UNIVERSITY OF ALBERTA

THE INFORMATIONAL EFFECT OF MANAGEMENT'S DECISION TO LOBBY AGAINST PROPOSED ACCOUNTING STANDARDS

BY

© **DENNIS Y. CHUNG**

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **The Informational Effect Of Management's Decision To Lobby Against Proposed Accounting Standards** submitted by **Dennis Y. Chung** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Accounting**.

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ABSTRACT

This study explored the possibility that certain information might be revealed through management's lobbying position. In the first part of this study, a lobbying model was formulated to examine a proposed accounting standard which, if passed, would require the financial statement recording of some previously undisclosed liabilities. Given proprietary cost, management had the incentive to lobby against this standard. However, lobbying against the standard might reveal to the market information about the liabilities. The lobbying model examined how management's lobbying behaviour might be affected by such informational effect.

In the second half of this study, empirical data were collected to provide some evidence on the informational effect. Lobbying data on the FASB's 1982/83 proposal of accruing postretirement benefits were used. If management's lobbying against this standard did reveal some information about the existence of the obligations, then different market reactions to the first-time disclosure of the information might be detected between the groups of "lobbying" and "no-lobbying" companies, conditional on their liability levels. Consistent with the predicted implications, significant positive abnormal returns were found for the "lobbying/low OPEB" companies. There were some indications of negative abnormal returns for the "no-lobbying/high OPEB" companies. However, these negative returns were generally not statistically significant.

Additional procedures were also performed to gain further insights into the observed differences in the market's response between the "lobbying" and the "no-lobbying" groups. An alternative approach to the event study methodology was used to measure the information content of the management's lobbying position. However, the results were poor suggesting that there might not be sufficient gains for a market trader to act on and benefit from the information.

Cross-sectional regressions were also used to investigate the relationships between the market response and the accounting disclosure of the OPEB information. The results showed that the abnormal returns were significantly related to the lobbying position of a firm, the amount of OPEB expenditures reported in its first-time OPEB disclosure, and to a lesser extent, the size of the company.

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF SYMBOLS

$\tilde{V}$ Liquidation value of the firm

X Fixed cash inflow over life of the firm

$\tilde{L}$ Amount of the previously undisclosed liability,

$$\tilde{L} = \begin{cases} \bar{L} & \text{if the company has a high liability} \\ \underline{L} & \text{if the company has a low liability} \end{cases}$$

$\mathbb{L}$ Difference between the high and low levels of liability $\mathbb{L} = \bar{L} - \underline{L}$

p_i Prior probability of $\tilde{L} = \bar{L}$ for Company i, i = A, B

p'_i Market revised probability of $\tilde{L} = \bar{L}$ for Company i if Company i management does not lobby against the proposed accounting standard, i = A, B

p''_i Market revised probability of $\tilde{L} = \bar{L}$ for Company i if Company i management lobbies against the proposed accounting standard, i = A, B

$\tilde{M}$ Proprietary cost of disclosure

$$\tilde{M} = \begin{cases} \bar{m} & \text{if the proposed standard is passed and } \tilde{L} = \bar{L} \\ \underline{m} & \text{if the proposed standard is passed and } \tilde{L} = \underline{L} \\ 0 & \text{if the proposed standard is abandoned} \end{cases}$$

S_t Market value of firm shares at time t

Ω_t Set of information available to the market at time t

c Out-of-pocket cost of lobbying against the proposed accounting standard

q_j Probability of the standard setting body passing the proposed accounting standard when there are j firms lobbying against the proposed standard, j = 0, 1, 2

$\hat{q}$ Market assessed prior probability of the accounting standard setter passing the proposed acccunting standard

LIST OF SYMBOLS (CONTINUED)

LA	Choice of Company A management to lobby against the proposed accounting standard
NL	Choice of Company A management not to lobby against the proposed accounting standard
la	Choice of Company B management to lobby against the proposed accounting standard
nl	Choice of Company B management not to lobby against the proposed accounting standard
(ϑ,ξ)	Management's normalized strategy representing the choice of ϑ if the company has a high liability and the choice of ξ if the company has a low liability ϑ = LA or NL for Company A; la or nl for Company B ξ = LA or NL for Company A; la or nl for Company B
φ_{ik}	Probability measures specifying the use of (ϑ,ξ) by Company i management φ_{A1} and φ_{B1} for the use of (LA,LA) and (la,la) respectively φ_{A2} and φ_{B2} for the use of (LA,NL) and (la,nl) respectively φ_{A3} and φ_{B3} for the use of (NL,LA) and (nl,la) respectively φ_{A4} and φ_{B4} for the use of (NL,NL) and (nl,nl) respectively

CHAPTER 1
NATURE OF THE STUDY

1.1 Introduction

The setting of accounting standards plays an important role in affecting how, when, and where corporate financial information is disclosed. It is an area that should be of interest to all members of the accounting profession and the general business community. The choice of proper accounting standards has always been a contentious issue facing the accounting profession. With the often diverse and conflicting interests of financial statement users, there rarely exists an accounting standard that is acceptable to all parties involved. The procedure involved in gaining the general acceptance of a standard is essentially a political process. As many accounting researchers have pointed out, it is the political competence and not the technical competence of an accounting standard that can most affect the effectiveness of the standard (Horngren 1973; Gerboth 1973; Sunder 1988).

One way special interest groups can influence the setting of accounting standards is through lobbying. This study examines one particular type of lobbying activity undertaken by corporate management in its attempt to influence the outcome of the standard setting process. The study focuses specifically on management's submission of comment letters as a means to lobby the standard setting body.

In a recent study, Gibbins, Richardson and Waterhouse (1989,1990) reported evidence that companies might follow an opportunistic or a ritualistic approach in dealing with financial disclosure. If companies are concerned about the impact of certain information on the market, they may take extra steps to manage its disclosure. It is also possible that, in concert with managing their disclosure policy, these companies may also be managing their lobbying policy too. This study attempts to address the questions of why management may or may not want to lobby against a proposed accounting standard and whether some of management's private information may be revealed to the general public through its lobbying decision.

1.2 Prior Research

Studies of corporate lobbying activities have been conducted by many accounting researchers. A more complete description of the major accounting studies on lobbying is presented in Appendix A.

Positive research is the predominant approach used in accounting for the study of corporate lobbying behaviour. Watts and Zimmerman (1978) conducted the first study in this area to explicitly recognize the motivation behind management's lobbying decision. Observable firm-specific variables were used to capture the anticipated effects of the proposed accounting standard. These variables were then used in regression models to explain management's lobbying position. Similar studies include Dhaliwal (1982), McKee, Bell and Boatsman (1984), Kelly (1985), O'Keefe and Soloman (1985), Francis (1987), Sutton (1988) and Deakin (1989).[1] Firm size, used as a proxy for political costs, was

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[1] These studies examined management's lobbying positions on proposed accounting standards covering topics such as capitalization of interest costs, general price level adjustment, foreign currency translation, oil and gas accounting, and pension accounting in the U.S. and current cost accounting in the U.K.

found consistently to be a significant determinant of management's lobbying position in almost all these studies.

Hakansson (1981) examined the preferences of different interest groups in a disclosure model and suggested that management and large investors would oppose accounting standards that imposed stringent disclosure requirements. The actual modelling of management's lobbying behaviour was attempted in only a few studies. Sutton (1984) used Downs (1957)'s simple voting model to characterize some features of the lobbying scenario in the accounting standard setting process. However, the development of this model in the lobbying setting was generally incomplete. Amershi, Demski and Wolfson (1982) formulated another voting model to show that the single-period perspective used in most empirical lobbying studies might produce misleading results about the true preferences and rewards of the lobbying parties. This voting model was richer in the sense that it took into consideration the strategic interactions among the different lobbying parties. However, their model required a very special structure of payoff dependencies over a series of voting decisions, which might not be present in the accounting standard setting process.

There were also accounting studies which focused on other aspects of corporate lobbying behaviour and the standard setting process. For example, Kelly (1982) and King and O'Keefe (1986) examined the economic consequences of management's reaction to proposed accounting standards and suggested that lobbying positions expressed in the comment letters might provide information to the standard setter about the potential effect of a standard. Haring (1979), Brown (1981) and Puro (1985) examined the influence of special interest groups by studying the empirical relationships among their lobbying positions.

Lobbying was also studied in a policy making context by Hope and Briggs (1982) and Gorton (1991). The lobbying of accounting standards was also examined by Hope and Gray (1982) using a framework of power taken from the sociology and political science literature. These studies provided evidence that accounting standard setting is a highly political process.

In a related line of research, Noreen and Sepe (1981), Smith (1981), Schipper and Thompson (1983), and Ziebart and Kim (1987) examined the stock market's reactions to major shifts in the standard setter's position on proposed accounting standards. Results in these studies generally showed that the market was aware of and responded quickly to the changing position of the standard setter.

1.3 Purpose of this Study

Since the work of Watts and Zimmerman (1978), positive accounting studies on corporate lobbying behaviour have generally assumed a causal relation between lobbying activities and changes in managerial wealth. Lobbying is considered a means to influence the setting of accounting standards, which in turn can affect the company and the well-being of management through the anticipated effects on the reported accounting numbers. These prior studies measured the anticipated effects of a proposed accounting standard by focusing on the increased political exposure of the company, the higher information production costs, the increased likelihood of debt covenants violations, and the changes on managerial incentive compensation. Such effects could affect the stock price of the company which either directly or indirectly would also affect managerial wealth. In this linkage, lobbying affects the stock price of the company through the accounting standards in the form of an indirect "second-order" effect. What may also be possible is a more direct "first-order" effect lobbying can have on the company's stock price. The fact that management is lobbying on a proposed accounting standard may reveal certain information about the company to the market. The revelation of such information to the public will have a more direct effect on the stock price of the firm. This study focuses specifically on this first-order informational effect and examines how it may affect management's lobbying behaviour.

This study has a twofold purpose. First, a model of corporate lobbying behaviour is formulated to describe the informational effect of management's lobbying decision. Equilibrium conditions are derived to show that management's choices can be affected by the existence of the informational effect. Second, empirical data are then gathered in the study to provide some evidence on the possible existence of this informational effect.

To focus on an area which has the potential of producing a strong informational effect, the study deals with corporate lobbying activities on only one particular type of accounting standard. This study focuses on accounting standards that require the financial statement recording of some previously undisclosed liabilities. If the knowledge of such liabilities is private information known only to management of the firm, the public disclosure of the liabilities will produce an immediate negative effect on the firm's stock price. In this case, management may have an incentive to lobby against a standard that requires the disclosure of the private information. However, the fact that management is lobbying against the proposed accounting standard may itself reveal to the market some information about the existence and the amount of the undisclosed liabilities. In other words, if management does not lobby, the accounting standard will likely be passed and management will have to report the liabilities in the financial statements. Alternatively, management can lobby against the proposed standard to try to stop the required disclosure. However, doing so may reveal to the market information about what management is trying to hide in the first place. If the effects of recording the liabilities are sufficiently damaging, management may still lobby even though this will also inform the market about the existence of the liabilities. It is in this setting that the lobbying model attempts to describe the equilibrium lobbying behaviour of corporate management.

It is recognized that management's lobbying activities can take on many different forms. As Lowe, Puxty and Laughlin (1983) and Thompson (1987) pointed out, the setting of accounting standards is a very complex process. It involves the interplay of power and influence among many different groups. A party with special interest can also covertly defeat an accounting standard by making sure that it never gets on the agenda of the standard setting body.[2] The lack of reliable evidence is a major problem hindering the research of such covert lobbying behaviour. For the purpose of this study, only a public form of corporate lobbying activities is examined. Evidence of management's lobbying position is obtained from the comment letters submitted by

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[2] Different forms of lobbying at various stages of the standard setting process were discussed by Hope and Briggs (1982) and Hope and Gray (1982).

management to the standard setting body on the proposed accounting standard. Other more covert forms of activities, such as lobbying through the auditors or trade associations, are not considered in this study.

At this stage of the research, emphasis is placed on only two types of lobbying positions management can take. This study concentrates only on settings in which management would either lobby against the proposed accounting standard or refrain from lobbying totally. The third possible position of lobbying in favour of the standard will not be incorporated in the lobbying model in this study.[3] To rule out the possibility of positive lobbying, it is assumed in this study that, at least in the short run, corporate management will always be worse off if the proposed accounting standard is passed. The assumption also eliminates any incentive for voluntary disclosure in the model. Furthermore, this study does not consider the strategic implications of one company directly benefiting from the use of sensitive information disclosed by another company under the proposed accounting standard.

This study uses a game theoretic model to capture some of the important features of management's lobbying environment in the accounting standard setting process. Studies such as Kelly (1982) and King and O'Keefe (1986) suggested that there might be informational value in management's lobbying position. However, these studies

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[3] Prior studies such as Haring (1979) suggested that preferences of corporate enterprises were often opposite to those of the standard setting body. In this respect, the instances of management lobbying in favour of the proposed accounting standard are expected to be rather limited.

focused only on information about the economic consequences of the proposed accounting standards and ignored other information that might also be revealed through management's lobbying decision. In addition to incorporating the first-order informational effect, the lobbying model in this study also allows "free-riding" in corporate lobbying behaviour. Because of the informational effect, management has an incentive to remain silent on an accounting issue and count on other companies to lobby against the proposed accounting standard. The implication of such "free-riding" possibilities is another area that has not been examined in the accounting literature.

Research on management's lobbying activities will add to our understanding of the political nature of accounting standard setting. Research in this area can also provide insights into the motivation behind management's preferences and choices of certain accounting methods. Results of this study may also be useful in understanding certain findings of previous lobbying research. For example, the results of McKee, Bell and Boatsman (1984) indicated that there might be underlying differences between the two samples of companies which responded to the Financial Accounting Standards Board (FASB) discussion memorandum and the subsequent FASB exposure draft. At these two different stages of lobbying, empirical results on the determinants of management's lobbying position could have been confounded by possible informational effects.[4]

The informational effects of lobbying can also have implications

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[4] At the stage of exposure draft lobbying, the fact that management had previously responded to the discussion memorandum might involve informational effects that were quite different from those present at the stage of discussion memorandum lobbying.

for the interpretation of the significant firm size variable found in most positive lobbying studies. Empirical market studies such as Banz (1981), Atiase (1987) and Ro (1988) have suggested that the amount of predisclosure information available in the market increases with firm size. If management is reluctant to lobby because such action may reveal certain information to the market, then a larger firm would more likely be willing to lobby because the market may already have access to that information and the potential informational effect is smaller. Conversely, as a result of the stronger informational effect, a smaller firm would be more reluctant to lobby because such action may reveal some new information to the market. The existence of the informational effect could have contributed to the significance of the size variable found in previous lobbying studies.

