 (x^2+2s-z_R^2)^{-1/2}}
\] (15)

The nominator in expression (16) is negative. The denominator is negative in both cases where $\beta$ is equal 0 and 1. In addition, we note that solving for $z_L$ in (13) will give a smaller value for $\beta=1$ than for $\beta=0$. For $\beta=1$, $z_L$ has a value less than $x+s$; the condition for the large shareholder's cutoff point at equilibrium is now $z_L > (1-\beta)x+s$. Both functions for $z_L$ and $z_R$ are continuous in $\beta$, and $\frac{\partial z_L}{\partial \beta}$ will have the opposite sign of $\frac{\partial z_R}{\partial \beta}$.

Given the information above, the dotted lines in Figure 14 depict approximately the movement in the two cutoff points as $\beta$ increases. They both start at the same value when $\beta$ is equal to zero; as $\beta$ increases, $z_R$ increases and $z_L$ decreases. When we set $\beta=1$, $z_L$ is less than $x+s$ as shown in Figure 14.
Figure 14

Illustration of the expected changes in the cutoff points of R and L as β changes in the one period model

Proposition 14: \( \frac{\partial z_R}{\partial x} \) and \( \frac{\partial z_R}{\partial s} \) are positive for β approaching 0 and 1.

Proof:
\[
\frac{\partial z_R}{\partial x} = \frac{-\beta z_R^2 - 2x(\beta + (1-\beta)z_R)(x^2 + 2s - z_R^2)^{-1/2}}{\beta x - (x^2 + 2s - z_R^2)^{-1/2}(2z_R^2(1-\beta) + 2z_R \beta) + (1-\beta)(x^2 + 2s - z_R^2)^{1/2}}
\]

Expression (16) has a negative nominator, and it has a negative denominator for β approaching 0 and 1, at equilibrium. Therefore \( \frac{\partial z_R}{\partial x} \) is positive for β equal to 0 and 1, but we could not sign it for intermediate values of β.

\[
\frac{\partial z_R}{\partial s} = \frac{1-2(\beta + (1-\beta)z_R)(x^2 + 2s - z_R^2)^{-1/2}}{\beta x - (x^2 + 2s - z_R^2)^{-1/2}(2z_R^2(1-\beta) + 2z_R \beta) + (1-\beta)(x^2 + 2s - z_R^2)^{1/2}}
\]
therefore:
\[
\frac{\partial z_R}{\partial s} = \frac{1-2(\beta+(1-\beta)z_R)(x^2+2s-z_R^2)^{-1/2}}{-\beta z_R - 2x(\beta+(1-\beta)z_R)(x^2+2s-z_R^2)^{-1/2}} \frac{\partial z_R}{\partial x}
\] (17)

\[\frac{\partial z_R}{\partial s}\] is positive for \(\beta\) approaching 0 and 1, but we could not sign it for intermediate values of \(\beta\).

**Proposition 15:** We expect \(\frac{\partial z_R}{\partial x}\), \(\frac{\partial z_R}{\partial s}\), \(\frac{\partial z_L}{\partial x}\) and \(\frac{\partial z_L}{\partial s}\) to be positive for \(1>\beta>0\). We could not provide a formal proof for proposition 15. The calculations for the derivatives of \(z_L\) with respect to \(x\) and \(s\) proved to be very complicated, and we could not determine the signs even when we consider extreme cases as \(\beta = 0\) and 1. We do however, expect the derivatives of both cutoff points with respect to \(x\) and \(s\) to be positive. The introduction of a large shareholder affects the relationship between the cutoff points and, \(x\) and \(s\), only quantitatively and not qualitatively. We do however expect that a change in \(x\) or \(s\) will affect \(R\) more than \(L\), because of \(L\)'s large shareholding. The dotted lines in Figure 15 depict how we expect the derivatives of the cutoff points with respect to \(x\) and \(s\) to vary, as we vary \(\beta\). Both derivatives are equal for \(L\) and \(R\) when \(\beta=0\). As \(\beta\) increases, the derivatives of \(R\)'s cutoff point with respect to both \(x\) and \(s\) increase, and the derivatives of \(L\)'s cutoff point decrease.

**Two-period model**

Now we turn to a two-period model and characterize the two pairs of cutoff points for the large shareholder \(L\) and the raider \(R\). Each potential bidder will decide on the time of entry depending on his valuation, and the expected time of entry and expected valuation of his rival.
Illustration of the expected changes in the derivatives of the cutoff points as $\beta$ increases in the one period model.

To determine the equations for the cutoff points we must first determine the relative positions of these cutoff points. The decision to enter depends on the probability that another raider enters and whether he will have a higher or lower valuation. Therefore it depends on where are the cutoff points of the rival raider. To illustrate this, let us look at the case of a raider with valuation $z_R$, who is indifferent between entering in the first period or the second. The probability that he loses the bid if he enters in the first period is $(1-z_R)$ when $z_L$ (the valuation of $L$ when she is indifferent between entering in the first or the second period) is to the right of $z_R$, and it is $(1-z_L)$ when $z_L$ is to the left of $z_R$.

Depending on how they are positioned, each configuration of the cutoff points will determine a different equilibrium. We choose the order where the cutoff points for $L$, $Z_L$ and $W_L$ to be respectively smaller than (to the right of) the cutoff points for $R$, $Z_R$ and $W_R$ (as illustrated in Figure 16).
This order seems to be intuitively appealing to us since, due to the percentage he owns in the target, the large shareholder will be willing to enter faster and assume a greater risk of possible competition. We present a more formal discussion of our choice at the end of this section.

Assuming the positions indicated in Figure 16, we present a tree for the possible decisions by L and R, and the expected outcome, \( y \), of such decisions.

- **R enters**
  - **L enters** \( v_L > v_R, y = -s \)
  - **L.d.n. enter** \( v_L < v_R, y = v_R - v_L - s \)

- **L.d.n. enter**
  - **L enters** \( y = v_R - x - s \)
  - **L.d.n. enter** \( y = 0 \)

- **R d.n. enter**
  - **L.d.n. enter** \( y = \text{Expected payoff for the next period} \)
\[ v_L > v_R, \quad y = v_L^{-1-\beta}v_R^{-s} \]
\[ v_L < v_R, \quad y = \beta v_L \]
\[ y = v_L^{-(1-\beta)x-s} \]
\[ y = \beta x \]
\[ y = \text{Expected payoff for the next period} \]

The equations that determine the cutoff points in the two-periods model with one raider and one raider/large shareholder

We now specify the equations that will determine the four cutoff points.

The valuation of a raider that is indifferent between entering in the first period or the second period is \( z_R \). The expected payoff of a raider with valuation \( z_R \) if he decides to enter in the first period is:

\[ (1-z_R)(-s) + (z_R - z_L)(z_R - \frac{z_R + z_L}{2} - s) + z_L(z_R - x - s) \]

The expected payoff for a raider with valuation \( z_R \) if he decides to enter in the second period is:

\[ (1-z_L)(0) + (z_L - w_L)(z_L - \frac{z_L + w_L}{2} - s) + w_L(z_R - x - s) \]

Equating the two expected payoffs and simplifying we get:

\[ \frac{z_R^2}{2} + z_L^2 - \frac{w_L^2}{2} - z_L(x-s) - z_Lz_R + xw_L - s = 0 \] (18)

The valuation of a raider that is indifferent between entering in the second period and not entering is \( w_R \). The expected payoff for a raider with valuation \( w_R \) if he enters in the second period is:

\[ (1-z_L)(0) + (z_L - w_R)(-s) + (w_R - w_L)(w_R - \frac{w_R + w_L}{2} - s) + w_L(w_R - x - s) \]
The expected payoff for a raider if he does not enter is 0. After equating the two expected payoffs and simplifying we get:

\[
\frac{w_R^2}{2} + \frac{w_L^2}{2} - sz_L - xw_L = 0
\]  

(19)

The valuation of a large shareholder, L, that is indifferent between entering the first period and the second period is \(z_L\).

The expected payoff for L with valuation \(z_L\) from entering the first period:

\[(1-z_R)(-s+\beta z_L) + z_R(z_L-(1-\beta)x-s)\]

The expected payoff for L with valuation \(z_L\) if she enters the second period is:

\[(1-z_R)\beta x + (z_R-z_L)(\beta z_L-s) + (z_L-w_R)(z_L-(1-\beta)\frac{z_L+w_R}{2}-s) + w_R(z_L-(1-\beta)x-s)\]

Equating and simplifying we get:

\[-(1-\beta)\frac{z_L^2}{2} - (1-\beta)\frac{w_R^2}{2} + (1-\beta)xw_R + s z_R z_L x (1-2\beta) + z_L z_R (2\beta+1) + \beta z_L - \beta x - s = 0\]  

(20)

The valuation of a large shareholder, that is indifferent between entering the second period and not entering, is \(w_L\). Her expected payoff if she enters in the second period is:

\[(1-z_R)\beta x + (z_R-w_R)(-s+\beta w_L)+w_R(w_L-(1-\beta)x-s)\]

Her expected payoff if she does not enter at all is:

\[(1-w_R)\beta x\]

Equating and simplifying we get:

\[-z_R \beta x s z_R + 8 w_L z_R + w_L w_R (1-\beta) - x w_R + 2 \beta x w_R = 0\]  

(21)

**Proposition 16:** The four equations that we obtained 18, 19, 20 and 21 solve for the values of the four cutoff points \(z_R, w_R, z_L, w_L\) in function of the three parameters \(x, s\) and \(\beta\). The solutions should also satisfy the following constraints:
\[ z_R > z_L > w_R > w_L \]
\[ z_R > w_R > x + s \]
\[ z_L > w_L > (1-\beta)x + s \]

Note that if we set \( \beta=0 \), \( z_R = z_L \) and \( w_L = w_R \). In 18, 19, 20 and 21, we obtain the two equations we had in the two-period model with two raiders.