The rest of the thesis proceeds as follows. Chapter 2 describes the basic structure of the corporate lobbying model and presents the results on management's equilibrium lobbying behaviour. Chapter 3 describes the empirical tests conducted in this study and provides evidence on the possible existence of the informational effect. The summary and conclusion are included in Chapter 4.

CHAPTER 2

THE CORPORATE LOBBYING MODEL

2.1 Basic Structure of the Model

The corporate lobbying model consists of four players: two firms identified as Company A and Company B, an accounting standard setting body, and a group of unanimous investors collectively referred to as the market. In this model, it is assumed that management acts in the best interest of the firm's current shareholders. The objective function of management is to maximize the current market value of the firm in a risk neutral manner.[5]

In the lobbying model, there is uncertainty about the amount of a liability, $\tilde{L}$, that each company has to discharge at some future date prior to the liquidation of the firm. For each company, the amount of the liability can be either high or low, denoted by $\bar{L}$ or $\underline{L}$ respectively. Each company has its own unique discrete distribution of $\tilde{L}$ which is known to all the players in the game. Specifically, it is common knowledge that p_A is the probability of Company A having a high liability, and p_B is the probability of Company B having a high liability. Conversely, the probability of a low liability is $(1 - p_A)$ for Company A and $(1 - p_B)$ for Company B.

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[5] In other words, management's utility increases linearly with current firm value and it is not an issue whether management derives its utility from increasing cash flows to the company, negotiating better terms of loan contracts for the company, incentive compensation plans, owning or selling firm shares, or enhancing its own reputation and value of its human capital in the managerial labour market. The managerial objective of maximizing current market value of the firm was commonly used in accounting disclosure models. Examples include Verrecchia (1983), Dye (1985), Jung and Kwon (1988), and Wagenhofer (1990).

At the start of the game, management of each company is endowed with private information about its own company which fully reveals the true amount of the firm's liability. Management of each company knows whether its company has a high level of liability but is unsure whether the other company also has or does not have a high liability.[6]

Before the accounting standard setter comes into the picture, an equilibrium exists such that neither Company A nor Company B makes any voluntary disclosure about their liability levels to the market. It is assumed that the costs of voluntary disclosure are sufficiently high to preclude the possibility of such disclosure.[7]

The above equilibrium is interrupted when the accounting standard setting body expresses its interests in developing reporting standards for the undisclosed liability. The accounting standard setter is entrusted with the responsibility of promulgating financial accounting standards which are used by companies for external reporting purposes. Application of accounting standards in financial reporting is guided by the concept of materiality. For the purpose of the lobbying model, a liability level of $\bar{L}$ is considered material and a liability level of $\underline{L}$ is considered immaterial. It is in this setting that the standard setter issues a proposed accounting standard which, if passed, will require companies to record the amount of their previously undisclosed liability on the financial statements. Before the standard setter makes its final deliberation, management has an opportunity to express

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[6] In the model, management and other insiders are not allowed to trade on the inside information they have about the liability level of the company.

[7] Such costs can be considered as part of the proprietary cost which is described later in the model.

its views on the proposed standard. In this sense, management has an opportunity to lobby against the proposed accounting standard. The act of lobbying involves out-of-pocket expenses which are denoted by c. If there is sufficient opposition from the companies, the standard setting body may change its mind and abandon the proposed standard. Otherwise, the standard will be passed and the reporting requirements for the liability will become mandatory.

The standard setting body is not modelled as a strategic player in this study. It is simply assumed that the standard setter has an incentive to work towards passing this particular proposed accounting standard. In reality, such incentive could be derived indirectly from the existence of some other interested parties who can benefit from the reporting requirements of the proposed accounting standard. Such interested parties may in one way or another "encourage" the accounting standard setter to develop reporting standards for the previously undisclosed liability, $\tilde{L}$.

The following time line illustrates the sequence of events in the corporate lobbying model:

Management is endowed with the private information	Standard setter issues the proposed accounting standard	Management decides whether to lobby on the proposed standard	Standard setter decides whether to pass the standard	Management makes the required disclosure if standard is passed	Management discharges the liability and liquidates the firm
t = 0	t = 1	t = 2	t = 3	t = 4	t = 5

It is assumed that each firm owns some productive facilities which will generate a nonstochastic amount of total cash inflows, X, over the remaining life of the firm. For simplicity, a zero discount rate is assumed for all time periods.

If the proposed accounting standard is passed, the mandatory recording of the liability on financial statements will give rise to additional proprietary cost to the companies. Verrecchia (1983)'s notion of proprietary cost is used in this study to represent the decrease in the final liquidating value of the firm if the standard setter passes the proposed accounting standard requiring the mandatory recording of the liability.[8]

In this model, proprietary cost is used to capture all the adverse effects of the mandatory recording of the liability. It includes the effects of higher information production costs, potential debt covenant violations, and possible limitations in the flexibility in future financing. It also includes any losses that may be suffered by the company as a result of sensitive information being disclosed along with the recorded liability. The recording of the liability on the financial statements can also be viewed by some as a step towards confirming the legality of their claims against the company. This may prompt special interest groups to start demanding control over some of the company's assets. Proprietary cost also applies to a low liability company in the sense that certain special interest groups may penalize the company for not having a high level of the liability. These and other similar effects can reduce the liquidating value of a firm and

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[8] Therefore, the liquidating value of a firm would be different if there is no mandatory requirement for recording the liability.

are all included as part of the proprietary cost in the lobbying model. Proprietary cost is denoted by $\bar{m}$ for a high liability company and $\underline{m}$ for a low liability company. In this study, it is assumed that $\bar{m} \geq \underline{m}$.

The liquidation value of a firm can be described as follows:

$$\tilde{V} = X - \tilde{L} - \tilde{M} - C \tag{1}$$

where $\tilde{V}$ is the final liquidation value of the firm

X is the fixed total cash inflow from some productive facilities during the life of the firm

$\tilde{L}$ is the amount of the previously undisclosed liability,

$$\tilde{L} = \begin{cases} \bar{L} & \text{if the company has a high liability} \\ \underline{L} & \text{if the company has a low liability} \end{cases}$$

$\tilde{M}$ is the proprietary cost

$$\tilde{M} = \begin{cases} \bar{m} & \text{if the proposed standard is passed and } \tilde{L} = \bar{L} \\ \underline{m} & \text{if the proposed standard is passed and } \tilde{L} = \underline{L} \\ 0 & \text{if the proposed standard is abandoned} \end{cases}$$

C is the out-of-pocket costs of lobbying,

$$C = \begin{cases} c & \text{if management chooses to lobby} \\ 0 & \text{if management chooses not to lobby} \end{cases}$$

Let Ω_t represent the set of information available to the market at time t. The stock price of the firm at time t, denoted by S_t, is an unbiased estimate of $\tilde{V}$ made by the market at time t conditional on Ω_t. Therefore, using (1),

$$S_t = E[\tilde{V}|\Omega_t]$$
$$= X - E[\tilde{L}|\Omega_t] - E[\tilde{M}|\Omega_t] - C$$

where E is the expectation operator. In the model, management's objective is to maximize S_t, or equivalently, to

$$\text{minimize} \left\{ E[\tilde{L}|\Omega_t] + E[\tilde{M}|\Omega_t] + C \right\} \tag{2}$$

Focusing on the informational effect of management's lobbying activities, the model also allows the "free-riding" possibility that management of a company with an undisclosed high liability may decide to refrain from lobbying to avoid the informational effect and count on the other company to lobby against the proposed accounting standard. However, this "free-riding" alternative is not always reliable because management of a company knows that the other company may not lobby if it does not have a high liability. With this uncertainty, a company simply cannot always count on the other company to lobby. Even when both companies have the high liability, it may still be necessary for management of the two companies to join forces together in their common fight against the proposed standard. The standard setting body may be so committed to the standard that it will change its mind only if there is strong opposition from both companies.

In the lobbying game, the influence management's lobbying efforts can have on the decision of the standard setting body is modelled through changes in the probability of the standard setting body passing the proposed accounting standard. The presumption is that the probability of the standard setter abandoning the proposed standard becomes higher as more companies are lobbying against it. In other words, each company through lobbying can reduce the likelihood of the proposed accounting standard becoming mandatory. In the lobbying model, if no company lobbies against the proposed accounting standard, the probability of the standard becoming mandatory is denoted by q_0. If only one of the companies lobbies, this probability is q_1. If the two companies both lobby, the probability of the standard setting body passing the proposed standard is q_2. In the model, it is assumed that

$$0 \le q_2 \le q_1 \le q_0 \le 1 \qquad (3)$$

The model also assumes that, at time t = 1, the market has some prior beliefs about the likelihood of the standard setter passing the proposed accounting standard. This market assessed prior probability of the standard becoming mandatory is denoted by $\hat{q}$ where $0 \le \hat{q} \le 1$. There is no particular restriction as to where $\hat{q}$ lies relative to any of the q_j's.

Upon observing management's choice, the market will revise its beliefs about the likelihood of a high liability for the company. If management of Company A lobbies against the proposed accounting standard, the market-revised probability of Company A having a high liability is denoted by p''_A. On the other hand, if management chooses not to lobby, the market-revised probability is p'_A. Similarly, for Company B, the market-revised probability of a high liability is p''_B if Company B management lobbies against the proposed standard and is p'_B if management does not lobby.[9]

In summary, the lobbying game attempts to capture some major features of the corporate lobbying environment. It is assumed that management of a company affected by the proposed accounting standard will suffer if the proposed standard becomes mandatory. The market's knowledge of this previously undisclosed liability will result in a drop in the market price of the firm. The required recording of the liability will also further reduce firm value in the form of additional proprietary cost. On the one hand, management can engage in lobbying to try to defeat the proposed accounting standard. Such lobbying effort will reduce the likelihood of the standard setting body passing the standard. The proprietary cost and the related decline in firm value will be avoided if the lobbying effort is successful. However, management's lobbying will also have informational effects reducing the potential benefits of its lobbying effort. By observing management's lobbying position, the market is able to make better inferences about the level of the firm's liability.

Instead of lobbying, management can remain silent on the issue and count on the other company to lobby against the proposed accounting

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[9] Using Company A as an example, if management's lobbying position will reveal perfectly the existence of the company's high liability, then the case can be described by $p''_A = 1$. This occurs when a low liability company will never lobby against the proposed accounting standard. However, if there is a possibility that a low liability company may also lobby against the standard, then p''_A will lie between 1 and p_A. If there is no "free-riding" and high liability companies will always lobby, then the case can be described by $p'_A = 0$. In other cases where "free-riding" is possible, p'_A will lie between p_A and 0.

standard. This way management can avoid the informational effect of lobbying and may still be able to evade the proprietary cost. However, in this case, management is unsure whether the other company is also affected by the standard and interested in lobbying at all. In fact, management of the two companies is facing exactly the same kind of uncertainties, not knowing whether the other company has the high liability and whether the other company will also lobby.

The accounting standard setting body can be flexible or obstinate in terms of its willingness to change its mind on the proposed standard. If the standard setting body is flexible, there is perhaps no point in being the second company to lobby because this will needlessly generate the informational effect. If the standard setting body is obstinate, then there is no point in being the only company to lobby. However, if nobody lobbies and the standard eventually becomes mandatory, the informational effect will nevertheless come into play. In this case, it would not hurt either company to have lobbied in the first place. Facing all these uncertainties, management has to decide on a course of action. It is in this context that the study attempts to characterize management's equilibrium lobbying strategies and the related equilibrium conditions.

2.2 Payoffs to Management

For Company $\imath$, the effect on its stock price under different possible outcomes can be derived as follows. At t = 1, on the basis of only the prior beliefs, the market's assessments of $\tilde{L}$ and $\tilde{M}$ are

$$E[\tilde{L}|\Omega_1] = p_\imath \bar{L} + (1 - p_\imath) \underline{L}$$

$$E[\tilde{M}|\Omega_1] = \hat{q}\left[p_i\, \bar{m} + (1 - p_i)\, \underline{m} \right]$$

At t = 2, if Company i lobbies against the proposed standard, the market revises its beliefs about the existence of $\bar{L}$,

$$E[\tilde{L}|\Omega_2] = p_i''\, \bar{L} + (1 - p_i'')\, \underline{L}$$

$$E[\tilde{M}|\Omega_2] = q_j\left[p_i''\, \bar{m} + (1 - p_i'')\, \underline{m} \right]$$

At t = 2, if Company i does not lobby, the market also revises its beliefs about the existence of $\bar{L}$,

$$E[\tilde{L}|\Omega_2] = p_i'\, \bar{L} + (1 - p_i')\, \underline{L}$$

$$E[\tilde{M}|\Omega_2] = q_j\left[p_i'\, \bar{m} + (1 - p_i')\, \underline{m} \right]$$

At t = 3, if the proposed accounting standard is passed, and if Company i had previously lobbied,

$$E[\tilde{L}|\Omega_3] = p_i''\, \bar{L} + (1 - p_i'')\, \underline{L}$$

$$E[\tilde{M}|\Omega_3] = p_i''\, \bar{m} + (1 - p_i'')\, \underline{m}$$

but if Company i had not previously lobbied,

$$E[\tilde{L}|\Omega_3] = p_i'\, \bar{L} + (1 - p_i')\, \underline{L}$$

$$E[\tilde{M}|\Omega_3] = p_i'\, \bar{m} + (1 - p_i')\, \underline{m}$$

On the other hand, at t = 3, if the proposed accounting standard is rejected, and if Company i had previously lobbied,

$$E[\tilde{L}|\Omega_3] = p''_i\,\bar{L} + (1 - p''_i)\,\underline{L}$$

$$E[\tilde{M}|\Omega_3] = 0$$

but if Company i had not previously lobbied,

$$E[\tilde{L}|\Omega_3] = p'_i\,\bar{L} + (1 - p'_i)\,\underline{L}$$

$$E[\tilde{M}|\Omega_3] = 0$$

At t = 4, if the proposed accounting standard was passed, the companies are required to adopt the standard and record the liability on their financial statements. It is at this time that the market can confirm the true liability level of each company. Therefore, at t = 4, for a high liability company, regardless of whether or not it had previously lobbied,

$$E[\tilde{L}|\Omega_4] = \bar{L} \quad ; \quad E[\tilde{M}|\Omega_4] = \bar{m}$$

and for a low liability company,

$$E[\tilde{L}|\Omega_4] = \underline{L} \quad ; \quad E[\tilde{M}|\Omega_4] = \underline{m}$$

Changes in the market expectation of $\tilde{L}$ and $\tilde{M}$ for a company with a high liability and a low liability are summarized in Tables 1 and 2 respectively.