An experimental analysis of the equilibrium equations

We could not obtain a general solution for the cutoff points; so we solved for the cutoff points using specific values of \( x \), \( s \) and \( \beta \). Table 3 shows some of our calculations. We then chose a set of parameter values and we experimented with it, to see the changes in the cutoff points as we change the parameters. We started with the values, \( \beta=0.1 \), \( x=0.6 \), \( s=0.3 \). We next varied respectively, \( s \) (table 4), \( x \) (table 5) and \( \beta \) (table 6).

Table 3: Simulations of the cutoff points in a two-period model with a large shareholder

<table>
<thead>
<tr>
<th>( x )</th>
<th>( s )</th>
<th>( \beta )</th>
<th>( Z_R )</th>
<th>( Z_L )</th>
<th>( W_R )</th>
<th>( W_L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.01</td>
<td>0.50</td>
<td>0.2504</td>
<td>0.1169</td>
<td>0.1107</td>
<td>0.1092</td>
</tr>
<tr>
<td>0.2</td>
<td>0.05</td>
<td>0.3</td>
<td>0.5366</td>
<td>0.2691</td>
<td>0.2540</td>
<td>0.2480</td>
</tr>
<tr>
<td>0.2</td>
<td>0.05</td>
<td>0.5</td>
<td>0.5359</td>
<td>0.2613</td>
<td>0.2533</td>
<td>0.2441</td>
</tr>
<tr>
<td>0.25</td>
<td>0.2</td>
<td>0.02</td>
<td>0.6903</td>
<td>0.6878</td>
<td>0.5200</td>
<td>0.5086</td>
</tr>
<tr>
<td>0.6</td>
<td>0.05</td>
<td>0.1</td>
<td>0.8522</td>
<td>0.6450</td>
<td>0.6505</td>
<td>0.6363</td>
</tr>
<tr>
<td>0.6</td>
<td>0.05</td>
<td>0.3</td>
<td>0.8937</td>
<td>0.6500</td>
<td>0.6519</td>
<td>0.5980</td>
</tr>
<tr>
<td>0.6</td>
<td>0.03</td>
<td>0.05</td>
<td>0.7948</td>
<td>0.6414</td>
<td>0.6308</td>
<td>0.6235</td>
</tr>
<tr>
<td>0.6</td>
<td>0.1</td>
<td>0.03</td>
<td>0.8215</td>
<td>0.8155</td>
<td>0.7164</td>
<td>0.6987</td>
</tr>
<tr>
<td>0.6</td>
<td>0.3</td>
<td>0.03</td>
<td>0.9570</td>
<td>0.9460</td>
<td>0.9160</td>
<td>0.8978</td>
</tr>
<tr>
<td>0.6</td>
<td>0.3</td>
<td>0.1</td>
<td>0.9749</td>
<td>0.9336</td>
<td>0.9170</td>
<td>0.8805</td>
</tr>
</tbody>
</table>
Proposition 17: \( \frac{\partial z_R}{\partial s}, \frac{\partial z_L}{\partial s}, \frac{\partial w_R}{\partial s}, \text{ and } \frac{\partial w_L}{\partial s} \) are positive. Table 4 shows that the cutoff points increase as we increase \( s \).

Proposition 18: \( \frac{\partial z_R}{\partial x}, \frac{\partial z_L}{\partial x}, \frac{\partial w_R}{\partial x}, \text{ and } \frac{\partial w_L}{\partial x} \) are positive. Table 5 shows that the cutoff points increase as we increase \( x \).

Proposition 19: \( \frac{\partial z_R}{\partial B} \) and \( \frac{\partial w_R}{\partial B} \) are positive, and \( \frac{\partial z_L}{\partial B} \) and \( \frac{\partial w_L}{\partial B} \) are negative. Finally in table 6, the cutoff points for \( R \) increase and the cutoff points for \( L \) decrease with \( B \).

Table 4: Simulations to illustrate the movement in the cutoff points as \( s \) changes

<table>
<thead>
<tr>
<th>( s )</th>
<th>( z_R )</th>
<th>( z_L )</th>
<th>( w_R )</th>
<th>( w_L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35</td>
<td>0.988929</td>
<td>0.9623804</td>
<td>0.97097983</td>
<td>0.90143922*</td>
</tr>
<tr>
<td>0.33</td>
<td>0.97730972</td>
<td>0.94769242</td>
<td>0.95214821</td>
<td>0.88087505*</td>
</tr>
<tr>
<td>0.30</td>
<td>0.95991</td>
<td>0.92592</td>
<td>0.923371</td>
<td>0.8508812</td>
</tr>
<tr>
<td>0.32</td>
<td>0.90092</td>
<td>0.8729</td>
<td>0.82748</td>
<td>0.7563633</td>
</tr>
<tr>
<td>0.15</td>
<td>0.8634901</td>
<td>0.8414275</td>
<td>0.77538762</td>
<td>0.70584096</td>
</tr>
<tr>
<td>0.10</td>
<td>0.81661637</td>
<td>0.80435425</td>
<td>0.71978398</td>
<td>0.65274342</td>
</tr>
<tr>
<td>0.09</td>
<td>0.8054928</td>
<td>0.79592858</td>
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<td>0.64179269</td>
</tr>
<tr>
<td>0.08</td>
<td>0.7935437</td>
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<td>0.69640469</td>
<td>0.63073028</td>
</tr>
<tr>
<td>0.07</td>
<td>0.780595</td>
<td>0.7775341</td>
<td>0.68445033</td>
<td>0.61955824</td>
</tr>
<tr>
<td>0.06</td>
<td>0.76691521</td>
<td>0.76693327</td>
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</tr>
<tr>
<td>0.01</td>
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<td>0.67383513</td>
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<td>0.55194656</td>
</tr>
</tbody>
</table>

Table 5: Simulations to illustrate the movement in the cutoff points as \( x \) changes

<table>
<thead>
<tr>
<th>( x )</th>
<th>( z_R )</th>
<th>( z_L )</th>
<th>( w_R )</th>
<th>( w_L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.670</td>
<td>0.998692</td>
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<td>0.98862463</td>
<td>0.91167539*</td>
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<tr>
<td>0.607</td>
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<td>0.92939639</td>
<td>0.85644132*</td>
</tr>
<tr>
<td>0.605</td>
<td>0.96231</td>
<td>0.928073</td>
<td>0.92761842</td>
<td>0.8547866</td>
</tr>
<tr>
<td>0.600</td>
<td>0.959919</td>
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<td>0.9233717</td>
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<td>0.500</td>
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<tr>
<td>0.400</td>
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<td>0.350</td>
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Table 6: Simulations to illustrate the movement in the cutoff points as $\beta$ changes

<table>
<thead>
<tr>
<th>$\beta$</th>
<th>$z_R$</th>
<th>$z_L$</th>
<th>$w_R$</th>
<th>$w_L$</th>
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<tr>
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<td>0.925928</td>
<td>0.9233717</td>
<td>0.85088122</td>
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<td>0.85704844</td>
</tr>
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<td>0.86943599</td>
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</tr>
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</tr>
</tbody>
</table>

All the cutoff points decrease as $x$ or $s$ decreases. When the minimum premium or the takeover cost the raider expects to pay, decreases he decides to enter in the bidding earlier whether he is a large shareholder or not. Some raiders that had decided not to enter, now as $x$ or $s$ decreases, decide to enter in the second period. When $\beta$ increases $z_R$ and $w_R$ increase while $z_L$ and $w_L$ both decrease. The large shareholder enters faster in the bidding if she owns more shares in the firm. The raider is however, discouraged from entry as his rival increases the amount of shares she owns in the company. At $\beta = 0$, we obtain: $z_R = z_L$ and $w_R = w_L$. We note that for some values of $x$, $s$ and $\beta$ we did not obtain solutions that satisfy the constraints. All these solutions had a $w_R$ that is greater than $z_L$. For these solutions the value of $x+s$ were close to one. It is difficult for the raiders to decide to enter specially the raider that owns no shares in the firm, and that knows that his rival owns some shares (which makes the cutoff points of his rival smaller). The solutions, that did not satisfy the constraints, used the upper value of whichever parameter we were experimenting with: $x+s = 0.95$, $\beta = 0.1$; $x+s = 0.93$, $\beta = 0.1$; $x+s = 0.97$, $\beta = 0.1$; $x+s = 0.907$, $\beta = 0.1$; $x+s = 0.9$, $\beta = 0.2$; $x+s = 0.9$, $\beta = 0.15$. For these cases, we did not find a solution.
with the order that we have imposed. The second cutoff points for the raider are larger than
the first cutoff point for the large shareholder/raider. (See Appendix 2.)

The analysis of the partial derivatives of the cutoff points with respect to $\beta$

![Diagram showing cutoff points Z_R, W_R, Z_L, W_L with X+S and 0.]

Figure 17

The relative position of the cutoff points

in the two-period model with a large shareholder

We next, derive the equations for the partial derivatives of the cutoff points with respect to

$\beta$. Let:

$$a = \frac{dz_L}{d\beta}, \quad b = \frac{dz_R}{d\beta}, \quad c = \frac{dw_L}{d\beta} \quad \text{and} \quad d = \frac{dw_R}{d\beta}.$$  

We take the total derivatives of equations 18-21 with respect to $\beta$. After making some
simplifications, we obtain the following equations:

$$-z_L b + a(2z_L - x + s) - c(w_L - x) = 0$$
$$c(w_L - x) - sa + w_R d = 0$$
$$a[\beta(z_L - 2z_R) - z_L + z_R + \beta] + b[2\beta(x - z_L) + s - x + z_L] + d[(\beta - 1)(w_R - x)] + e = 0$$
$$b(-s - 8x + 8w_L) + c[z_R \beta + w_R (1 - \beta)] + d[2\beta x - x + w_L (1 - \beta)] + f = 0$$
$$e = -\frac{z_L^2}{2} + \frac{w_R}{2} + 2xz_R - 2zw_L - xw_R + z_L - x$$
$$f = -xz_R + 2xw_R + z_R w_L - w_L w_R$$
These four equations should be true for all the values of x, s and β. We look at the limiting case where β tends to 0, to see how the cutoff points will change if β changes from 0 to a small positive number. When β=0, z_L=z_R=z and w_L=w_R=w, replacing, we obtain:

\[ - z \beta + a(2z-x+s) - c(w-x) = 0 \]  \hspace{1cm} (22)

\[ c(w-x) - s a + w d = 0 \]  \hspace{1cm} (23)

\[ d(x-w) + b(s-x+z) + g = 0 \]  \hspace{1cm} (24)

\[ - s b + d(w-x) + w c + h = 0 \]  \hspace{1cm} (25)

\[ g = \frac{z^2}{2} + \frac{w^2}{2} + 2xz-2z^2 - xw + z - x \]

\[ h = -xz + 2xw + zw - w^2 \]

Since we set β equal to zero, w and z will solve for the equations, 2 and 3, obtained in the two period game with two raiders:

For given values of x and s we solve for a, b, c and d. Table 7 gives some solutions for the derivatives.