TABLE 1

CHANGES IN MARKET EXPECTATION OF THE LIABILITY LEVEL AND THE PROPRIETARY COST FOR A HIGH LIABILITY FIRM

	If Company i has high liability and lobbies against the standard	If Company i has high liability and does not lobby on the standard
At t = 2,		
$E[\tilde{L}\|\Omega_2] - E[\tilde{L}\|\Omega_1] =$	$(p_i'' - p_i)(\bar{L} - \underline{L})$	$(p_i' - p_i)(\bar{L} - \underline{L})$
$E[\tilde{M}\|\Omega_2] - E[\tilde{M}\|\Omega_1] =$	$(\bar{m} - \underline{m})(q_j p_i'' - \hat{q}\, p_i) + \underline{m}(q_j - \hat{q})$	$(\bar{m} - \underline{m})(q_j p_i' - \hat{q}\, p_i) + \underline{m}(q_j - \hat{q})$
At t = 3, if standard is passed,		
$E[\tilde{L}\|\Omega_3] - E[\tilde{L}\|\Omega_2] =$	0	0
$E[\tilde{M}\|\Omega_3] - E[\tilde{M}\|\Omega_2] =$	$(1-q_j)\left[p_i''\bar{m}+(1-p_i'')\underline{m}\right]$	$(1-q_j)\left[p_i'\bar{m}+(1-p_i')\underline{m}\right]$
if standard is rejected,		
$E[\tilde{L}\|\Omega_3] - E[\tilde{L}\|\Omega_2] =$	0	0
$E[\tilde{M}\|\Omega_3] - E[\tilde{M}\|\Omega_2] =$	$- q_j\left[p_i''\bar{m}+(1-p_i'')\underline{m}\right]$	$- q_j\left[p_i'\bar{m}+(1-p_i')\underline{m}\right]$
At t = 4, only if standard was passed,		
$E[\tilde{L}\|\Omega_4] - E[\tilde{L}\|\Omega_3] =$	$(1 - p_i'')(\bar{L} - \underline{L})$	$(1 - p_i')(\bar{L} - \underline{L})$
$E[\tilde{M}\|\Omega_4] - E[\tilde{M}\|\Omega_3] =$	$(1 - p_i'')(\bar{m} - \underline{m})$	$(1 - p_i')(\bar{m} - \underline{m})$

TABLE 2

CHANGES IN MARKET EXPECTATION OF THE LIABILITY LEVEL AND THE PROPRIETARY COST FOR A LOW LIABILITY FIRM

	If Company i has low liability and lobbies against the standard	If Company i has low liability and does not lobby on the standard
At t = 2,		
$E[\tilde{L}\|\Omega_2] - E[\tilde{L}\|\Omega_1] =$	$(p_i'' - p_i)(\bar{L} - \underline{L})$	$(p_i' - p_i)(\bar{L} - \underline{L})$
$E[\tilde{M}\|\Omega_2] - E[\tilde{M}\|\Omega_1] =$	$(\bar{m} - \underline{m})(q_j p_i'' - \hat{q}\, p_i) + \underline{m}(q_j - \hat{q})$	$(\bar{m} - \underline{m})(q_j p_i' - \hat{q}\, p_i) + \underline{m}(q_j - \hat{q})$
At t = 3,		
if standard is passed,		
$E[\tilde{L}\|\Omega_3] - E[\tilde{L}\|\Omega_2] =$	0	0
$E[\tilde{M}\|\Omega_3] - E[\tilde{M}\|\Omega_2] =$	$(1-q_j)\left[p_i''\bar{m}+(1-p_i'')\underline{m}\right]$	$(1-q_j)\left[p_i'\bar{m}+(1-p_i')\underline{m}\right]$
if standard is rejected,		
$E[\tilde{L}\|\Omega_3] - E[\tilde{L}\|\Omega_2] =$	0	0
$E[\tilde{M}\|\Omega_3] - E[\tilde{M}\|\Omega_2] =$	$-\, q_j\left[p_i''\bar{m}+(1-p_i'')\underline{m}\right]$	$-\, q_j\left[p_i'\bar{m}+(1-p_i')\underline{m}\right]$
At t = 4,		
only if standard was passed,		
$E[\tilde{L}\|\Omega_4] - E[\tilde{L}\|\Omega_3] =$	$-\, p_i''(\bar{L} - \underline{L})$	$-\, p_i'(\bar{L} - \underline{L})$
$E[\tilde{M}\|\Omega_4] - E[\tilde{M}\|\Omega_3] =$	$-\, p_i''(\bar{m} - \underline{m})$	$-\, p_i'(\bar{m} - \underline{m})$

Using the results in Table 1, if Company ι has a high liability, total changes in the market price of the firm between t = 1 and t = 4 can be derived. The payoffs to management in accordance with the objective function in (2) are:

	If Company ι has High Liability and lobbies	If Company ι has High Liability and does not lobby
If the proposed accounting standard is passed	$-(1-p_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - \bar{m} - c$	$-(1-p_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - \bar{m}$
If the proposed accounting standard is rejected	$-(p''_\iota-p_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - c$	$(p_\iota-p'_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m})$

Similar procedures are also applied using the results in Table 2 to derive management's payoffs if Company ι has a low level of liability. In this case, total changes in the market price of the firm between t = 1 and t = 4 are:

	If Company ι has Low Liability and lobbies	If Company ι has Low Liability and does not lobby
If the proposed accounting standard is passed	$p_\iota(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - \underline{m} - c$	$p_\iota(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - \underline{m}$
If the proposed accounting standard is rejected	$-(p''_\iota-p_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m}) - c$	$(p_\iota-p'_\iota)(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_\iota(\bar{m}-\underline{m})$

The term $\left(p_i(\bar{L}-\underline{L}) + \hat{q}p_i(\bar{m}-\underline{m}) + \hat{q}\underline{m}\right)$ is included above in each of the payoff calculations for both the high liability firm and the low liability firm. Therefore, the expressions can be simplified by subtracting this common term from the payoff calculation in each of the above cases. This procedure will not affect the overall results of the subsequent equilibrium analysis in this study.[10] After deducting the common term, the payoffs to management under each possible outcome can be represented as follows.

For a high liability firm:

	If Company i has High Liability and lobbies	If Company i has High Liability and does not lobby
If the proposed standard is passed	$-\mathbb{L} - \bar{m} - c$	$-\mathbb{L} - \bar{m}$
If the proposed standard is rejected	$-p_i''\mathbb{L} - c$	$-p_i'\mathbb{L}$

For a low liability firm:

	If Company i has Low Liability and lobbies	If Company i has Low Liability and does not lobby
If the proposed standard is passed	$-\underline{m} - c$	$-\underline{m}$
If the proposed standard is rejected	$-p_i''\mathbb{L} - c$	$-p_i'\mathbb{L}$

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[10] Furthermore, for the rest of this chapter, the notation $\mathbb{L} = \bar{L} - \underline{L}$ is used to simplify the expressions.

2.3 Formulation of the Bayesian Game

In the lobbying model, each company is not sure whether the other company has a high level of liability. This is a game with incomplete information. Using Harsanyi (1967,1968)'s approach, the lobbying game can be analysed in the form of a Bayesian game. Management's choices can then be studied in terms of normalized strategies. Whether or not the company has a high liability can be considered an attribute of the company. At the beginning of the game, the attributes of the two players are unknown to the players. The Bayesian game is a game in which nature moves first. The game tree, shown in Figure 1, describes the four possible combinations of the two companies' attributes. The lobbying game is a game with incomplete information because the players will not know which one of the four branches they are at when they make their moves. In essence, the two companies know that they are playing a game but they do not know exactly which of the four games they are playing.

Branch I of the game tree in Figure 1 describes the portion of the game in which both companies have a high level of the undisclosed liability. This portion of the game is also expressed in extensive form and presented in Figure 2. The extensive form of Branches II, III, and IV are shown in Figures 3, 4, and 5 respectively.

The dotted line in each of Figures 2, 3, 4, and 5 indicates the presence of an information set in each branch of the lobbying game. In this study, management's lobbying behaviour is modelled as a simultaneous move game. It is assumed that when management of one company makes its choice, it does not know what move the other company has made.

FIGURE 1

GAME TREE SHOWING DIFFERENT COMBINATIONS OF PLAYERS' ATTRIBUTES

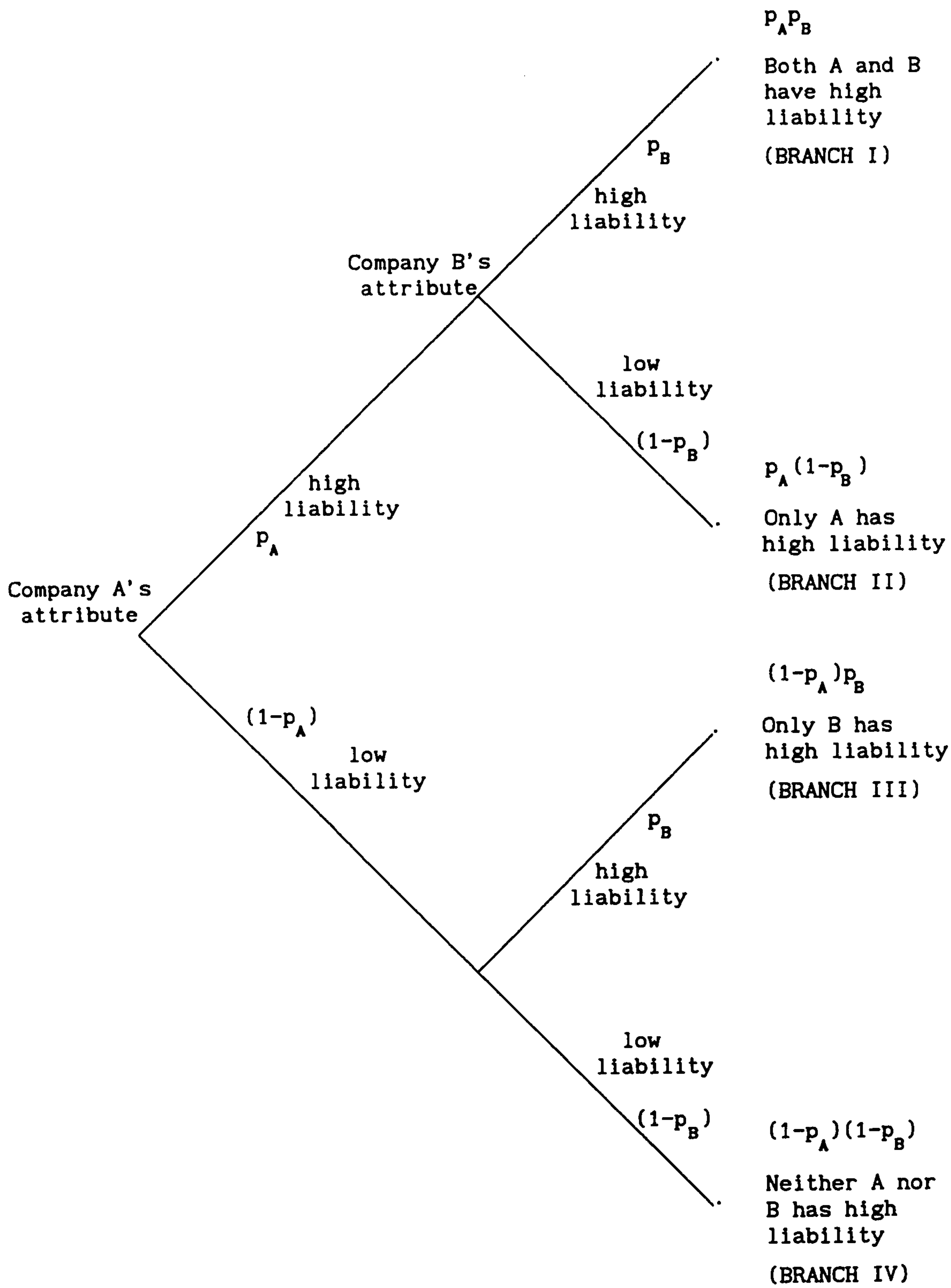


FIGURE 2

PORTION OF THE LOBBYING GAME (BRANCH I)
IN WHICH BOTH COMPANIES HAVE HIGH UNDISCLOSED LIABILITIES
EXPRESSED IN EXTENSIVE FORM