Table 7: Simulations to illustrate the movement in the derivatives of the cutoff points with respect to β, as β changes

<table>
<thead>
<tr>
<th>x</th>
<th>s</th>
<th>w</th>
<th>dZ_L/db</th>
<th>dZ_R/db</th>
<th>dW_L/db</th>
<th>dW_R/db</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>0.25</td>
<td>0.95560</td>
<td>-0.06908</td>
<td>0.084885</td>
<td>-0.73101</td>
<td></td>
</tr>
<tr>
<td>0.7</td>
<td>0.2</td>
<td>0.90927</td>
<td>-0.06434</td>
<td>0.065842</td>
<td>-0.73066</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>0.36</td>
<td>0.86243</td>
<td>-0.07366</td>
<td>0.099808</td>
<td>-0.57879</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>dW_R/db</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15401</td>
<td>0.95141</td>
</tr>
<tr>
<td>0.17747</td>
<td>0.97711</td>
</tr>
<tr>
<td>0.22079</td>
<td>0.93740</td>
</tr>
</tbody>
</table>

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As expected, \( \frac{dw_R}{d\beta} \) is positive, and \( \frac{dw_L}{d\beta} \) is negative, which assures that \( w_L \) is to the left of \( w_R \). For some values of \( x \) and \( s \), \( \frac{dz_R}{d\beta} \) is negative and greater in absolute value than \( \frac{dz_L}{d\beta} \); we could not explain these results. (See Appendix 3.)
Determining the relative positions of the cutoff points

![Diagram](image)

Figure 18

The two-period model with a large shareholder, where the cutoff points of L and R are equal

To justify our choice of the equilibrium where the cutoff points for the raider are bigger than the cutoff points for the large shareholder, we start from the situation where both raiders have no ownership in the target and then, consider that one of them has a small ownership \( \beta \). Since we look at \( \beta \) small, we assume that the cutoff points are the same for R and L (in Figure 18, \( z_R = z_L = z \) and \( w_R = w_L = w \)), and we study how the incentives of the shareholder-raider change. The expected payoffs of a raider, with a valuation \( z \), and that was indifferent between entering in the first period or entering in the second period will change, since now she owns \( \beta \) shares in the firm.

The expected payoff for L if she enters in the first period will increase by:

\[ (1-z)\beta z + (z-w)\beta x + w\beta x, \]

this is explained as follows:
\((1 - z)\beta z\): In the case where a raider, R, with a higher valuation than L enters in the first period, R has to pay L for the shares she owns, and he has to pay \(z\) (the valuation of L) for these shares.

\((z - w)\beta x + w\beta x\): When R decides to enter in the second period or not enter at all, L wins the firm but has to buy only the shares she does not own \((1 - \beta)\).

When she enters in the second period her expected payoff will increase by:

\[(1 - z) \beta x + (z - w) \beta \frac{z + w}{2} + w \beta x\]

\((1 - z) \beta x\): When a raider decides to enter in the first period, he has to pay L for the shares she owns, even if L does not enter.

\((z - w) \beta \frac{z + w}{2}\): When a raider, R, decides to enter in the second period and if he has a valuation less than \(z\), he bids higher the price of the firm (expected price is equal to \(\frac{z + w}{2}\)). L, however, has to buy only \((1 - \beta)\) of the shares.

\(w \beta x\): In case no other raider enters, L has to buy only \((1 - \beta)\) of the shares and pays a premium \(x\) for them.

The change in the behavior of a raider, that was indifferent between entering in the first period and entering in the second period, cannot be determined from our calculations, and it depends on the relative values of \((1 - z)\) and \((z - w)\). However, we already determined that at equilibrium \(z = \frac{w^2 - xw}{s}\) and \(\frac{dz}{dw}\) positive. For small \(\beta\) and for continuity reasons, we expect \(\frac{dz}{dw}\) to have the same sign as in the previous equilibrium. Therefore the change in \(z\) will be the same as \(w\).
Claim 3: The second cutoff of a raider that owns a small but positive percentage of ownership in the target is smaller than his cutoff point if he had no ownership in the firm in a two-period model.

Proof: The expected payoffs of a raider with valuation \( w \), that was indifferent between entering in the second period and not entering, will change when she owns \( \beta \) shares in the target. Her expected payoff if she decides to enter in the second period will increase by:

\[
(1-z)\beta x + (z-w)\beta w + w\beta x
\]

Her expected payoff if she decides not to enter will increase by:

\[
(1-w)\beta x
\]

Since \( w \) is greater than \( x \), L's second cutoff point increases when L acquires \( \beta \). Therefore we also expect \( z \) to be smaller for L compared to a raider with no ownership in the target. It is possible to characterize other equilibria if we assume a different position of the cutoff points. However, given that in reality waiting itself is costly, a factor we do not take account of here since we consider no discount rate, and for continuity reasons, we will study the case where the cutoff points for L are respectively, smaller than the cutoff points for R.
An infinite horizon model

Figure 19

We look next at the case of an infinite period model. We show that in an infinite horizon model, a raider (large shareholder/raider) with a valuation greater than \( x+s \), \( ((1-\beta)x+s) \) will eventually decide to enter. We consider a Bayesian Nash equilibrium, where the cutoff points for the large shareholder/raider are respectively smaller than the cutoff points for the raider. Again, the rational behind this consideration is that the raiders prefer fast entry and the shares they hold in the target permit them to cover some of their fixed cost and therefore to enter faster. We could not solve explicitly for the cutoff points, or to analyze the effect of the model's parameters on them. We will however, derive the equations that would solve for these cutoff points and present some results about the limits of these cutoff points.
Determining the equations for the cutoff points

The equations that determine all the cutoff points $z^R_n$ and $z^L_n$, for all $n$, are $n$ equations that relate $z^R_{n-1}$, $z^R_n$, and $z^R_{n+1}$, and $n$ equations that relate $z^L_{n+1}$, $z^L_n$, and $z^L_{n-1}$. The equations are determined as follows:

A raider with a valuation $z^R_n$ is indifferent between entering in period $n-1$ and period $n$, therefore:

\[
(z^L_n - z^R_n)(z^R_n - z^L_n) - (z^R_n)^2 + (z^R_n + z^L_n)^2 - z^L_n(z^R_n - x - s)
\]

\[
= (z^L_n - z^L_{n+1})(z^R_n - z^L_n) - (z^R_n + z^L_n)^2 - z^L_n(z^R_n - x - s)
\]

A large shareholder/raider, with valuation $z^L_n$, is indifferent between entering in period $n-1$ and period $n$, therefore:

\[
(1-z^R_n)(z^R_n - z^R_{n-1}) - (z^R_n)^2 + (z^R_n + z^L_n)^2 - z^R_n(z^L_n - (1-\beta)x - s)
\]

\[
= (1-z^R_n)(z^R_n - z^L_{n+1}) - (z^R_n)^2 + (z^R_n + z^L_{n+1})^2 - z^R_n(z^L_n - (1-\beta)x - s)
\]

Developing we get equations 26 and 27:

\[
\frac{(z^R_n)^2}{2} + \frac{(z^L_{n+1})^2}{2} - \frac{(z^L_n)^2}{2} - \frac{z^L_{n+1}z^R_n}{2} - \frac{s(z^L_{n-1} - z^L_n)}{2} - x(z^L_n - z^L_{n+1}) = 0
\]

\[
(26)
\]

\[
-\frac{(z^R_{n+1})^2}{2} - (1-\beta)(z^L_n)^2 + \beta z^L_n z^R_{n-1} + (1-2\beta)z^R_n z^L_n - (-\beta x - s)z^R_{n-1} - (1-\beta + s)z^R_n + (1-\beta)x z^R_{n+1} = 0
\]

\[
(27)
\]

Equations 26 and 27 are true for each $n$, and $z^R_0 = z^L_0 = 1$. When we set $\beta = 0$,
\[ z_n^R = z_n^L, \quad z_{n-1}^R = z_{n-1}^L \] and \[ z_{n+1}^R = z_{n+1}^L, \] we get the same equations obtained for the case of two raiders and \( n = \infty. \)

**Proposition 20:** As the number of periods increases and approaches infinity the limit of the cutoff points for \( R \) is \( x+s \) and for \( L \) is \( (1-\beta) x + s. \)

**Proof:** Assume that \( Z^*_R \) and \( Z^*_L \) are respectively the limits of the decreasing series of the cutoff points for \( R \) and \( L \), as the number of periods approaches \( \infty. \) These limits represent respectively the cutoff points between the valuations of raiders (large shareholders) that enter and those that do not enter. The expected payoff for a raider with a valuation \( z^R_T \) when he enters in period \( T \) is:

\[
(1-z^L_T) (0) + (z^L_{T-1} - z^L_T) (z^R_T - x - s) + z^L_T (z^R_T - x - s).
\]

For \( T = \infty \), we have \( \lim_{T \to \infty} z^L_{T-1} = \lim_{T \to \infty} z^L_T = Z^*_L \), and \( \lim_{T \to \infty} z^R_T = Z^*_R. \) As the number of periods increases, \( R \) becomes indifferent between entering and not entering therefore,

\[ Z^*_L (Z^*_R - x - s) = 0 \] and \( Z^*_R \) is equal to \( x+s. \)

The expected payoff for \( L \) with valuation \( z^L_T \), when she enters in period \( T \), is equal to:

\[
(1-z^R_{T-1}) (\beta x) + (z^R_{T-1} - z^R_T) (-s + \beta x) + z^R_T (z^L_T - (1-\beta) x - s) = (1-z^R_T) \beta x.
\]

For \( T = \infty \), \( \lim_{T \to \infty} z^R_{T-1} = \lim_{T \to \infty} z^R_T = Z^*_R \) and \( \lim_{T \to \infty} z^L_T = Z^*_L. \) The expected payoff for \( L \) from entering, should be equal to her expected payoff if she does not enter, which is equal to \( (1-z^R_T) \beta x. \) Therefore, \( Z^*_L \) is equal to \( (1-\beta)x+s. \) As \( n \) increases, the probability of entry by a rival decreases and it is equal to zero. Therefore a raider, (large shareholder / raider), with valuation greater than \( x+s \) ((1-\beta)x+s), will eventually enter into the bidding.

We note again that it was not possible to conduct any further analysis on the equilibrium in this case due to the complex expressions that are involved.
THE ROLE OF MANAGEMENT AND DEFENSIVE TACTICS

The target’s management and board of directors can delay the takeover process, by delaying the acceptance of a bid, in order to increase the chance of an entry by a rival raider, and therefore increasing the bid price. They can also increase the perceived \( x \) and \( s \). We want to see how such actions can affect our model, and whether they serve the shareholders’ interests.

Delaying the takeover

Looking at the two period case, and considering that only one bidder enters in the first period, the bidder will offer \( x \) as a bid price for the firm. The management might want to delay acceptance of the bid until the second period, allowing the other bidder the chance to enter the bidding, and therefore raising the price offered for the firm. However, if we consider the equilibrium structure, the bidder would not choose to enter in the second period after he observes a bid in the first period, even if the bid is low. He knows he will eventually lose the bidding, since the early entry of the first bidder would signal to him that his rival has a higher valuation than his own. The management has to promise the second bidder a part of the surplus obtained due to his entry, or this second bidder has to be a large shareholder benefitting from a higher bid. This context provides a rationale for the management to cultivate "White Knights", so that it is not left defenseless when it faces a low bid. In the case where a White Knight exists, the raider would expect to pay at least the valuation of the firm to the White Knight, in order to win the bid for the firm. When this valuation is greater than \( x \), the raider will delay his entry to the takeover process. Allowing for the possibility of such an activity changes the structure of the equilibrium. All
the bidders, when calculating their expected payoffs, consider this possibility of delay, and therefore the entry of bidders that were not considered as potential rivals in the initial context. The bidders would consider the power of the management to delay the takeover. Given that in reality the shareholders would discount their expected payoffs with respect to time, they would benefit from the management’s actions to delay the takeover, only if the prospect of a higher bid outweighs the losses from waiting and the decrease in the probability of entry.

The payment of Greenmail to a large shareholder in order to inactivate her as a raider could also be an effort by the management to encourage the entry of the other raiders. This is the case when the management has information on the large shareholder’s valuation. If the valuation is low, the management wants to eliminate the large shareholder from the bidding, and encourage other bidders to enter faster (Shleifer and Vishny, 1986b)

Affecting the takeover cost and the reservation price

The management can affect the reservation bid price by the passage of fair price amendments, super majority rules, golden parachute plans or poison pill provisions. These are actions that affect the price the raider has to pay to the target, in the case where he wins the takeover.

How could the management affect the takeover sunk costs? That is mainly done through litigation, since the raiders will lose the costs of going through litigation, whether they win the bid or lose it. When the management increases x, it increases, on average, the premium it receives from the bidders. That is because x is the bid price when a single entry occurs, and the raiders that enter would have higher valuations on average. However, the management also discourages entry. The probability of delay increases, and the probability
of entry decreases. Because there is no discount rate in our model, the delay in entry from the first to the second period, will have no direct negative effect on the shareholders' payoff. However, the decrease in the probability of entry will clearly have a negative effect. When there is an increase in $s$, we expect the average valuations of raiders that enter to be higher but the probability of entry will decrease.

We next analyze how the management would set $x$ and $s$ in order to maximize shareholders' payoff. We consider first the simple cases of one period with one raider and one period with one large shareholder/raider, in order to gain some insight. Later, we consider the case of two raiders with one period, as well as with two periods. Finally, we look at the two-period case with one raider and one large shareholder. The complicated calculations in other cases give no further insights from considering them.

A. The Case of one raider and one period

We will start with the case where we have one raider and one period. We define $\pi$ to be the expected payoff for the shareholders.

\[
\begin{array}{c|c|c}
0 & \text{enter} & \text{not enter} \\
\hline
 & x+s & \\
1 & & \\
\end{array}
\]

\[
\begin{array}{c|c|c}
0 & \text{enter} & \text{not enter} \\
\hline
 & (1-\beta)x+s & \\
1 & & \\
\end{array}
\]

Figure 20

The one-period model with one raider, and with one large shareholder
**Proposition 21:** In a one period model with one raider, \( \frac{\partial \pi}{\partial s} < 0 \) and the optimal \( x \) is equal to \( x^* = \frac{(1-s)}{2} \) with \( \frac{\partial x^*}{\partial s} < 0 \).

**Proof:** The expected payoff for the small shareholders:

\[ \pi = (1-(x+s))(x) + (x+s)(0) = x-x(x+s), \]

(1-(x+s)): the probability that a raider enters.

\( x \): the expected payoff if a raider enters (since we have one raider there is no competition).

(x+s): the probability that no raider enters. In this case the expected payoff is zero.

\[ \frac{\partial \pi}{\partial x} = 1 - [(x+s)+x] = 1-2x-s, \text{ and } \frac{\partial \pi}{\partial s} = -x. \]

To maximize the shareholders' expected payoff, the management must set \( x = \frac{(1-s)}{2} \), and set \( s \) as small as possible. When \( s \) is large, the management sets \( x \) smaller to offset the effect a higher \( s \) has on the probability of entry. When \( s \) is equal to zero, the optimal \( x \) would be equal to the expected valuation of a raider, equal to 1/2.

**B. Case of a one period model with one large shareholder**

**Proposition 22:** In a one period model with one raider/large shareholder, \( \frac{\partial \pi}{\partial \beta} > 0, \frac{\partial \pi}{\partial s} < 0 \) and \( x^* = \frac{1-s}{2(1-\beta)}, \) with \( \frac{\partial x^*}{\partial s} < 0 \).

\[ \pi = (1-((1-\beta)x+s))(x)+(1-\beta(x+s))0 \]

\[ \frac{\partial \pi}{\partial \beta} = x^2, \text{ it is positive.} \]
The existence of a large shareholder has a positive effect on the other shareholders' expected payoff. Furthermore, the shareholders profit from an increase in the ownership of the large shareholder. We must not forget that we are looking at the case where the large shareholder has no competitor. Therefore we are not considering the negative effect of the existence of the large shareholder in deterring the other raider from entry (or delaying his entry).

\[ \frac{\partial \pi}{\partial s} = -x, \] 
the derivative is negative, and the the manager should try to decrease s as much as possible. \[ \frac{\partial \pi}{\partial x} = 1-2(1-\beta)x-s, \] 
and to maximize \( \pi \) we need to set the derivative equal to zero therefore 
\[ x = \frac{1-s}{2(1-\beta)}. \] 
We notice that the value of \( x \) in this case is greater than what we obtained in the case of one period with one raider. This is explained by the fact that a higher \( x \) will have a smaller negative effect on the probability of entry for the large shareholder, as opposed to the raider. The large shareholder has to pay only \( (1-\beta)x \), as opposed to the raider that has to pay \( x \).

C. The case of one period with two raiders

Proposition 23: In a one period model with two raiders, \[ \frac{\partial \pi}{\partial s} < 0 \] 
and \( x^* = f(s) \).

\[ \pi = (1-z)^2 \left( \frac{z+1}{2} \right) + 2(1-z)zx \]

\( (1-z)^2 \): The probability that two raiders enter.

\( \frac{(z+1)}{2} \): The expected payoff for the shareholders if two raiders enter.

\( 2(1-z)z \): The probability that only one raider enters.

\( x \): The expected payoff for the small shareholders if only one raider enters.

\[ \frac{\partial \pi}{\partial x} = \frac{\partial z}{\partial x} \left[ -2(1-z)(\frac{1+z}{2}) + (1-z)^2 \frac{2}{2} + 2(1-z)x-2zx \right] + 2(1-z)z = 0, \]
implies:
\[
\frac{\partial z}{\partial x} (1-z)(x-\frac{1+z}{2}+z+x) - 2zx = -2(1-z)z.
\]
\[
\frac{\partial \pi}{\partial s} = \frac{\partial z}{\partial s} \left( -2(1-z)(\frac{1+z}{2}) + \frac{(1-z)^2}{2} + 2(1-z)x - 2zx \right)
\]
\[
= \frac{\partial z}{\partial s} (1-z)(x-\frac{1+z}{2}+z+x) - 2zx), \text{ which is negative.}
\]

In addition we know that at equilibrium we have:
\[
\frac{\partial z}{\partial x} = \frac{1}{2}(x^2+4s)^{-1/2}, \quad \frac{\partial z}{\partial s} = 2(x^2+4s)^{-1/2} \text{ and } z = \frac{x}{2} + \frac{\sqrt{x^2+4s}}{2}.
\]

We seem to have the same basic structure of the previous results, where the derivative with respect to \( s \) is negative. There is an optimal value for \( x \) that decreases with \( s \).

\[D. \text{ The case of two raiders and two periods}\]

**Proposition 24**: In a two-period model with two raiders, \( \frac{\partial \pi}{\partial s} < 0 \text{ and } x^* = f(s) \).