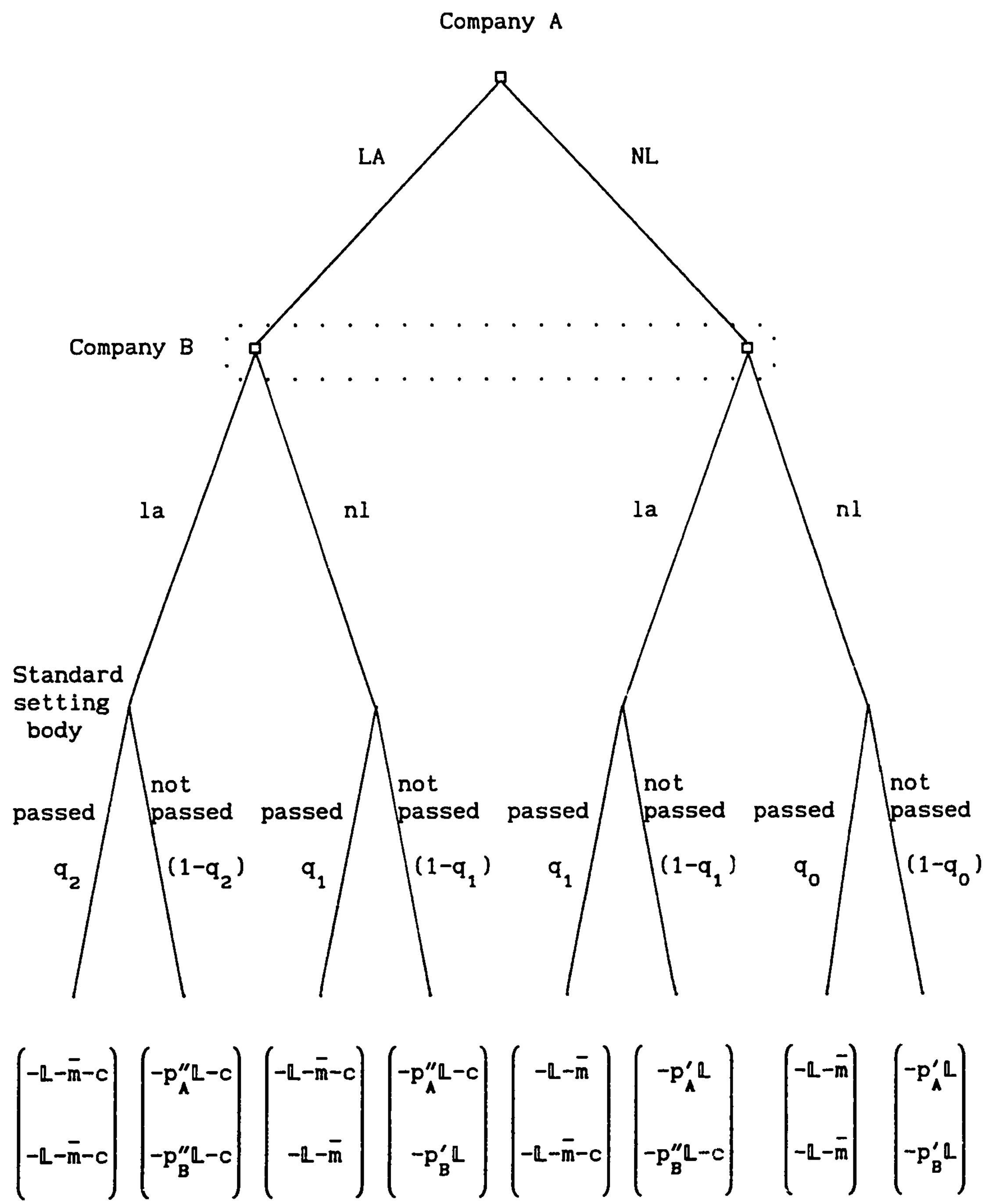


FIGURE 3

PORTION OF THE LOBBYING GAME (BRANCH II)
IN WHICH COMPANY A HAS HIGH UNDISCLOSED LIABILITIES
AND COMPANY B HAS LOW UNDISCLOSED LIABILITIES
EXPRESSED IN EXTENSIVE FORM

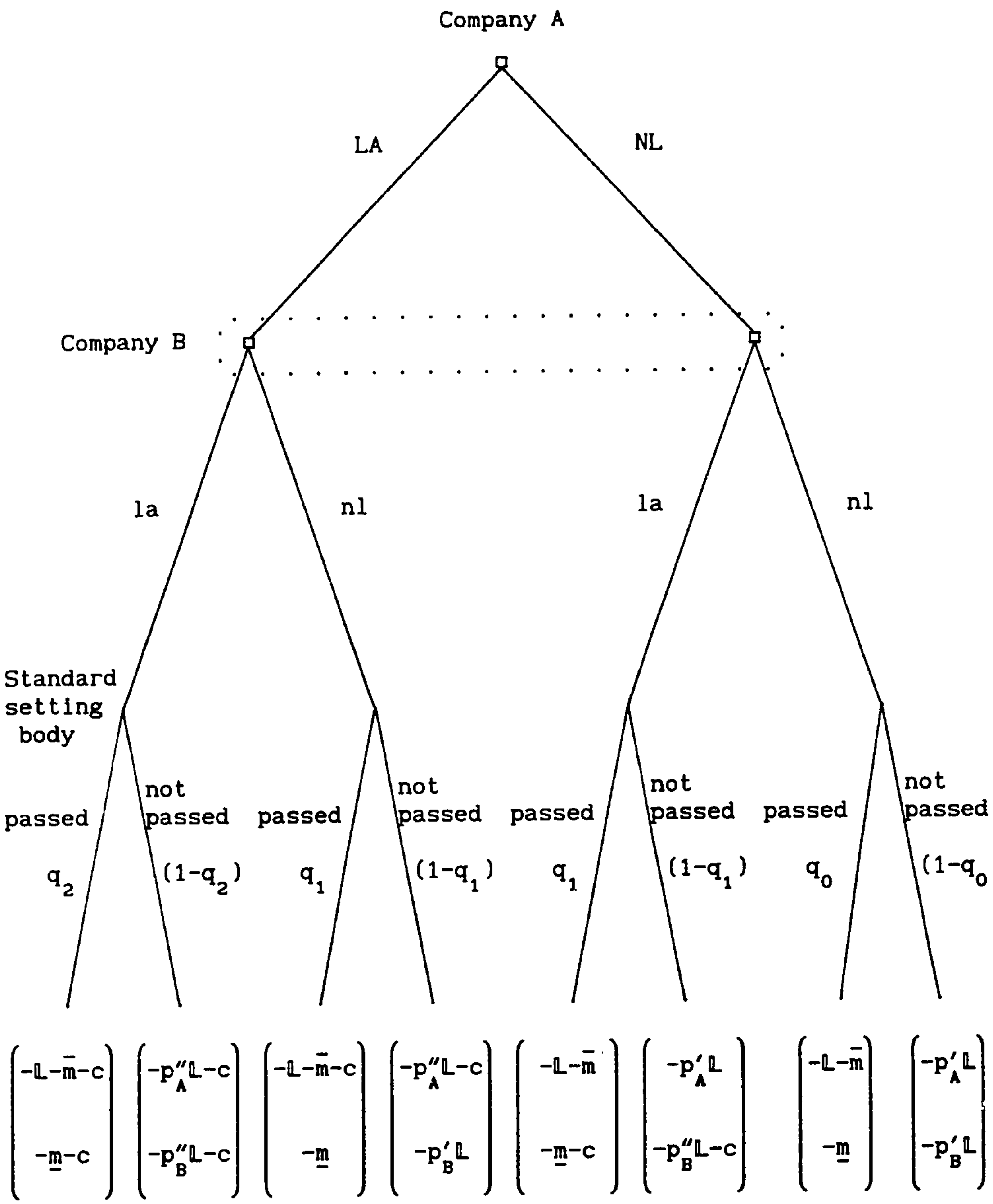


FIGURE 4

PORTION OF THE LOBBYING GAME (BRANCH III)
IN WHICH COMPANY A HAS LOW UNDISCLOSED LIABILITIES
AND COMPANY B HAS HIGH UNDISCLOSED LIABILITIES
EXPRESSED IN EXTENSIVE FORM

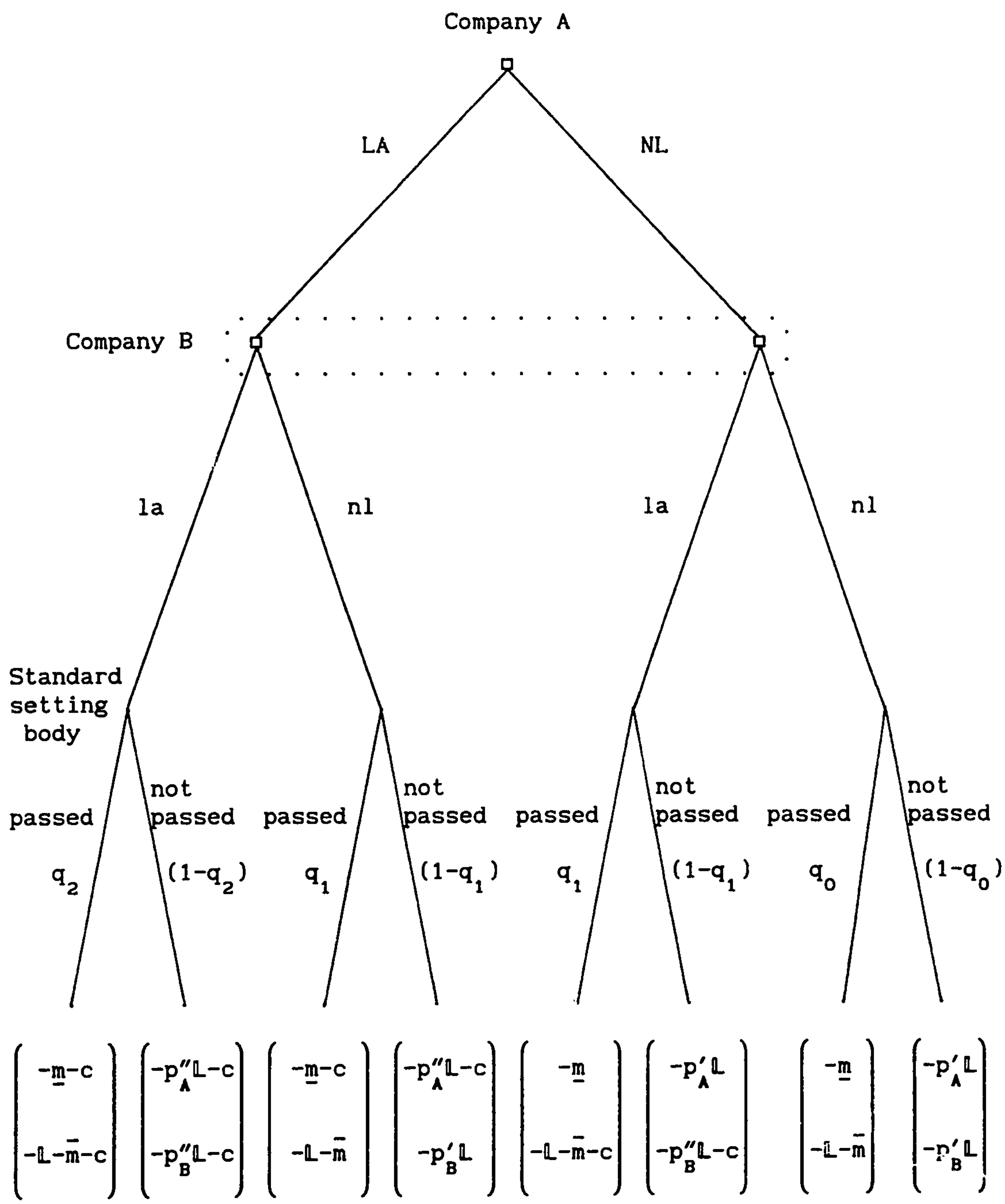
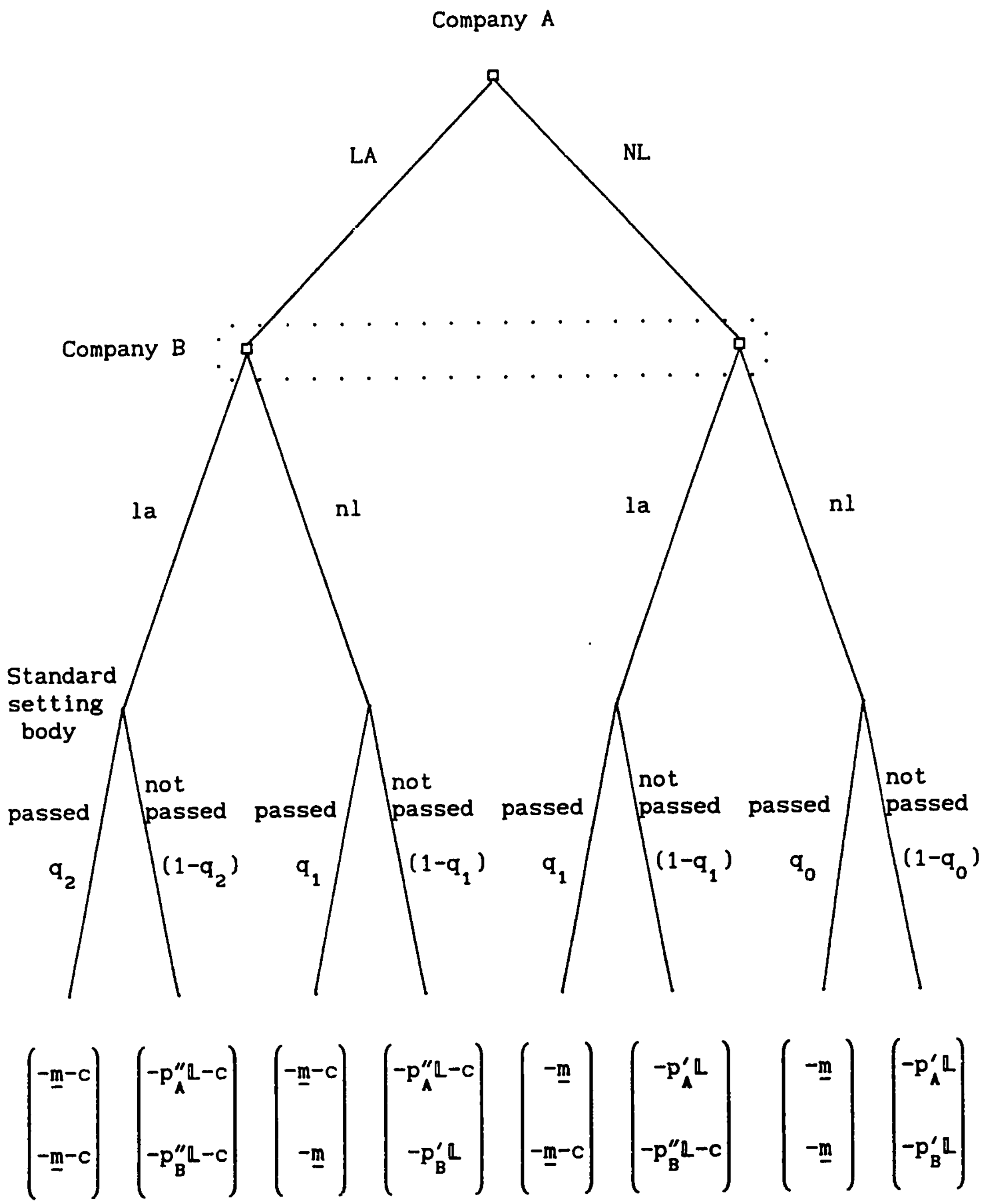


FIGURE 5

PORTION OF THE LOBBYING GAME (BRANCH IV)
IN WHICH BOTH COMPANIES HAVE LOW UNDISCLOSED LIABILITIES
EXPRESSED IN EXTENSIVE FORM



Using the information presented in Figure 2, Branch I of the lobbying game can also be expressed in terms of a bimatrix which is shown in Table 3. Similarly, the bimatrix forms for Branches II, III, and IV are shown in Tables 4, 5, and 6 respectively.