The shareholders' expected payoff is:
\[
\pi(x,s) = (1-z)^2(\frac{1+z}{2}) + 2(1-z)zx + (z-w)^2(\frac{z+w}{2}) + 2(z-w)wx
\]
\[
\frac{d\pi}{dx} = \frac{\partial z}{\partial x} \left[ -(1-z)^2 + \frac{(1-z)^2}{2} + 2(1-z)x - 2zx + (z-w)(z+w) + \frac{(z-w)^2}{2} + 2wx \right] + \\
\frac{\partial w}{\partial x} \left[ -(z^2-w^2) - (z-w) w + 2x(z-w) - 2wx \right] + 2z(1-z) + 2(z-w)w
\]
\[
= \frac{\partial z}{\partial x} \left[ 3z^2 - z - 4xz - zw - \frac{w^2}{2} + 2wx + 2x - \frac{1}{2} \right] + \frac{\partial w}{\partial x} \left[ \frac{3w^2}{2} - \frac{z^2}{2} - zw + 2zx \right]
\]
\[-4wx + 2z(1+w) - 2(z^2+w^2)
\]
\[
\frac{d\pi}{ds} = \frac{\partial z}{\partial x} \left[ 3z^2 - z - 4xz - zw - \frac{w^2}{2} + 2wx + 2x - \frac{1}{2} \right] + \frac{\partial w}{\partial x} \left[ \frac{3w^2}{2} - \frac{z^2}{2} - zw + \\
2zx - 4wx \right]
\]
Although the calculations become clearly much more involved, the structure is still the same. We expect the derivative with respect to $s$ to be negative, and $x$ has an optimal value.

**E. The case of two periods with one raider and one large shareholder**

**Proposition 25:** In a two-period model with a raider and a raider/large shareholder, we expect $\frac{\partial \pi}{\partial s} < 0$ and $x^*=f(s)$ however the sign of $\frac{\partial \pi}{\partial B}$ is ambiguous.

\[
\pi = x(z_R(1-z_L) + z_L(1-z_R)) + z_Rz_L(0) + (1-z_R)^2 \left( \frac{1+z_R}{2} \right) + (1-z_R)(z_R-2z_L) \left( \frac{z_R+z_L}{2} \right)
\]

$z_R(1-z_L) + z_L(1-z_R)$: the probability that either R or L enters the bidding, and $x$ is the expected payoff for the shareholders in this case.

$z_Rz_L$: the probability that neither of the two raiders enter the bid.

$(1-z_R)^2$: the probability that both enter the bid, and that they both have valuations greater than $z_R$. In this case, the expected payoff for the shareholders is $\left( \frac{1+z_R}{2} \right)$.

$(1-z_R)(z_R-2z_L)$: the probability that they both enter and that R has a valuation greater than $z_R$ and L, a valuation between $z_L$ and $z_R$.

$$
\pi = x \left( z_R - z_Lz_R + z_Lz_R \right) + \frac{1-z_R}{2} \left( (1-z_R)(1+z_R) + (z_R - z_L)(z_R+z_L) \right)
$$

$$
= x \left( z_R - 2z_Lz_Rz_L + \frac{1-z_R}{2}(1-z_L)^2 \right)
$$

$$
\frac{\partial \pi}{\partial x} = \frac{\partial z_R}{\partial x} (x-2z_Lx - \frac{1-z_L}{2}) + \frac{\partial z_L}{\partial x} (x-2z_Rx - z_L(1-z_R)) + z_R + z_L \cdot z_R
$$

$$
\frac{\partial \pi}{\partial s} = \frac{\partial z_R}{\partial s} (x-2z_Lx - \frac{1-z_L}{2}) + \frac{\partial z_L}{\partial s} (x-2z_Rx - z_L(1-z_R))
$$
We expect $\frac{\partial z_R}{\partial x}$, $\frac{\partial z_L}{\partial x}$, $\frac{\partial z_R}{\partial s}$ and $\frac{\partial z_L}{\partial s}$ to be positive and $(z_R + z_L - 2z_L z_R)$ is positive. The other two expressions are negative:

\[
\frac{(x-2z_L)(1-z_L)}{2} = (x(1-2z_L) - \frac{1+z_L}{2} (1-z_L)), \text{ and that is negative.}
\]

\[
(x-2z_R x_z_L)(1-z_R) = (x(1-2z_R) - z_L(1-z_R)) \text{ and that is also negative.}
\]

Again, optimally the shareholders would set $s$ as low as possible, and $x$ is determined by the equation $\frac{\partial \pi}{\partial x} = 0$.

What about the effect of a change in $b$ on the expected payoff for the shareholders?

\[
\frac{\partial \pi}{\partial b} = \frac{\partial z_R}{\partial b} \left( x - 2z_L \frac{1-z_L}{2} \right) + \frac{\partial z_L}{\partial b} (x-2z_R x_z_L (1-z_R))
\]

\[
\frac{\partial z_L}{\partial b} = \frac{-2z_R}{\sqrt{x^2 + 2s - z_R}}.
\]

This means that $|\frac{\partial z_L}{\partial b}| > |\frac{z_R}{\partial b}|$.

$x^2 + 2s - z_R^2 < z_R^2 < 4z_R^2$ implies, $\sqrt{x^2 + 2s - z_R^2} < 2z_R$. We however cannot sign $\frac{\partial \pi}{\partial b}$.

When we allow for competition, an increase in $b$ has both a positive and a negative effect on the shareholders' expected payoff. The positive effect comes from an increase in the large shareholder's probability of entry. A higher $b$, however, discourages the other raider from entry, and it is not clear which of the two effects is larger.

The shareholders do not profit from legal actions that would increase the sunk takeover cost. They could, however, profit from actions that would increase the takeover premium that the shareholders would get in the case where the raider wins the bid. The intuition behind this result is that when there is an increase in $s$, the effect on the shareholders is a delay in the takeover process, and a decrease in the probability of entry. The shareholders do not gain directly from such an increase. On the other hand, when $x$ increases, there is a direct positive effect and that is of the increase in the premium the shareholders get.
WELFARE ANALYSIS AND GOVERNMENT REGULATIONS

A complete welfare function should include the effect of the takeover on the management of the target firm as well as its employees; however we do not include these two parties in our analysis. The takeover, in our model, affects the shareholders and the raiders. Some state laws that delay takeovers, or past court cases where the court has taken a stand against takeovers, are considered by a potential raider to signal delay and the possibility of failure, even if he is not challenged by a raider with a higher valuation. Delays in the takeover process will also increase $x$, since it will give more time for the shareholders and the management to gather information about the takeover. Laws that limit the purchase of shares (such as the SEC 13D disclosure rule) will cause an increase in $s$, in the sense that they prevent the raiders from trying to decrease their sunk cost through share purchase. When regulations exist, the raiders will incorporate them in their expectations and decide to delay entry on average. The raiders want the lowest $x$ and $s$ possible. Shareholders do not benefit from delays that would be caused by an increase in the sunk costs, but they might benefit from delays caused by an increase in $x$. Actions that affect the sunk cost of a takeover, harm both the shareholders and the raiders. Increases in $x$ redistribute some of the gains of the takeover from the raiders to the shareholders but lead to a decrease in the probability of value-increasing takeovers, therefore they are not optimal from a welfare point of view.

However, we are assuming here that raiders know their valuations perfectly, therefore we are ignoring any possible gains in information to raiders, when they are given more time. Otherwise, more waiting will also mean a higher probability of entry by the rival raider, since he will have more time to gather information about his valuation. To incorporate such a possibility, we will need a dynamic model where the raiders' valuations,
x and s are dependent on time. Such a model will incorporate the value of time as it permits the shareholders and the raiders to gather more information on the target, which means that the raiders' valuations as well as x and s increase with time.
EMPIRICAL TESTS AND RESULTS

Introduction

In this section we indirectly test some of the conclusions of the theoretical model. We estimate a regression model relating the length of the pre-bidding period to takeover costs, the raiders' valuations and the existence of large shareholdings. Since we have no direct measure of the takeover's fixed costs or the reservation price at which a raider can hope to acquire a target firm, we chose some variables that affect them. We assume that the raiders can predict the management's reaction to the takeover. Therefore, they expect the takeover's sunk cost and price to be higher in the case of a hostile takeover. Based on aforementioned, we expect a longer pre-bidding waiting period for hostile takeover attempts than for friendly ones. We expect the size of the target to have some effect on the takeover costs, and we test whether this variable affects the pre-bidding period. We also look at the effect of the bid premium on the pre-bidding period. A high premium signals a high valuation since a raider has an incentive to signal a high bid to deter his competitors (Fishman, 1988). Our model predicts that raiders offering high premiums will have, on the average, a shorter pre-bidding period.

We also study the effect of the existence of a large shareholder and the fraction of shares she owns in the firm on the pre-bidding period. In our model, a raider enters faster when she owns some shares in the firm. However, she also discourages other bidders from entering. The overall effect, therefore, is not clear.

We conduct a separate test to study the effect of the existence of the large shareholder on the total number of active bidders. We expect the number of bidders to be smaller when a large shareholder is active in the bidding.
**Hypotheses**

We now formalize the testable hypotheses that emerge from the theoretical model.

**H1.** The pre-bidding period depends on the size of the target firm and is shorter for smaller firms. We argue that the takeover costs are higher for larger firms, since it takes more time and effort from the raider to analyze the firm and to secure credit for the bid.

**H2.** The pre-bidding waiting period in a takeover, with a large shareholder that is also an active bidder, could be shorter or longer than, with a raider that owns no shares in the target. The percentage of shares owned by the large shareholder also affects the pre-bidding period. We expect the large shareholder to have a shorter waiting period. However, the other raiders will have on average a longer pre-bidding waiting period. The final effect is therefore not clear.

**H3.** The pre-bidding waiting period for takeovers with higher initial bids is, on average, shorter. A higher premium signals that the valuation of the bidder is higher and, therefore, the pre-bidding period will be shorter.

**H4.** The pre-bidding waiting period is longer when the target's management is expected to be hostile to the bid. When the raider believes that the management will be hostile to the takeover attempt, he expects to pay higher takeover costs and the probability that his bid will succeed decreases due to possible litigation. The price he expects to pay for the firm also increases, since the shareholders will have more time to study the bid and it is harder to persuade them to tender their shares against the
management's advice. Therefore, we expect the pre-bidding waiting period to be longer for hostile takeovers, assuming the raiders will have an indication of the management's intent.

H5. The pre-bidding waiting period will be longer, the larger is the number of active raiders in the bidding. This hypothesis is not a direct result from our model, but since the rationale behind waiting is to avoid a bidding war we expect that when the number of potential rivals increases, the raider will have a longer pre-bidding period. We assume that the actual number of raiders is correlated with the expectations of the raiders before the bidding.

H6. The number of active raiders will, on average, be smaller when there is an active raider that is also a large shareholder. The existence of the large shareholder, because of the advantage of his large ownership in the firm, discourages the entry of other raiders. Therefore, we expect that on average less of them will decide to enter when there is a raider/large shareholder.

We first specify a linear regression model to test the hypotheses H1 through H5 and describe the variable measurement and data sources. We present preliminary t-tests analyses for hypotheses H2 and H4 before reporting and discussing the regression results. Finally, we conduct a t-test to test hypothesis H6.

**Model specification**

To test hypotheses H1, H2, H3, H4 and H5, we use the following linear regression model:

\[ t = a_0 + a_1 S + a_2 O + a_3 Pr + a_4 M + a_5 N + e \]
where:

\( t: \) Time before entry in the bidding, i.e., the period between the time when the target was first put in play and when a first bid was made.

\( S: \) A variable that reflects the size of the bid.

\( O: \) Percentage of shares owned by the first bidder at the time of the bid.

\( Pr: \) The premium paid for the firm.

\( M: \) A dummy variable that indicates the management's reaction to the bid. \( M = 0 \) when the takeover is hostile, and \( M = 1 \) when it is friendly.

\( N: \) The number of raiders.

We expect the sign of the coefficients in the regression to be as follows: \( a_1 \) - positive, \( a_2 \) - positive or negative, \( a_3 \) - negative, \( a_4 \) - negative and \( a_5 \) - positive.

**Variable measurements and data sources**

We obtained data on tender offers from the University of Rochester's Managerial Economics Research Center (MERC) database which contains almost all tender offers where one of the companies involved in the takeover was listed on the NYSE (New York Stock Exchange) or the AMEX (American Exchange) over the period 1958-1984. We chose the period between 1975 and December 1984, to look at the more recent takeovers.
Illustration of the calculation for the pre-bidding period

1. Measured in days, as the time lag between the date when a company was first put on play (t1), and the date at which the first bid was made (t2), as shown in figure 21.

A company was considered put on play when there was some public interest in acquiring the company. Such information was obtained from the Wall Street Journal Index (WSJI) issues preceding the year of the bid announcement. We used the following signals to determine the date at which the target was first put on play:

1. Acquisition or change in control of a large block of the target's shares
2. Discussions or rumors of discussions with the target of a possible merger or acquisition
3. Rumors or talk of the possibility that the firm is on play
4. Reports that the firm received some interest from potential raiders (usually unidentified)
5. The initiation of litigation against a large shareholder
6. Proxy fight or the blockage of a proxy fight.
We started with 195 tender offers but could find information on date 1 for only 61 tender offers. The data on date 2 was also obtained from the WSJI. In Appendix 1 we present some illustrations of the way in which we determined date 1 and date 2.

\( S \) Measured as the number of shares, \( X \), sought by the raider, multiplied by the price per share, \( P_1 \), of the target one month prior to date 1. The data on \( X \) was obtained from the MERC data base. The data on \( P_1 \) was found in the Standard and Poor's Daily Stock Exchange Record for the stock exchange to which the target belongs (NYSE, the ASE or the OTC).

\( Q \) Measured as the percentage of shares owned by the first bidder. The percentage of shares owned by the raiders was calculated by dividing the number of shares held at the time of the bidding, by the total number of shares outstanding. We obtained the data on these two variables from the MERC data base. We note that whenever there was a raider that owned some shares in the target firm, that raider was the first entrant.

\( Pr \) Measured as the difference between the first offer price per share \( P_3 \) and the price per share of the target \( P_2 \), 30 days before the bidding, divided by \( P_2 \). We obtained the data on \( P_3 \) from the MERC data base and the data on \( P_2 \) from the Standard and Poor's Daily Stock Price Record (DSPR) of the stock exchange in which the target was listed.

\( M \) Measured as a dummy variable equal to 0 when the takeover was hostile and 1 when it was friendly. The information on the management's reaction was obtained from the WSJI and the MERC data base.

\( N \) Measured as the number of active raiders. Our source for this variable was again the MERC data base.
Preliminary tests of the hypotheses H2 and H4

We now present the results of t-tests that test for hypotheses H2 and H4. Using ranked data because of the large differences between data points (the data sets are in Appendix 2), we stratified the data into four samples as follows:

S 1*: Sample of friendly takeovers with a population mean of the pre-bidding period equal to M1.

S 2*: Sample of hostile takeovers with a population mean of the pre-bidding period equal to M2

S 3*: Sample of the takeovers where one of the raider is a large shareholder (she owns 5% of the target's shares or more), with a population mean for the pre-bidding period equal to M3.

S 4*: Sample of the takeovers where no one of the raider is a large shareholder, with a population mean for the pre-bidding period equal to M4.

We use the asterisks to designate ranked data samples, all the samples are presented in the appendix.

Testing for differences between M1 and M2

The pooled standard deviation:

\[ s_p = \sqrt{\frac{20(11.87) + 22(11.28)}{21 + 23 - 2}} = 3.4 \]

The t-statistic:
\[
 t = \frac{28.02 \cdot 16.45}{3.4 \sqrt{\frac{1}{21} + \frac{1}{23}}} = 11.34
\]

Our test of a difference in the pre-bidding waiting period between hostile and friendly takeovers is significant at a 1% significance level. We, therefore, conclude that on average the raiders have a longer waiting period when the management reacts negatively to the takeover. If we assume that raiders have some indication of the management's reaction before the bidding, the result is consistent with our findings, since the raiders expect higher \(x\) (reservation price) and \(s\) (takeover costs) in case the takeover is hostile.

*Testing the difference between M3 and M4*

The pooled standard deviation:

\[
 s_p = \sqrt{\frac{21(13.86) + 21(11.867)}{22 + 22 - 2}} = 3.5
\]

The t-statistic:

\[
 t = \frac{23.795 - 21.204}{3.5 \sqrt{\frac{1}{22} + \frac{1}{22}}} = 2.456
\]

Our test shows that the pre-bidding waiting period for the large shareholder/raider is on average longer than for the raider that does not own any shares in the target. This result is contrary to our expectation, we note, however, that whenever there was a raider/large shareholder, he was the first entrant. This latter fact is consistent with our discussion of the case with a large shareholder.
Results of the regression

Table 8 summarizes the results of the regression. The variables with significant coefficients are noted by asterisks.

Model: \( t = a_0 + a_1 S + a_2 O + a_3 Pr + a_4 M + a_5 N + e. \)

Table 8: Results of the regression

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>T-ratio</th>
<th>Mean</th>
<th>Std. D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>95.3142</td>
<td>2.743</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>S</td>
<td>0.0000049</td>
<td>0.169</td>
<td>151120</td>
<td>301540</td>
</tr>
<tr>
<td>O*</td>
<td>98.868</td>
<td>1.983</td>
<td>0.119</td>
<td>0.1652</td>
</tr>
<tr>
<td>Pr*</td>
<td>-31.9752</td>
<td>-0.946</td>
<td>0.499</td>
<td>0.261</td>
</tr>
<tr>
<td>M*</td>
<td>-44.213</td>
<td>-2.523</td>
<td>0.477</td>
<td>0.505</td>
</tr>
<tr>
<td>N</td>
<td>-8.599</td>
<td>-0.527</td>
<td>1.432</td>
<td>0.586</td>
</tr>
<tr>
<td>t</td>
<td>............</td>
<td>..........</td>
<td>58.477</td>
<td>58.7005</td>
</tr>
</tbody>
</table>

\( R^2 = 0.269 \)

The coefficient of S, the size of the bid, is positive as we expected. When the target is large the raider needs more time to gather information on it and to secure financing. It is, however, not significant.

The coefficient of O, the percentage of shares owned by the first entrant is positive and significant. The result reflects the effect of the existence of a large shareholder on the time of entry of rival raiders. We, however, expected the coefficient to be negative since the large shareholder is the first entrant in all the cases we looked at except one. Since the first entrant is a large shareholder, we expected him to enter faster on average. The fact that in most cases the first entrant was the large shareholder whenever there is a large shareholder
active in the bidding, indicates that rival bidders were discouraged from entry. A possible reason for the delay in entry by the large shareholder is that in our sample the large shareholder owned such a large percentage (55% in some cases) of the target's outstanding shares that she was not concerned about facing competition.

The coefficient on Pr (bid premium) is negative, as we expected, but not statistically significant. The coefficient on M (management's reaction) is negative and significant. The result is consistent with our predictions. For the takeover attempt where the management's reaction was hostile, the pre-takeover waiting period was on average longer. The coefficient for N is positive but not significant.

Testing for H6

We finally conduct a t-test to test H6. We look at the difference between the number of active bidders in takeovers with a large shareholder and those that have no raider/large shareholder. We divide the data into two samples S5 and S6 where:

S5: Sample of the takeovers that have an active raider/large shareholder, and with a population mean for the total number of active raiders equal to M5.

S6: Sample of the takeovers that have no active raider/large shareholder, and with a population mean for the total number of active raiders equal to M6.

We present the two samples in the appendix.