TABLE 3

PORTION OF THE LOBBYING GAME (BRANCH I)
IN WHICH BOTH COMPANIES HAVE HIGH UNDISCLOSED LIABILITIES
EXPRESSED IN TERMS OF A BIMATRIX

		B	
		la	nl
A	LA	$-q_2(\mathbb{L}+\bar{m}+c) - (1-q_2)(p''_A\mathbb{L}+c)$, $-q_2(\mathbb{L}+\bar{m}+c) - (1-q_2)(p''_B\mathbb{L}+c)$	$-q_1(\mathbb{L}+\bar{m}+c) - (1-q_1)(p''_A\mathbb{L}+c)$, $-q_1(\mathbb{L}+\bar{m}) - (1-q_1)p'_B\mathbb{L}$
	NL	$-q_1(\mathbb{L}+\bar{m}) - (1-q_1)p'_A\mathbb{L}$, $-q_1(\mathbb{L}+\bar{m}+c) - (1-q_1)(p''_B\mathbb{L}+c)$	$-q_0(\mathbb{L}+\bar{m}) - (1-q_0)p'_A\mathbb{L}$, $-q_0(\mathbb{L}+\bar{m}) - (1-q_0)p'_B\mathbb{L}$

TABLE 4

PORTION OF THE LOBBYING GAME (BRANCH II)
IN WHICH COMPANY A HAS HIGH UNDISCLOSED LIABILITIES
AND COMPANY B HAS LOW UNDISCLOSED LIABILITIES
EXPRESSED IN TERMS OF A BIMATRIX

		B	
		la	nl
A	LA	$-q_2(\mathbb{L}+\bar{m}+c) -(1-q_2)(p''_A\mathbb{L}+c)$, $-q_2(\underline{m}+c) -(1-q_2)(p''_B\mathbb{L}+c)$	$-q_1(\mathbb{L}+\bar{m}+c) -(1-q_1)(p''_A\mathbb{L}+c)$, $-q_1\underline{m} -(1-q_1)p'_B\mathbb{L}$
	NL	$-q_1(\mathbb{L}+\bar{m}) -(1-q_1)p'_A\mathbb{L}$, $-q_1(\underline{m}+c) -(1-q_1)(p''_B\mathbb{L}+c)$	$-q_0(\mathbb{L}+\bar{m}) -(1-q_0)p'_A\mathbb{L}$, $-q_0\underline{m} -(1-q_0)p'_B\mathbb{L}$

TABLE 5

PORTION OF THE LOBBYING GAME (BRANCH III)
IN WHICH COMPANY A HAS LOW UNDISCLOSED LIABILITIES
AND COMPANY B HAS HIGH UNDISCLOSED LIABILITIES
EXPRESSED IN TERMS OF A BIMATRIX

		B: la	B: nl
A	LA	$-q_2(\underline{m}+c) -(1-q_2)(p''_A\mathbb{L}+c)$, $-q_2(\mathbb{L}+\bar{m}+c) -(1-q_2)(p''_B\mathbb{L}+c)$	$-q_1(\underline{m}+c) -(1-q_1)(p''_A\mathbb{L}+c)$, $-q_1(\mathbb{L}+\bar{m}) -(1-q_1)p'_B\mathbb{L}$
A	NL	$-q_1\underline{m} -(1-q_1)p'_A\mathbb{L}$, $-q_1(\mathbb{L}+\bar{m}+c) -(1-q_1)(p''_B\mathbb{L}+c)$	$-q_0\underline{m} -(1-q_0)p'_A\mathbb{L}$, $-q_0(\mathbb{L}+\bar{m}) -(1-q_0)p'_B\mathbb{L}$

TABLE 6

PORTION OF THE LOBBYING GAME (BRANCH IV)
IN WHICH BOTH COMPANIES HAVE LOW UNDISCLOSED LIABILITIES
EXPRESSED IN TERMS OF A BIMATRIX

		B: la	B: nl
A	LA	$-q_2(\underline{m}+c) - (1-q_2)(p''_A\mathbb{L}+c)$, $-q_2(\underline{m}+c) - (1-q_2)(p''_B\mathbb{L}+c)$	$-q_1(\underline{m}+c) - (1-q_1)(p''_A\mathbb{L}+c)$, $-q_1\underline{m} - (1-q_1)p'_B\mathbb{L}$
	NL	$-q_1\underline{m} - (1-q_1)p'_A\mathbb{L}$, $-q_1(\underline{m}+c) - (1-q_1)(p''_B\mathbb{L}+c)$	$-q_0\underline{m} - (1-q_0)p'_A\mathbb{L}$, $-q_0\underline{m} - (1-q_0)p'_B\mathbb{L}$

2.4 Assumption on Proprietary Cost

As described in Section 1.3, this study focuses only on settings in which management would either lobby against the standard or refrain from lobbying totally. To eliminate the possibility of any company lobbying in favour of the proposed accounting standard, it is assumed in the model that the proprietary cost is sufficiently high even for a low liability company such that this company will not benefit from trying to signal its low liability level to the market. Technically, this assumption requires that

$$\underline{m} \geq \left[\frac{(1 - q_{j+1})}{(q_j - q_{j+1})}\right] p_i' \mathbb{L} - \frac{c_f}{(q_j - q_{j+1})} \quad , \; j = 0,1 \tag{4}$$

where c_f is the out-of-pocket cost of lobbying in favour of the proposed standard. The derivation of the restriction in (4) on the proprietary cost is shown in Appendix B.

2.5 Requirements for Rational Expectation

An additional consideration in analysing the lobbying game is that an equilibrium solution should always be consistent with the rational expectation of the market. Specifically, the market's revised beliefs in terms of p_i'' and p_i' about Company i having a high liability should be consistent with the equilibrium strategy of Company i management. For example, if Company A management uses a (LA,NL) strategy,[11] then the

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[11] As described in the List of Symbols, (LA,NL) represents the normalized strategy of Company A management for using LA if the company has a high liability and NL if the company has a low liability. Similarly, (NL,LA) describes management's strategy for using NL if the company has a high liability and LA if it has a low liability.

market knows for sure that Company A has a high liability if Company A management lobbies against the proposed accounting standard. In this case, rational expectation suggests that $p''_A = 1$. On the other hand, if management uses a (LA,LA) strategy, then the market is still uncertain about the company's liability level even though management lobbies against the proposed standard. In this case, the market cannot extract any information from management's lobbying position and therefore may make no revision about its beliefs suggesting that $p''_A = p_A$. For the purpose of this study, the requirements for rational expectation of the market are defined in the following manner.[12]

Let $\varphi_{i1}+\varphi_{i2}+\varphi_{i3}+\varphi_{i4} = 1$, $i=A,B$, and use $\{\varphi_{i1}, \varphi_{i2}, \varphi_{i3}, \varphi_{i4}\}$ to represent the equilibrium strategy of Company i management such that the values of φ_{i1}, φ_{i2}, φ_{i3}, and φ_{i4} are all non-negative and can be interpreted as probability measures specifying management's choices of (LA,LA), (LA,NL), (NL,LA), and (NL,NL) in the case of Company A, or the choices of (la,la), (la,nl), (nl,la), and (nl,nl) in the case of Company B, respectively under the equilibrium strategy.[13] Using Company A as an example, the game tree showing management's different equilibrium strategies is shown in Figure 6.

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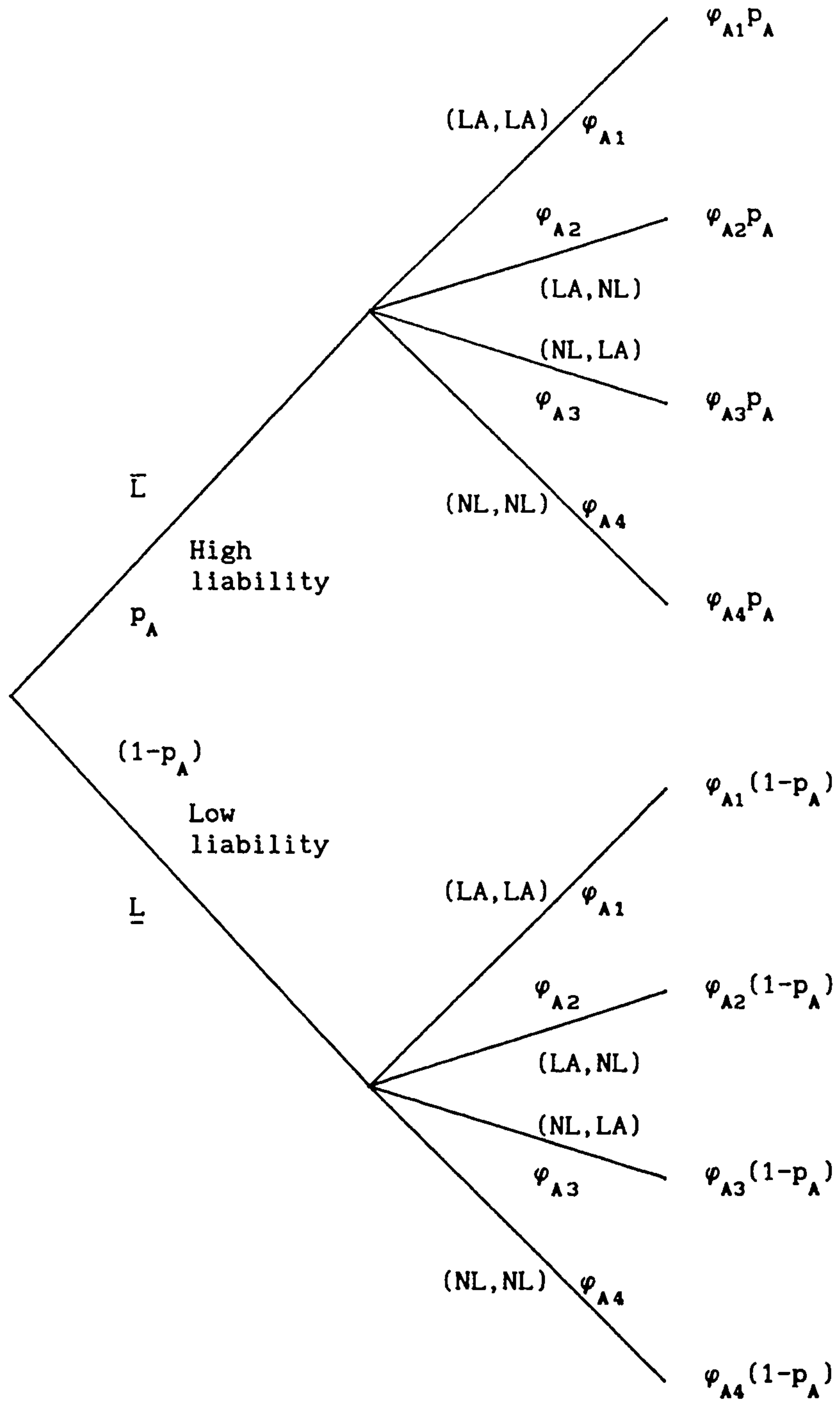
[12] An alternative way to define rational expectation of the market is to borrow the concept of "skeptical belief" from studies such as Wagenhofer (1990) and set $p''_i = 1$ and $p'_i = p_i$ under all situations.

[13] For example, $\{\varphi_{A1},\varphi_{A2},\varphi_{A3},\varphi_{A4}\} = \{1, 0, 0, 0\}$ represents an equilibrium strategy of (LA,LA) for Company A management. Similarly, {0, 0.5, 0, 0.5} can be used to represent a mixed strategy equilibrium in which management randomizes equally between (LA,NL) and (NL,NL).

FIGURE 6

TREE DIAGRAM SHOWING MANAGEMENT'S EQUILIBRIUM STRATEGIES



Under rational expectation, the market's revised probabilities of p''_ι and p'_ι are expected to be consistent with the equilibrium strategy of Company ι management. Using Figure 6, the consistency requirements for the equilibrium solutions are derived in (5) and (6).[14] To avoid the cases in which p''_ι and p'_ι may be undefined, the revised probability p''_ι is assigned a value of 1 when $\varphi_{\iota 4} = 1$; and p'_ι is assigned a value of p_ι when $\varphi_{\iota 1} = 1$.

$$p''_\iota = \frac{\varphi_{\iota 1}p_\iota + \varphi_{\iota 2}p_\iota}{\varphi_{\iota 1}p_\iota + \varphi_{\iota 1}(1-p_\iota) + \varphi_{\iota 2}p_\iota + \varphi_{\iota 3}(1-p_\iota)}, \quad \varphi_{\iota 4} \neq 1$$

$$= \begin{cases} \dfrac{(\varphi_{\iota 1} + \varphi_{\iota 2})\, p_\iota}{(\varphi_{\iota 1} + \varphi_{\iota 3}) + (\varphi_{\iota 2} - \varphi_{\iota 3})\, p_\iota}, & \varphi_{\iota 4} \neq 1 \\ 1, & \varphi_{\iota 4} = 1 \end{cases} \tag{5}$$

$$p'_\iota = \frac{\varphi_{\iota 3}p_\iota + \varphi_{\iota 4}p_\iota}{\varphi_{\iota 2}(1-p_\iota) + \varphi_{\iota 3}p_\iota + \varphi_{\iota 4}p_\iota + \varphi_{\iota 4}(1-p_\iota)}, \quad \varphi_{\iota 1} \neq 1$$

$$= \begin{cases} \dfrac{(\varphi_{\iota 3} + \varphi_{\iota 4})\, p_\iota}{(\varphi_{\iota 2} + \varphi_{\iota 4}) - (\varphi_{\iota 2} - \varphi_{\iota 3})\, p_\iota}, & \varphi_{\iota 1} \neq 1 \\ p_\iota, & \varphi_{\iota 1} = 1 \end{cases} \tag{6}$$

2.6 Management's Equilibrium Lobbying Strategies

Harsanyi (1968)'s concept of Bayesian equilibrium is used in this

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[14] Using Bayes' theorem, the revised probability p''_ι is calculated as $Pr(\bar{L}|LA)$ for Company A and $Pr(\bar{L}|la)$ for Company B. Similarly, p'_ι is calculated as $Pr(\bar{L}|NL)$ for Company A and $Pr(\bar{L}|nl)$ for Company B.

study to identify management's equilibrium lobbying strategies. In this section, results on the different equilibrium solutions are summarized in nine propositions. The proofs of the propositions are shown in Appendix C.

Proposition 1 (Case 1)

A necessary condition for the use of the "always-lobby" strategy by Company i management is

$$\underline{m} > \left[\frac{(1 - q_{j+1})(p_i'' - p_i')}{(q_j - q_{j+1})}\right]\mathbb{L} + p_i'\mathbb{L} + \frac{c}{(q_j - q_{j+1})} \quad , \ j = 0 \text{ or } 1 \qquad (7)$$

In fact, if the condition in (7) with $j = 0$ is satisfied for Company A and Company B, then management of the two companies will both use the "always-lobby" strategy. In this case, $\big((LA,LA),(la,la)\big)$ is a Bayesian equilibrium point.

In using the "always-lobby" strategy, management will always lobby against the proposed standard regardless of whether the company has a high or low liability. Since management will always lobby, the market will not be able to infer from management's action the liability level of the company. By following such a strategy, the company is able to avoid completely the informational effect of lobbying.

Proposition 2

The strategy of using (NL,LA) or (nl,la), i.e., not lobby when the liability is high and lobby when the liability is low, is inferior and will not form part of any Bayesian equilibrium solution.

Other Cases:

To examine the implications of the informational effect, it is assumed that, for the remaining cases in this section, the condition in (7) is not satisfied. With the previous assumption described earlier in (4), the overall restriction on the proprietary cost, $\underline{m}$, becomes:

$$\left[\frac{(1-q_{j+1})(p''_i-p'_i)}{(q_j-q_{j+1})}\right]\mathbb{L}+p'_i\mathbb{L}+\frac{c}{(q_j-q_{j+1})} > \underline{m} > \left[\frac{(1-q_{j+1})}{(q_j-q_{j+1})}\right]p'_i\mathbb{L}-\frac{c_f}{(q_j-q_{j+1})} \qquad (8)$$

$$i=A,B, \quad j=0,1$$

The assumption in (8) essentially ensures that, while proprietary cost would not be so low that the low liability company will always lobby in favour of the proposed accounting standard, the proprietary cost would also not be so high that it is to every company's advantage to lobby against the standard under all circumstances.

Without loss of generality, for the rest of this section, it is also assumed that $p_A < p_B$. In other words, between the two companies, Company A is the one which has the potentially stronger informational effect. Furthermore, to facilitate the description of equilibrium conditions, the following notation is used:

$${}_i\mathbb{E}_j = \mathbb{L}+\bar{m}-\left[\frac{(1-q_{j+1})(p''_i-p'_i)}{(q_j-q_{j+1})}\right]\mathbb{L}-p'_i\mathbb{L}-\frac{c}{(q_j-q_{j+1})} \quad , \; i=A,B, \; j=0,1 \qquad (9)$$

<u>**Proposition 3**</u>

With $p_A < p_B$, $\big((LA,NL),(nl,nl)\big)$ can never be a unique Bayesian equilibrium point. In other words, a company with the potentially weaker informational effect, which is Company B in this case, can never "free-ride" on the other company's lobbying effort by following only the "never-lobby" strategy.

Given (8), the following five cases describe all the remaining possible equilibrium solutions of the lobbying game.

Proposition 4 (Case 2)

$\big((LA,NL),(la,nl)\big)$ is the only Bayesian equilibrium point if

$$\begin{cases} (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 > 0 \ , \\ (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 > 0 \ , \text{ and} \\ \text{at least one of } {}_A\mathbb{E}_0>0 \text{ and } {}_B\mathbb{E}_0>0 \text{ is satisfied.} \end{cases}$$

Proposition 5 (Case 3)

$\big((NL,NL),(nl,nl)\big)$ is the only Bayesian equilibrium point if

$$\begin{cases} {}_A\mathbb{E}_0 < 0 \ , \\ {}_B\mathbb{E}_0 < 0 \ , \text{ and} \\ \text{at least one of } (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 < 0 \text{ an} \\ \qquad (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 < 0 \text{ is satisfied.} \end{cases}$$

Proposition 6 (Case 4)

$\big((LA,NL),(la,nl)\big)$ and $\big((NL,NL),(nl,nl)\big)$ are both Bayesian equilibrium points if

$$\begin{cases} {}_A\mathbb{E}_0 < 0 \ , \\ {}_B\mathbb{E}_0 < 0 \ , \\ (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 > 0 \ , \text{ and} \\ (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 > 0 \ . \end{cases}$$

Proposition 7 (Case 5)

$\big((NL,NL),(la,nl)\big)$ is the only Bayesian equilibrium point if

$$\begin{cases} (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 < 0 \,, \\ {}_B\mathbb{E}_0 > 0 \,, \text{ and} \\ \text{at least one of } {}_A\mathbb{E}_0 < 0 \text{ and} \\ \quad (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 > 0 \text{ is satisfied.} \end{cases}$$

Proposition 8 (Case 6)

$\big((LA,NL),(nl,nl)\big)$ and $\big((NL,NL),(la,nl)\big)$ are both Bayesian equilibrium points if

$$\begin{cases} {}_A\mathbb{E}_0 > 0 \,, \\ {}_B\mathbb{E}_0 > 0 \,, \\ (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 < 0 \,, \text{ and} \\ (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 < 0 \,. \end{cases}$$

Proposition 9

Under the conditions for Case 4 in which both cell(2,2) and cell(4,4) are Bayesian equilibrium points, the equilibrium in cell(2,2) will always payoff-dominate the equilibrium in cell(4,4).[15]

2.7 Discussion of Results

The equilibrium analysis shows that when the proprietary cost for a low liability firm is very high, a firm will lobby against the proposed accounting standard even though the firm may only have a low

[15] The concept of payoff-dominance as described by Harsanyi and Selten (1988, p.81) is used.

level of liability. The necessary conditions for such a case are described in Proposition 1. In this case, it is more important to the company that the standard be stopped. The low liability firm will always lobby and does not mind being pooled together with the high liability firm by the market. At the same time, a high liability firm will also want to lobby and stop the proposed standard. In fact, given the appropriate conditions, each firm will follow the "always-lobby" strategy to evade the informational effect entirely.

In order to examine the informational effect, it is necessary that the proprietary cost for a low liability firm, $\underline{m}$, be held at a moderate level. The requirements are specified in (8). The results are several possible equilibrium cases which involve the use of different lobbying strategies by management.

Case 2 describes a separating equilibrium in which a company will always lobby against the standard if it has a high liability and refrain from lobbying if it has a low liability. The equilibrium conditions for Case 2 are likely satisfied if the proprietary cost for a high liability firm, $\bar{m}$, is sufficiently high. In this case, if the two companies have high liabilities, they will both lobby to try to defeat the standard and evade the proprietary cost. They choose this action even though lobbying will produce the informational effect and inform the market about the existence of the high liability. The conditions also require that the out-of-pocket cost of lobbying, c, is not too high. A sufficiently high c can always eliminate all benefits management can possibly derive from lobbying.

Case 3 characterizes the conditions under which neither company will lobby against the proposed standard even though the company may have a high liability. The conditions are likely satisfied when $\bar{m}$, p_1, and (q_0-q_1) are all not very high. This covers situations where the proprietary cost is low, the potential informational effect is strong, and being the first company to lobby has little effect on the standard setting body. In this case, both companies will use the "never-lobby" strategy and try to avoid the informational effect by not lobbying at all. The equilibrium in Case 3 illustrates how the informational effect may affect the lobbying decision of management. Even though a company can be seriously affected by the proposed accounting standard, management may decide not to lobby in order to evade the informational effect.

In Case 4, the game has two Bayesian equilibrium points in pure strategies. The two equilibria in this case suggest that the companies will either both use the "lobby-if-high-liability" strategy or both follow the "never-lobby" strategy. However, under the conditions for Case 4, it is likely that both companies will prefer and follow the "lobby-if-high-liability" strategy. As shown in Proposition 9, this strategy payoff-dominates the "never-lobby" strategy.

Case 5 describes an equilibrium in which only Company B will lobby even though both companies may have high liability. The equilibrium conditions in Case 5 are satisfied in situations where p_A is small and p_B is large. This case suggests that it is the company with the potentially stronger informational effect that will "free-ride" on the lobbying effort of the other company. The equilibrium solution of Case 5 illustrates how management's lobbying decision can be affected by the informational effect. In this case, Company A management will never lobby against the proposed accounting standard even though the company may be seriously affected by the standard.

A related result is described in Proposition 3 which shows that the company with the potentially weaker informational effect can never "free-ride" on the other company's lobbying effort by following only the "never-lobby" strategy. The only way this company with the weaker informational effect can possibly enjoy "free-riding" is to accept the responsibility that it will also lobby sometimes. This situation is described as one of the equilibria in Case 6.

Case 6 has two pure strategy equilibria. In addition, a mixed strategy equilibrium is also possible in which management may randomize between the "lobby-if-high-liability" strategy and the "never-lobby" strategy. The equilibrium conditions for Case 6 are satisfied in situations where p_A and p_B are both small and also close to each other. In this case, the two companies essentially count on each other to have on average only one of them lobby against the proposed standard and the other company "free-rides" on the effort of the lobbying company. It is clear that in this case the informational effect plays an important part in influencing management's behaviour.

Results of the equilibrium analysis show that, under appropriate conditions, the informational effect can have significant impact on management's lobbying decision. Facing many uncertainties, management may in some situations act strategically and refrain from lobbying totally. Management may even choose to randomize between different lobbying strategies. The results also indicate that the use of the "lobby-if-high-liability" strategy is optimal under only certain conditions. Therefore, even though a company is seriously affected by the proposed accounting standard, management may still rationally choose not to lobby against it.

For the purpose of illustration, numerical examples are complied for the equilibrium solutions in Cases 1 to 6. These examples are presented in Appendix D.

CHAPTER 3

EVIDENCE ON THE INFORMATIONAL EFFECT OF LOBBYING

3.1 Proposed Accounting Standard on "Postemployment Benefits Other Than Pension"

The FASB's continuing effort during the 1980's on the development of reporting standards for "Other Postemployment Benefits" (OPEB) provides a good opportunity for studying the possible informational effect of lobbying. Prior to 1984, the FASB had issued a number of documents on what used to be the combined project of pension and OPEB information. In February 1984, the FASB's attention on the OPEB topic was spun off as a separate agenda project. The following is a listing of all the OPEB-related documents issued by the FASB:

July 12, 1979 - Exposure Draft on Disclosure of Pensions and Other Postretirement Benefits Information

February 19, 1981 - Discussion Memorandum on Employers' Accounting for Pensions and Other Postretirement Benefits

November 22, 1982 - Preliminary Views on Employers' Accounting for Pensions and Other Postretirement Benefits

April 19, 1983 - Discussion Memorandum on Employers' Accounting for Pensions and Other Postretirement Benefits

July 3, 1984 - Exposure Draft on Disclosure of Postretirement Health Care and Life Insurance Benefits Information

November 1984 - Statement of Financial Accounting Standards No. 81 on Disclosure of Postretirement Health Care and Life Insurance Benefits Information

February 14, 1989 - Exposure Draft on Employers' Accounting for Postretirement Benefits Other Than Pensions

December 1990 - Statement of Financial Accounting Standards No. 106 on Employers' Accounting for Postretirement Benefits Other Than Pensions

The 1982 preliminary views and the 1983 discussion memorandum were the first set of documents issued by the FASB proposing specifically the application of accrual accounting to pension and OPEB liabilities on a company's financial statements. Regarding the OPEB area, the FASB's position was subsequently revised. In its 1984 Statement 81, the FASB required only the footnote disclosure of some general information about the existence of OPEB offered by a company and the amount of OPEB-related expenses charged in the year. In 1989, the FASB's interests in the financial statement recording of the OPEB liabilities were resurrected through the issue of the 1989 exposure draft. Statement 106 was subsequently issued by the FASB in late 1990 which essentially mandated the application of accrual accounting to the OPEB liabilities.

The submission of comment letters to the FASB is one way the public can express its views on proposed accounting standards. It is also one way special interest groups can lobby and try to change the FASB's position. For the purpose of the empirical analyses in this study, the lobbying position of management was obtained from the viewpoints expressed in these comment letters. The FASB always sets a deadline for the submission of comment letters on all its exposure drafts, discussion memorandums and similar documents. This arrangement suggests that, at the time of lobbying, each company cannot know for sure whether or not the other companies will also lobby.[16]

The OPEB project was chosen to provide the source of lobbying data for several reasons. First, OPEB is a material item that affects a large number of companies. It was estimated that U.S. companies paid a

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[16] This suggests the characteristic of simultaneous moves by the players at the time of lobbying.

total of $77 billion in health care premiums for their employees and retirees and their dependents in 1983, which was more than what those companies paid in that year in the form of dividends (Vejlupek and Cropsey, 1984). A 1986 U.S. Bureau of Labor Statistics study showed that 72% of all full time employees in medium and large U.S. companies received OPEB from their employers (Gerboth, 1988). An U.S. House Select Committee on Aging estimated the total OPEB related liabilities of the largest 500 U.S. companies to be between $1.7 trillion and $2 trillion (Kimbrough, 1988; Newell, 1989; Lightfoot, 1989).

The proposed FASB standard on the accrual of the OPEB obligations would materially affect the financial statements of a large number of companies. A 1984 National Association of Accountants survey of the Fortune 1000 companies showed that 73% of respondents offered OPEB to their employees and 85% of these companies used the cash basis "pay-as-you-go" method to account for the OPEB benefits (Survey on Postretirement Benefits Tracks Reaction to FASB Proposal, 1984; FASB Reporting Proposal Panned by Corporate Chiefs, 1984). Similar results were also obtained in an Ernst & Whinney survey of 100 annual reports in 1985 (Schwartz and Lorentz, 1986). The application of accrual accounting was expected to affect significantly the reporting of OPEB on these companies' financial statements.

In terms of effects on the income statement, the proposed standard on the accrual of OPEB would significantly increase the reported expenses of affected companies. A 1988 survey of 76 companies showed that, if the accrual basis was used to account for OPEB, profits of the companies would be cut approximately in half. Furthermore, the same study estimated that there would be a 25% reduction in the reported profits of the Fortune 100 companies (Rappaport, 1988). Similar results were also obtained from actuarial studies which estimated that the accrual basis of accounting for OPEB would reduce the reported profits of the nation's largest corporations by 30% to 60% (Gerboth, 1988). For example, it was estimated that General Motors's net income would be reduced by $1 billion under the FASB proposal (Berton, 1989). Akresh, Bald and Dankner (1989) conducted a field test of 25 companies and found that the accrual basis OPEB expense could be less than 3 times the cash basis expense for highly matured companies but could be as high as over 10 times for other companies. On a per employee basis, Cole (1989) indicated that the FASB proposal would increase health care costs and reduce profits by $1,500 to $3,000 per active employee.