Testing for differences between M5 and M6:

The pooled standard deviation:

\[ s_p = \sqrt{\frac{21(0.505) + 21(0.673)}{22 + 22 - 2}} = 0.767 \]

The t-statistic:
\[
  t = \frac{1.590 - 1.409}{0.767 \sqrt{\frac{1}{22} + \frac{1}{22}}} \approx 0.787
\]

The t-statistic is not significantly different from zero and we find no support for hypothesis H6.

**Discussion of the empirical analysis**

Our empirical analysis does not constitute an exact or rigorous estimate of the theoretical model but rather, tests of some of its implications. The model predicts a faster entry into the bidding, the lower the cost of the takeover and the higher the bidders' valuations. The model also predicts faster entry when the bidder is a large shareholder. To the extent that we cannot precisely identify the time of the initial interest in the target, our measure of the dependent variable is likely to be noisy. However, with measurement errors in the dependent variable, the coefficients of the explanatory variables will still be unbiased and consistent. If unbiased, the measurement errors result in higher error variance. If biased, the measurement errors generate a significant intercept term as, in fact, we do observe. With respect to the explanatory variables, we have more confidence in our proxy measures for the costs of the takeover than for the bidders' valuations relative to the targets' reservation price. The management reaction to the bid, friendly or hostile, and the size of the target are reasonable measures of the bidders' costs. The coefficient of the latter variable is significant with the expected sign while the coefficient for the target's size tested insignificant. The bidders' valuations are very approximately measured by the premium offered relative to the pre-bid price rather than with respect to the target's reservation price, which is not observable. The coefficient of this variable is insignificant. Our findings with respect to the large shareholder as the raider are not consistent with the predictions of the
model. However as we have mentioned there might be another factor affecting the behavior of the large shareholder that we do not consider in our model. The large shareholder due to his large shareholding in the target might not be concerned with rivalry and might be spending more time on information gathering about the value of the target to her.

Overall, the analysis provides support for some of the predictions of the theoretical model, the problems in the measurement not withstanding.

There is the possibility of some future work that would provide further evidence on the results of our model. A possible test that we did not consider here is for the relation of the target's anti-takeover amendments to the pre-bidding waiting period. We, however, predict that such a test would provide similar results as the management's reaction to the bid. We expect the takeover costs to be higher for targets with anti-takeover amendments and therefore the pre-bidding period to be longer.

A test for the effect of the period of time in which the takeover took place using a more recent set of data could also be useful. Takeovers' costs in the latter part of the 80's have been higher due to harsher anti-takeover state laws. We could also study the effect of the target's state of incorporation on the pre-bidding period. Takeover state laws vary among states and harsher laws mean higher costs for the raiders.
CONCLUSION AND FUTURE RESEARCH

We investigated the timing decision of potential raiders in the context of a takeover with asymmetric information. We found that raiders delay entry when the takeover cost and the target's reservation price increase and that the existence of a large shareholder would discourage other potential raiders from entering. The large shareholder will on average enter into the bidding faster than a raider that owns no shares in the target. Finally, the management of the target firm could potentially be acting in the shareholders' interests when it increases the price a raider has to pay to acquire the firm. However, when the takeover sunk cost increases the shareholders' expected payoff decreases.

Some of our empirical results generally support the theoretical model. One major result is that the raiders involved in friendly takeovers have on average a smaller pre-bidding period. The raiders expect a lower takeover cost and reservation price when they expect a friendly takeover. The premium offered by the raiders and the size of the target had no significant effect on the pre-bidding period in our results. The takeovers that had a raider that is a large shareholder had on average a longer pre-bidding waiting period. In these takeovers the first bidder was the large shareholder except in one case. This fact supports our theoretical results, however we expected the large shareholder to enter faster on average. A possible explanation to this result is that many of these large shareholders had such a large percentage of ownership in the target that they were not threatened by competition. Such raiders could have taken their time in preparing their bid. Fishman (1988) recognizes time as an important factor in a takeover. He notes that since takeovers "can last weeks and even months" potential raiders can have the time to gather information about the target firm. He focuses on the signal value of a high initial bid that can discourage other bidders from gathering information about the target during the time a bid remains open. Here we argue that there is another aspect to timing. A raider with a low valuation will wait longer before he makes a bid since he is afraid of facing a bidding war with a bidder with a higher valuation.
The raider however would not want to wait too long since he risks loosing the bid. A basic assumption of our model is that the raider has to make the decision of entering at the beginning of each period and cannot change this decision. The assumption reflects the actual time and the resources needed to prepare a bid. However, in our model the raiders’ valuations are independent of time and each raider perfectly knows his valuation. In a more general model that would incorporate the importance of time in gathering information about the target firm, the valuations of the raiders, the takeover cost and the reservation price of the firm would be dependent on time. In such a dynamic model, the raider would want to wait enough time until he gathers information about his valuation. He would not however, want to wait too long since the takeover cost, the reservation price for the firm and the expected valuation of his rivals increase with time. Therefore the expected price he has to pay for the firm and the probability of facing competition increase. We believe that such a model would provide a more general understanding of the bidders’ strategies in a takeover and should be the subject of further research.
REFERENCES


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Appendix 1

We consider any set of cutoff points $v_{m-2}$, $v_{m-1}$, $v_m$ and $v_{m+2}$. Then we look at the case of a raider with a valuation equal to $(v_{m-1} - \beta)$, which is by definition also equal to $(v_m + \mu)$, with $\beta$ and $\mu$ positive numbers satisfying the equality $v_{m-1} - \beta = v_m + \mu$.

![Diagram showing the position of a raider's valuation in the general model]

**Figure 22**

*Illustration of the position of a raider's valuation in the general model*

The expected payoff of a raider with a valuation $v_{m-1}$ if he decides to enter in period $m-1$:

$$(1-v_{m-2})0 + (v_{m-2} - v_{m-1})(-s) + v_{m-1}v_{m-1}x-s)$$

Expected payoff for a raider with a valuation $v_{m-1}$ if he decides to enter in period $m$:

$$(1-v_{m-1})0 + (v_{m-1} - v_m)\left(v_{m-1} - \frac{v_{m-1} + v_m}{2}s\right) + v_m(v_m - x - s)$$

These two expected payoffs should be equal since the cutoff point $v_{m-1}$ is equal to the valuation of a raider that is indifferent between entering in period $m-1$ and $m$.

The expected payoff of a raider with a valuation $v_{m-1} - \beta$ if he enters in period $m-1$:

$$(1-v_{m-2})0 + (v_{m-2} - v_{m-1})(-s) + v_{m-1}(v_{m-1} - \beta - x - s)$$

Expected payoff of a raider with a valuation $v_{m-1} - \beta$ if he enters in period $m$:

$$(1-v_{m-1})0 + (v_{m-1} - v_{m-1} + \beta)(-s) + (v_{m-1} - \beta - v_m)$$
\[(v_{m-1} - \frac{\beta + v_m}{2}) - s) + v_m(v_{m-1} - \frac{\beta - x}{2})\]

The difference between the expected payoff for a raider with valuation \(v_{m-1}\) and the expected payoff for a raider of valuation \(v_{m-1} - \beta\) if they decide to enter in period \(m-1\):

\[\beta v_{m-1}\]

The difference between the expected payoff for a raider with valuation \(v_{m-1}\) and the expected payoff for a raider of valuation \(v_{m-1} - \beta\) if they decide to enter in period \(m\):

\[\beta v_{m} + (v_{m-1} - v_{m})(v_{m-1} - \frac{v_{m-1} + v_m}{2}) - (v_{m-1} - \beta - v_{m})(v_{m-1} - \frac{\beta}{2} - \frac{v_{m-1} + v_m}{2})\]

\[= \beta v_{m} + \beta(v_{m-1} - \frac{v_{m-1} + v_m}{2}) + (v_{m-1} - v_{m})(\frac{\beta}{2})\]

\[= \beta v_{m} + \beta(v_{m-1} - v_{m}) - \frac{\beta^2}{2}\]

The expected payoff of a raider of valuation \(v_{m-1} - \beta\) in case he enters in period \(m\) is, therefore, greater than his expected payoff if he enters in period \(m-1\).

The raider with valuation \(v_{m-1} - \beta\) will prefer to enter in period \(m\) rather than \(m-1\).

We next prove that the raider with valuation \(v_m + \mu = v_{m-1} - \beta\) prefers to enter in period \(m\) rather than \(m+1\).

Expected payoff of a raider with valuation \(v_m\) if he enters in period \(m\):

\[(1-v_{m-1})0 + (v_{m-1} - v_{m})(-s) + v_m(v_{m} - x - s)\]

Expected payoff of a raider with valuation \(v_m\) if he enters in period \(m+1\):

\[(1-v_m)0 + (v_{m} - v_{m+1})(v_{m} + v_{m+1} - \frac{s}{2}) + v_{m+1}(v_m - x - s)\]

These two expected payoffs should be equal since the raider with valuation \(v_m\) is defined to be indifferent between entering in period \(m\) or \(m+1\).

Expected payoff of a raider with valuation \(v_m + \mu\) if he enters in period \(m\):

\[(1-v_{m-1})0 + (v_{m-1} - v_{m} + \mu)(-s) + (v_m + \mu - v_m)\]
\( (v_m + \frac{v_m + \mu + v_m}{2} \cdot s) + v_m (v_m + \mu - x - s) \)

Expected payoff of a raider with valuation \( v_m + \mu \) if he enters in period \( m+1 \):

\( (1 - v_m)0 + (v_m - v_{m+1} - (v_m + \mu - \frac{v_m + v_{m+1}}{2} - s) + v_{m+1} (v_m + \mu - x - s) \)

The difference between the payoffs of raiders with valuations \( v_m \) and \( v_m + \mu \) when they enter in period \( m \):

\[-\mu s - (v_m + \mu - v_m)(v_m + \frac{\mu}{2} - v_m - s) - \mu v_m \]

\[-\mu s - \mu (\frac{\mu}{2} - s) - \mu v_m = -\frac{\mu^2}{2} - \mu v_m \]

The difference between the payoffs of raiders with valuations \( v_m \) and \( v_m + \mu \) when they enter in period \( m+1 \):

\[-\mu (v_m - v_{m+1}) - \mu v_{m+1} = -\mu v_m \]

The difference in the expected payoffs of raiders with valuations \( v_m \) and \( v_m + \mu \) when they enter in period \( m \) is smaller in absolute value than when they enter in period \( m+1 \).