In terms of effects on the balance sheet, the proposed standard on OPEB would increase the reported liabilities of the affected companies. An actuarial study showed that, depending on the number of years of employees' working career, the amount of OPEB related liabilities could typically be between 60% to 175% of the company's pension liabilities (Taplin, 1985). However, while pension liabilities were funded, OPEB liabilities were usually not. The proposed reporting requirement on OPEB could therefore significantly increase the recorded liabilities on a company's balance sheet. Field tests conducted by Coopers & Lybrand showed that accrual accounting of OPEB would lead to significantly higher recorded expenses and liabilities, which might lead to the violation of restrictive debt covenants for some companies (McCarthy, 1989; Powers, 1989). There were also indications that companies were concerned about the potentially hugh OPEB liabilities on their balance sheets. Several approaches have been suggested by professional consultants in the health care literature to reduce the amount of these postretirement liabilities (Kirk and Teasley, 1989; Custis, 1991).

The effects of proprietary cost were also likely to be strong in the OPEB area. Sensitive information such as the salary projection rate and projected health cost trend rate might have to be disclosed along with the recorded OPEB liabilities. For example, an unusually high death rate for the retirees could be an indication of hazardous working environment in the company which might be translated into higher health care and life insurance obligations for the company. Damages resulted from the disclosure of such sensitive information could be significant and form part of the proprietary cost of the disclosure.

The financial statement recording of the OPEB liabilities might also have certain legal implications to the companies. Employers used to think that they could pretty much do whatever they wanted with OPEB. However, court decisions on the recent legal cases of Bethlehem Steel and White Farm Equipment suggested that employers could not easily reduce OPEB benefits previously offered to their employees (Taplin, 1985). The financial statement recording of the OPEB liabilities would no doubt enhance the legality of the retirees' claims against the companies. Furthermore, some companies expressed concerns that putting the OPEB liabilities on the balance sheet would prompt the government's enactment of some OPEB-specific legislations with requirements similar to those in the Employee Retirement Income Security Act (ERISA) of 1974 on the pension topic. Such requirements might create legal constraints which could greatly reduce the flexibility management had in running the company. From management's perspective, any damages resulted from the reduced flexibility would become part of the proprietary cost of the disclosure.

In the OPEB area, proprietary cost could also be high even for a company with no OPEB liability if the proposed reporting standard became mandatory. For example, in a comment letter submitted to the FASB, a respondent expressed the concern that the lack of OPEB could impose a "second-class citizen" type status on a company (Financial Accounting Stan[illegible] 1985, p.37). With the mandatory reporting standard, it woul[illegible]le for the market to identify and possibly even penalize [illegible]nies which did not have any OPEB obligations. From management's perspective, such penalties could form part of the proprietary cost of the disclosure.

There was indication that the potential informational effect of lobbying might also be strong in the OPEB area. In 1985, the leveraged buyout firm of Clayton & Dubilier was not aware of an estimated $600 million OPEB obligation that Uniroyal had when Clayton & Dubilier purchased the company (Gerboth, 1988). The FASB proposal had certainly increased the public's awareness of the potential OPEB liabilities in all companies. However, as Galant (1989) pointed out, details of corporations' benefit plans and their work-force demographics were generally not made public by the firms. In fact, there was evidence that even portfolio managers and financial analysts had difficulties getting such information to figure out what the OPEB obligation was for any one company (Galant, 1989).

Therefore, it appeared that at least in the early 1980's when the FASB started looking at the OPEB issue, the investing public might not be fully aware of the implications and the extent of the OPEB liabilities.[17] Furthermore, results of a survey in 1988 showed that, in many cases, even managers were not fully aware of the extent of their OPEB costs and liabilities (FASB's Valentine's Day Gift: OPEB Draft, 1989). To the extent that there were uncertainties about the existence of significant OPEB liabilities, the potential for strong informational effects would exist.

3.2 Empirical Implications of the Informational Effect

In response to the requirements in the FASB Statement 81 which was issued in November 1984, companies offering OPEB to their employees were for the first time required to make note disclosure about their OPEB liabilities. Prior to Statement 81, the market had to rely on other information to form expectations about the liability level. A firm's lobbying position on the OPEB issue could be an example of such information. After Statement 81 became effective, the required note disclosure would provide confirmation to the market about the existence of OPEB liability in the disclosing companies.

Although Statement 81 did not require the companies to accrue their OPEB expenses and liabilities, the description in Table 1 about changes in the market's expectation of the liability level, $\tilde{L}$, is still applicable.[18] Table 1 deals specifically with the situation of a

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[17] It is also important to point out that the FASB's interest on the OPEB topic represents an area in which the development of financial accounting standards was not preceded by legislative enactments such as ERISA in the pension area. Therefore, when the FASB first proposed the application of accrual accounting to OPEB, the topic was sufficiently "fresh" in the sense that the market might not have fully expected it.

[18] Since the financial statement recording of the OPEB liabilities was not required, the description in Table 1 regarding the changes in the market's expectation of the proprietary cost at $t = 4$ is not applicable.

high liability firm. Prior to $t = 4$, the market formed an expectation of the liability level based on the lobbying position of management. At $t = 4$, the market could for the first time confirm the existence of the high OPEB liability in these companies. For the purpose of this study, the first note disclosure about OPEB made by a company under the FASB Statement 81 was identified as the "first-time OPEB disclosure" for this company.

According to Table 1, the decline in the stock price of the high liability firm at $t = 4$ would be $(1-p''_1)\mathbb{L}$ if management had previously lobbied and $(1-p'_1)\mathbb{L}$ if management had not previously lobbied. The empirical implications hypothesized below allowed for the possibility that different equilibrium strategies might be played by the companies. Under the strategy of (LA,NL) or (la,nl), the high liability of a company would be fully revealed at the time of lobbying, i.e., $p''_1 = 1$. The stock price should, therefore, remain unchanged at $t = 4$. Under the "always-lobby" strategy of (LA,LA) or (la,la) and the "never-lobby" strategy of (NL,NL) or (nl,nl), lobbying would be non-revealing, i.e., $p''_1 = p'_1 = p_1$. Given that $p_1 > 0$, there should be a stock price decline at $t = 4$ regardless of whether or not the high liability company had previously lobbied. Under a mixed strategy between (LA,NL) and (NL,NL) or between (la,nl) and (nl,nl), lobbying would be partially revealing, i.e., $1 > p''_1 > p'_1 > 0$. Consequently, there should be stock price decline at $t = 4$ for the high liability company. Comparing between a high liability company which lobbied and one which did not, since $p''_1 \geq p'_1$, the expressions in Table 1 suggest that, on average, the stock price decline should be larger for the "no-lobbying" high liability company than for the "lobbying" high liability company.

Based on the above arguments, the informational effect of lobbying might be reflected in the following empirical relationships:

(1) No unexpected change or an unexpected decline in the stock price of a high liability company when the first-time OPEB disclosure was made if management had previously lobbied against the proposed accounting standard.

(2) An unexpected decline, one that is larger than in (1) above, in the stock price of a high liability company when the first-time OPEB disclosure was made if management had not previously lobbied against the proposed standard.

Similar arguments were also applied to a low liability company using the changes in market expectation presented in Table 2. In this case, the increase in the stock price of the low liability firm at $t = 4$ would be $p''_i\mathbb{L}$ if management had previously lobbied and $p'_i\mathbb{L}$ if management had not previously lobbied. Under the strategy of (LA,NL) or (la,nl), with $p'_i = 0$, the stock price of the company should remain unchanged at $t = 4$. Under the "always-lobby" strategy of (LA,LA) or (la,la) and the "never-lobby" strategy of (NL,NL) or (nl,nl), with $p''_i = p'_i = p_i$, there should be a stock price increase at $t = 4$ regardless of whether or not the low liability company had previously lobbied. Under a mixed strategy between (LA,NL) and (NL,NL) or between (la,nl) and (nl,nl), with $1 > p''_i > p'_i > 0$, there should be stock price increase at $t = 4$ for the low liability company. Comparing between a low liability company which lobbied and one which did not, since $p''_i \geq p'_i$, the expressions in Table 2 suggest that, on average, the stock price increase should be larger for the "lobbying" low liability company than for the "no-lobbying" low liability company.

With respect to the low liability company, determining the timing of its first-time OPEB disclosure could be problematic. Due to the use of the materiality guideline in financial reporting, there might be simply no OPEB disclosure at all for the low liability company. To the extent that the timing of the OPEB disclosure could be ascertained for the low liability firm, the following empirical relationships might be detected:

(3) An unexpected increase, one that is larger than in (4) below, in the stock price of a low liability company when the first-time OPEB disclosure was made if management had previously lobbied against the standard.

(4) No unexpected change or an unexpected increase in the stock price of a low liability company when the first-time OPEB disclosure was made if management had not previously lobbied against the standard.

The hypothesized empirical relationships discussed above are summarized in Table 7.

3.3 Data Collection

The purpose of the empirical analyses was to detect the possible differences in the market's response to the OPEB information at the time of the first OPEB disclosure between the "lobbying" and the "no-lobbying" companies conditional on their liability levels. This study focused only on cases in which the timing of the first-time OPEB disclosure can be determined. In this respect, only companies that actually made the OPEB disclosure in accordance with the FASB Statement 81 were included in the empirical analyses.

TABLE 7

HYPOTHESIZED EFFECT OF THE FIRST-TIME OPEB DISCLOSURE ON COMPANY STOCK PRICE

	Company previously lobbied	Company did not previously lobby
High liability company	No effect or small negative effect	large negative effect
Low liability company	large positive effect	No effect or small positive effect

The data collection procedures were designed to capture a sample of public companies which made OPEB disclosure under the requirements of Statement 81. The April 1990 version of the Compact Disclosure USA database was used to identify the sample companies for this part of the study.[19] A search of several OPEB-related key words resulted in an original sample of 623 NYSE and AMEX listed companies which disclosed OPEB information in the notes to their 1989/90 financial statements.[20]

For each company in the original sample, prior years' financial statements dated as far back as 1983 were examined to identify the first time the company made the note disclosure about their OPEB obligations. The majority of these companies started their OPEB disclosures in response to the requirements of the FASB Statement 81 which was issued in November 1984.[21]

To capture the market's reactions to the first-time disclosure of the OPEB information, the focus was placed on the particular year in which the financial statements contained the company's first-time OPEB disclosure. The date the annual report was released would provide an indication of the time the market first received the OPEB information. However, data on the release date of the annual report were not

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[19] The database of Compact Disclosure USA contains the full text financial statements of large U.S. public companies which are required to file a 10K or appropriate statements with the Securities and Exchange Commission. The April 1990 version of the database covers a total of 12,345 such companies.

[20] The following key words were used in the search: postretirement, postemployment, retiree benefit(s), health care benefit(s), medical benefit(s), and life insurance benefit(s).

[21] Most companies had to adopt the disclosure requirements in Statement 81 immediately after it was issued. The statement was effective for financial statements on fiscal periods ending after December 15, 1984.

available. For the purpose of this study, the date of the auditor's report was used as a surrogate to provide an indication of the time the annual report was released.[22] For each sample company, the week which contained the audit report date was identified as Week 0 in this study.

Weekly returns of the sample companies over the period from the beginning of 1983 to the end of 1989 were computed using daily returns obtained from the CRSP tapes.[23] Due to data availability and other reasons, a number of companies were dropped from the original sample. The final sample consists of a total of 444 companies. Information on sample selection is shown in Table 8.

For the purpose of this study, management's written submission to the FASB in response to the 1982 preliminary views and the 1983 discussion memorandum on the pension and OPEB topic was used to identify management's lobbying position.[24]

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[22] If an auditor's report was double dated, the later date on the audit report was identified as the audit report date in this study.

[23] For each calendar week, effective weekly return was computed for each stock using daily returns obtained from CRSP on all trading days in that week. For each week, the daily returns normally started on a Monday and ended on a Friday. Each holding period is from a Friday close to the next Friday close. The number of trading days actually used in the calculation of a weekly return could be less than 5 if there was a public holiday in that week. For any stock, no weekly return was calculated for a week if there were missing data reported by CRSP in any of the daily returns during that week. In such a case, for the purpose of subsequent analyses, the weekly return itself was treated as a missing value item.

[24] The document containing the combined public records of all the comment letters on the 1982 preliminary views and the 1983 discussion memorandum was published by the FASB in February 1987. Although the document was not officially released until 1987, copies of the comment letters contained in this document were in the public domain many years before 1987. The documentation specialist at the FASB indicated that there were lots of interest in the OPEB project and they received a large number of requests for copies of comment letters long before the public records were officially published.

TABLE 8

INFORMATION ON SAMPLE SELECTION

	Number of companies
Identified from Compact Disclosure USA database:	
Companies listed on NYSE or AMEX	2,345
No OPEB-related key words in note disclosure	1,722
Notes containing OPEB-related key words	623
Eliminated from sample for the following reasons:	
Prior years' financial statements not available to determine the year of first-time OPEB disclosure	(27)
Disclosure not related to OPEB obligations of the company	(18)
Companies not included on the CRSP daily stock return tape from 1983 to 1989	(55)
Companies with missing values in the weekly returns during the estimation or the forecast period	(73)
Companies which lobbied in favour of the proposed accounting standard	(6)
Companies in final sample	444

Among the 444 companies included in the sample, 161 submitted comment letters to the FASB on the combined document of the 1982 exposure draft and the 1983 discussion memorandum. To focus on only the two possible positions of "lobbying against" and "no lobbying", cases which involved management lobbying in favour of the proposed accounting standard were excluded from the empirical analyses. Of all the comment letters examined, only six companies expressed some indications of support for the FASB proposal of accruing the pension and the OPEB liabilities.[25]

Among the remaining 155 sample companies which submitted comment letters to the FASB, all expressed opposition to the accrual of the pension liabilities. With respect to the OPEB issue, none of these 155 companies provided support for the accrual of the OPEB liabilities.[26] For the purpose of this study, all these 155 companies were considered to have lobbied against the FASB proposal on the OPEB area. The sample companies were then classified into two different groups: the "lobbying" and the "no-lobbying" groups. As a result, the 155 companies were included in the "lobbying" group and the remaining 289

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[25] Only two companies provided full support for the FASB proposal. Three companies supported the FASB on accruing pension liabilities but indicated that further study was needed on the OPEB area. One company supported the accrual of both the pension and the OPEB liabilities but suggested that implementation should be delayed in the OPEB area and note disclosure should be used in the meantime.