However, this difference is negative, therefore the raider with valuation \( v_m + \mu \) will decide to enter in period \( m \) rather than period \( m+1 \).

We proved that a raider, with a valuation situated between any two cutoff points, will decide to enter in the period defined by the two cutoff points. Taking in consideration the beliefs the raider has on the other raider's valuation and that the other raider will act according to the structure of the equilibrium.
Appendix 2: Solutions that did not satisfy the constraints.

Table 9: Simulations to Illustrate the Multiplicity of Solutions

<table>
<thead>
<tr>
<th>x</th>
<th>s</th>
<th>( \beta )</th>
<th>( Z_R )</th>
<th>( Z_L )</th>
<th>( W_R )</th>
<th>( W_L )</th>
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<td>0.1</td>
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<td>0.21338</td>
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<td>0.432</td>
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Table 10: Simulations to Illustrate the Multiplicity of Solutions

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<th>( Z_L )</th>
<th>( W_R )</th>
<th>( W_L )</th>
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We could not get solutions that satisfy the constraints for all of the parameters values that we tried. We also noticed that we obtained two different solutions for some of the parameters values. For some parameter values we had two different results whether we approach the values slowly by asking the computer to calculate solutions for values that are close to the ones in question or whether we plug in the values immediately to find the solution (see tables 9 and 10). As it is illustrated in the tables we initially wanted to investigate certain sudden jumps in the values of the solutions when we changed the value of one of the parameters. For a change in the value of s from 0.0857 to 0.0856 the value of \( Z_R \) increased from 0.3904 to 0.5605. We kept on breaking up the change until it was between 0.085613 and 0.085614 when we broke it down further to the eight'th decimal the
jump in value in the solution disappeared and we ended up with two different solutions for $s = 0.08561386$. The same is true for $s=0.0998$ in table 10.

We did not however get two solutions for the same set of parameters that both satisfied the constraints.
Appendix 3

Table 11: Contradictory Results for the Sign of the Derivative of $Z_R$ with respect to $\beta$

<table>
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<th>$x$</th>
<th>$s$</th>
<th>$w$</th>
<th>$dZ_L/d\beta$</th>
<th>$dZ_R/d\beta$</th>
<th>$dW_L/d\beta$</th>
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</thead>
<tbody>
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<td>0.5</td>
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<td>-0.14765</td>
<td>-0.14649</td>
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<td>-0.40301</td>
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<td>0.31035</td>
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$dW_R/d\beta$ | $Z$
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<tbody>
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<td>0.57565</td>
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<tr>
<td>0.07893</td>
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We could not explain the results obtained in table 11 since they suggest that for certain values of $x$ and $s$, some of the raiders would decide to enter faster when their opponent acquires a small but positive percentage of ownership in the firm. The only explanation that we can suggest is that the raider expects the valuations of a possible opponent to be smaller on average.
Appendix 4: The effect of introducing the discount rate in the two-period model.

When we introduce a discount rate, \( r \), into the model the expected payoff for the raiders when they decide to enter in the second period changes, and must be discounted by \( r \). The condition for a raider with valuation \( z^* \), to be indifferent between entering in the first period and the second becomes:

\[
z^*(z^*-x-s)+(1-z^*)(-s) = r\{ w^*(z^*-x-s)+(z^*-w^*)(z^*-s-\frac{z^*+x}{2}) \}
\]

The condition for a raider with valuation equal to \( w^* \), to be indifferent between entering in the second period and not entering becomes:

\[
r\{(z^*-w^*)(-s) + w^*(w^*-x-s)\} = 0
\]

Therefore, the condition that \( z^* = \frac{w^*2-2xw^*}{s} \) still holds.

In the case where we had no discount rate, the two cutoff points for the two-period model with two raiders solve for the following two equations:

\[
z(z-x-s)+(1-z)(-s) = w(z-x-s)+(z-w)(z-s-\frac{z+x}{2})
\]

\[
z = \frac{w^*2-xw^*}{s}
\]

Therefore the cutoff points for the model with no discount rate, \( z \) and \( w \) will be respectively bigger than \( z^* \) and \( w^* \). Some of the raiders that used to enter the second period, since delaying entry involves a bigger cost, decide to enter the first period. For these raiders the extra risk from an early entry is offset by the extra costs from delay. Furthermore, some of the raiders that did not enter at all now decide to enter in the second period. This is due to a second effect of the introduction of the discount rate. The expected valuations of the raiders that enter in the second period and the probability of entry decrease, since some of the raiders with high valuations will now enter the first period. Therefore, the expected
payoff for a raider, that did not enter in our original model, when he enters the second period increases.
APPENDICES TO CHAPTER 4

Appendix 1

We will present how we determined the date when the target was put in play for some of the tender offers we considered:

1. Mostek Corp (target firm, T); United Tech corp (raider, R)
   - Date the firm was first put on play (t1=9/6/1979):
     *G K Technologies Inc. agreed to sell its 21% interest in firm to Gould Inc. for $51.5 million.*
   - Date of takeover (t2=9/28/1979):
     *Firm and United Tech. Corp. agreed that later will make tender offer for firm's stock at $62 a share.*

2. Wallace Murray Corp.(T); Household Intl. Corp. (R)
   - Date the firm was first put on play (t1 = 2/4/1981):
     *Firm approached by unspecified company "looking to a possible combination of the businesses".*
   - Date of takeover (t2 = 2/28/1981):
     *Household Intl. Corp. agreed in principle to buy Wallace-Murray for cash and stock, in a two-step transaction valued by Household at more than $ 300 million.*

3. St. Regis Corp. (T), Rupert Murdoch (R1), Champion Intl. Corp. (R2).
   - Date the firm was first put on play (t1 = 2/9/84):
     *St. Regis seen as likely takeover target as unidentified buyer pays 2-point premium for huge block of shares.*
• Date of takeover (t2 = 7/19/84):
  *Murdoch offered $52 a share to boost his stake to 50.1% of St. Regis Corp.; he also said he would offer to acquire each remaining share for $52 of securities within next year.*

4. Sunshine MNG Co. (T), Hunt Intl. Res. Corp. (R)

• Date the firm was first put on play (t1 = 9/27/78):
  *Hunt International Resources Corp. is discussing preliminary proposals with firm on possible combination of the two firms.*

• Date of takeover (t2 = 2/14/79):
  *Hunt proposed cash merger to board of firm offering each sunshine holder $15 a share.*

5. Alcon Labs Inc. (T), Nestle la mur Co. (R)

• Date the firm was first put on play (t1 = 10/7/77):
  *Exploring "expressions of interest" in acquiring it from several companies.*

• Date of takeover (t2 = 10/18/77):
  *Firm said Nestle S. A. of Switzerland proposed to make tender offer through U.S. unit for all of Alcon's outstanding common stock at $42 a share.*

6. Liggett Group Inc. (T), Grand Metropolitan Ltd (R1), Standard Brands Inc. (R2)

• Date the firm was first put on play (t1 = 3/25/1980):
  *Grand Metropolitan Ltd. has about doubled its stake in firm to 9.5%; firm declared it intends to repel further advances.*
7. Lehigh Portland Cement Co. (T), Portland Zementwerk (R)

- Date of takeover ($t_2 = 4/15/1980$):
  *Grand Metropolitan plans $415 million tender offer for firm. Bid faces variety of hurdles and wasn't welcomed.*

- Date the firm was first put on play ($t_1 = 6/29/1977$):
  *Holding "preliminary discussions" relating to its acquisition by an unidentified company.*

- Date of takeover ($t_2 = 9/6/77$):
  *Said West Germany company, Portland-Zementwerk Heidelberg A.G. offered to buy all of Lehigh Portland's outstanding common shares at $25 a share, down $2.125 from recent market price of stock.*

8. SAVA Stop Inc. (T), Consolidated Foods Corp. (R)

- Date the firm was first put on play ($t_1 = 1/17/82$):
  *Firm is negotiating with an unidentified large firm interested in acquiring the rack-merchandising concern.*

- Date of takeover ($t_2 = 1/11/82$):
  *Consolidated Foods Corp. agreed in principle to acquire Sav-A-Stop Inc. for $16 for each of the firm's 4.5 million shares.*

9. Telecom Corporation (T), Tiger International (R):

- Date the firm was first put on play ($t_1 = 6/22/79$):
  *Unidentified parties have expressed an interest in negotiating the purchase of certain Telecom assets, but it hasn't received a formal offer.*
• Date of takeover (t2 = 8/14/79): 
  *Tiger Int. Inc. offered to buy any and all of firm's shares for $21.50 cash for total of about $40.9 million.*

10. Pittsburgh Forgings Co. (T), Ampco-Pittsburgh Co.(R)

• Date the firm was first put on play (t1 = 6/26/79): 
  *Ampco-Pittsburgh Corp. is "reviewing some increase in its holdings" of firm's stock.*

• Date of takeover (t2 = 7/3/79): 
  *Ampco-Pittsburgh plans a tender offer for 600,000 shares of firm at $38 each.*
Appendix 2: Data samples for the t-tests

Table 12: Data samples. S1 and S2 representing the pre-bidding period for hostile and friendly takeovers. S3 and S4 representing the pre-bidding period for takeovers with and without a large shareholder, and S5 and S6 the number of active raiders in takeovers with and without a large shareholder.

<table>
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<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
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### Ranked data samples

Table 13: Ranked data of S1, S2, S3 and S4

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Appendix 3:

The data used in the regressions:

Table 14: Data used in the regression for the variables: t1, t2, t, P1, X and S

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