[26] Some companies indicated clearly that they opposed the FASB's proposal of accruing both the pension and the OPEB liabilities. Some companies simply expressed their strong opposition to the entire FASB proposal. Some companies indicated that they opposed the accrual of the pension liabilities and suggested a separate study for the OPEB area. Some companies indicated their opposition to the accrual of the pension liabilities but made no specific reference to the OPEB area. However, in all cases, the responses in the comment letters indicated no support for the FASB proposal of accrual for the OPEB liabilities.

companies were placed in the "no-lobbying" groups.

3.4 Distribution of Week 0 and the Formation of Stock Portfolios

Most of the sample companies made their first-time OPEB disclosure in early 1985 in response to the requirements of the FASB Statement 81. It is interesting to note that about 10% of the sample companies did not adopt the disclosure requirements of this accounting standard until at least one year later. Table 9 presents a breakdown on the timing and distribution of Week 0 for the 444 sample companies.

There was clearly a high degree of clustering of Week 0 at around February 1985. In fact, a total of 297 companies, representing about two-thirds of the entire sample, had Week 0 located within a six-week period starting on January 21, 1985. Most of these observations were from companies with the December 31 year end. To a lesser extent, there was also a small clustering of Week 0 at around July and August of 1985 representing several companies with the June 30 year end.

Week 0 was within the year 1985 for a total of 397 companies. Of the remaining firms, there were 19, 10, and 16 companies which did not make their first-time OPEB disclosures until 1986, 1987, and 1988 respectively.

On the basis of the timing of Week 0, the sample companies were grouped into portfolios of "lobbying" and "no-lobbying" firms. The purpose of forming these portfolios was to reduce the idiosyncratic noise in the stock returns of the individual companies. The market's reaction to the first-time OPEB disclosure would be examined in the context of the portfolio returns.

TABLE 9

DISTRIBUTION OF WEEK 0

Week 0 (First Trading Day in the Week)	Number of Companies: NL Group	LA Group	Total	%	Possible number of portfolios
26-Nov-84	1	0	1	0.23	1
:					
10-Dec-84	0	1	1	0.23	1
:					
31-Dec-84	1	0	1	0.23	1
07-Jan-85	2	1	3	0.68	2
14-Jan-85	6	6	12	2.70	2
21-Jan-85	25	16	41	9.23	2
28-Jan-85	37	17	54	12.16	2
04-Feb-85	36	26	62	13.96	2
11-Feb-85	46	27	73	16.44	2
19-Feb-85	22	12	34	7.66	2
25-Feb-85	21	12	33	7.43	2
04-Mar-85	7	2	9	2.03	2
11-Mar-85	3	2	5	1.13	2
18-Mar-85	2	3	5	1.13	2
25-Mar-85	6	1	7	1.58	2
01-Apr-85	2	0	2	0.45	1
08-Apr-85	2	0	2	0.45	1
15-Apr-85	1	0	1	0.23	1
:					
29-Apr-85	1	0	1	0.23	1
06-May-85	1	0	1	0.23	1
:					
20-May-85	3	0	3	0.68	1
28-May-85	1	0	1	0.23	1
03-Jun-85	1	0	1	0.23	1
:					
17-Jun-85	1	0	1	0.23	1
24-Jun-85	1	0	1	0.23	1
:					
08-Jul-85	0	1	1	0.23	1
15-Jul-85	2	0	2	0.45	1
22-Jul-85	2	1	3	0.68	2
29-Jul-85	5	1	6	1.35	2
05-Aug-85	3	1	4	0.90	2
12-Aug-85	5	0	5	1.13	1
:					
26-Aug-85	1	0	1	0.23	1
03-Sep-85	1	1	2	0.45	2
:					

TABLE 9 (CONTINUED)

DISTRIBUTION OF WEEK 0

Week 0 (First Trading Day in the Week)	Number of Companies				Possible number of portfolios
	NL Group	LA Group	Total	%	
:					
23-Sep-85	1	2	3	0.68	2
:					
28-Oct-85	1	0	1	0.23	1
04-Nov-85	5	0	5	1.13	1
11-Nov-85	0	1	1	0.23	1
18-Nov-85	2	2	4	0.90	2
25-Nov-85	1	0	1	0.23	1
:					
02-Dec-85	1	2	3	0.68	2
:					
16-Dec-85	1	0	1	0.23	1
:					
30-Dec-85	1	0	1	0.23	1
06-Jan-86	1	0	1	0.23	1
13-Jan-86	1	2	3	0.68	2
20-Jan-86	0	2	2	0.45	1
27-Jan-86	1	0	1	0.23	1
03-Feb-86	2	0	2	0.45	1
10-Feb-86	2	2	4	0.90	2
18-Feb-86	0	1	1	0.23	1
24-Feb-86	0	1	1	0.23	1
:					
17-Mar-86	0	1	1	0.23	1
:					
09-Jun-86	1	0	1	0.23	1
:					
28-Jul-86	0	1	1	0.23	1
:					
27-Oct-86	1	0	1	0.23	1
:					
19-Jan-87	1	3	4	0.90	2
26-Jan-87	1	0	1	0.23	1
02-Feb-87	0	1	1	0.23	1
09-Feb-87	0	1	1	0.23	1
:					
23-Feb-87	1	1	2	0.45	2
:					
23-Mar-87	0	1	1	0.23	1
:					

TABLE 9 (CONTINUED)

DISTRIBUTION OF WEEK 0

Week 0 (First Trading Day in the Week)	Number of Companies				Possible number of portfolios
	NL Group	LA Group	Total	%	
:					
18-Jan-88	2	0	2	0.45	1
25-Jan-88	1	0	1	0.23	1
01-Feb-88	3	0	3	0.68	1
08-Feb-88	2	0	2	0.45	1
16-Feb-88	2	0	2	0.45	1
22-Feb-88	1	0	1	0.23	1
:					
07-Mar-88	1	0	1	0.23	1
:					
04-Apr-88	2	0	2	0.45	1
:					
31-May-88	1	0	1	0.23	1
:					
22-Aug-88	1	0	1	0.23	1
Total	289	155	444	100.00	93

TOTALS BY YEAR:

Week 0 included in the year	Number of Companies				Possible number of portfolios
	NL Group	LA Group	Total	%	
1984	1	1	2	0.45	2
1985	260	137	397	89.42	59
1986	9	10	19	4.28	14
1987	3	7	10	2.25	8
1988	16	0	16	3.60	10
Total	289	155	444	100.00	93

As shown in Table 9, a maximum of 93 portfolios (59 "no-lobbying" portfolios and 34 "lobbying" portfolios) could be formed with each portfolio containing firms which made their first-time OPEB disclosures in the same calendar week.

To focus on the potential different market response between the different types of firms, attempts were made to reduce the effects of other confounding factors in the analyses. As a result, not all of the 93 possible portfolios were used in the study. A number of portfolios were excluded for the following two reasons. First, those companies which did not adopt the 1984 OPEB accounting standard until two or three years later could be very different from the other companies in the sample. Second, aligning event dates which spanned several years would introduce unnecessary noise into the analyses. Therefore, it was decided that the portfolios used in the analyses would include only those companies which had Week 0 located in the calendar year 1985.

In forming the stock portfolios, companies with the same Week 0 and the same lobbying position were placed in a portfolio on an equally-weighted basis. A total of 59 portfolios were formed, which included 38 portfolios of 260 "no-lobbying" firms and 21 portfolios of 137 "lobbying" companies. Close to 90% of all the sample companies were represented in the 59 portfolios.

3.5 Description of Portfolio Returns

For each of the 59 portfolios, weekly returns were calculated over a two-year period starting from Week -52 to Week 52. Returns of a market portfolio matching the same two-year period were also calculated using the CRSP value-weighted daily index of the NYSE and AMEX stocks.

The two-year period was further divided into four subperiods: Weeks -52 to -27, -26 to -1, 0 to 26, and 27 to 52.

To provide some insights into the behaviour of the portfolio returns over the test period, descriptive statistics on the return distribution of 12 particular portfolios (6 "no-lobbying" portfolios and 6 "lobbying" portfolios) and the matching market portfolios are presented in Table 10. These 12 portfolios were formed on the basis of the location of Week 0 such that Week 0 was within the six-week period starting on 21-Jan-85. This was the same six-week period which showed the highest clustering of Week 0 in Table 9.

The 12 portfolios of "no-lobbying" and "lobbying" firms covered in Table 10 represented about 67% of all the companies in the sample. Across the four subperiods, there were some indications of movements in both the means and the standard deviations of the portfolio returns. The mean returns had generally gone up between the first and the second subperiods, went down in the third subperiod and in most cases went up again slightly during the fourth subperiod. This observation was consistent across all the portfolios formed over the six-week period.

The return variances, on the other hand, exhibited some unusual movements which were quite different among the portfolios. Between the first two subperiods, the return variances went down for some of the portfolios but went up for the others. In terms of the changing variances, returns of the portfolios formed over the first two weeks (21-Jan-85 and 28-Jan-85) behaved very differently from those of the portfolios formed over the other four weeks (04-Feb-85, 11-Feb-85, 19-Feb-85 and 25-Feb-85).

TABLE 10

DISTRIBUTION OF PORTFOLIO RETURNS

Portfolios	Subperiods 1 Week -52 to -27	2 Week -26 to -1	3 Week 0 to 26	4 Week 27 to 52	Entire Period Week -52 to 52
Week 0 in week of 21-Jan-85					
Lobby - mean	-0.001	0.009	0.004	0.004	0.004
std. dev.	0.014	0.020	0.015	0.015	0.016
No-Lobby - mean	-0.005	0.008	0.005	0.003	0.003
std. dev.	0.020	0.022	0.017	0.017	0.020
Market - mean	-0.003	0.006	0.005	0.003	0.003
std. dev.	0.018	0.020	0.013	0.014	0.017
Week 0 in week of 28-Jan-85					
Lobby - mean	-0.001	0.007	0.003	0.003	0.003
std. dev.	0.017	0.020	0.013	0.015	0.016
No-Lobby - mean	-0.005	0.011	0.004	0.006	0.004
std. dev.	0.020	0.023	0.014	0.016	0.019
Market - mean	-0.002	0.007	0.004	0.004	0.003
std. dev.	0.018	0.021	0.012	0.014	0.017
Week 0 in week of 04-Feb-85					
Lobby - mean	0.001	0.007	0.004	0.007	0.005
std. dev.	0.022	0.015	0.013	0.014	0.017
No-Lobby - mean	0.003	0.006	0.002	0.006	0.004
std. dev.	0.023	0.015	0.012	0.014	0.017
Market - mean	0.001	0.005	0.003	0.006	0.004
std. dev.	0.023	0.016	0.013	0.014	0.017
Week 0 in week of 11-Feb-85					
Lobby - mean	0.002	0.006	0.001	0.006	0.004
std. dev.	0.023	0.016	0.012	0.014	0.017
No-Lobby - mean	0.000	0.006	0.004	0.007	0.004
std. dev.	0.027	0.018	0.012	0.014	0.019
Market - mean	0.003	0.005	0.002	0.007	0.004
std. dev.	0.023	0.016	0.012	0.014	0.017
Week 0 in week of 19-Feb-85					
Lobby - mean	0.005	0.006	0.002	0.005	0.008
std. dev.	0.023	0.016	0.012	0.019	0.017
No-Lobby - mean	0.004	0.008	0.005	0.009	0.006
std. dev.	0.022	0.014	0.016	0.018	0.018
Market - mean	0.003	0.005	0.002	0.007	0.004
std. dev.	0.023	0.016	0.012	0.014	0.017
Week 0 in week of 25-Feb-85					
Lobby - mean	0.004	0.006	0.005	0.007	0.005
std. dev.	0.021	0.016	0.013	0.015	0.016
No-Lobby - mean	0.000	0.004	0.003	0.004	0.003
std. dev.	0.024	0.019	0.013	0.016	0.018
Market - mean	0.003	0.004	0.003	0.007	0.004
std. dev.	0.023	0.016	0.012	0.014	0.017

Since the 28-Jan-85 and the 04-Feb-85 portfolios were formed with Week 0 being only one week apart, the large number of overlapping returns would suggest that their return distributions should be very similar. The only reasonable explanation for the observed differences was that there must be a single weekly return responsible for the fluctuations.

Following up on the observed differences between the 28-Jan-85 and the 04-Feb-85 portfolios, it was found that there was a large positive weekly return included in the second subperiod of the 21-Jan-85 and the 28-Jan-85 portfolios. The same weekly return was included in the first subperiod of the portfolios formed over the other four weeks. The large weekly return was traced all the way back to the CRSP return data and identified as for the week of 30-Jul-84. For some reason, daily returns were high on three out of the five trading days in this week. Returns on the daily CRSP value-weighted market index were 0.02128, 0.02476, and 0.02828 on August 1, 2, and 3 respectively. For this week, the calculated effective return of the market index was 0.0739 which increased the variance of any return series covering this week. A subsequent review of the *Wall Street Journal* confirmed the existence of a record trading week in the first week of August 1984. The Dow Jones Industrial Average reported its biggest jump ever at that time of 87.46 points (7.8%) during that week. No single development was quoted as being responsible for the market surge.[27]

[27] Subsequent analyses were performed with this weekly return included in the return series. The same analyses were also performed with the 30-Jul-84 weekly return replaced by an average return of the preceding and the following weeks. The results and conclusions of these analyses were generally not affected by removal of this return.

To test for any significant changes in the return distribution of the portfolios across the four subperiods, multivariate tests were performed on the mean vectors and the covariance matrices between each of the 12 portfolios and their matching market index portfolio. The tests were conducted on a pairwise basis over the four subperiods. The results are similar across the six different sets of portfolios formed over the six-week periods. A typical set of results representing portfolios that were formed over the week of 11-Feb-85 are presented in Table 11.

The Box's M statistic generated by the multivariate homogeneity of covariance test generally showed that there were significant overall differences in the covariance matrices of the portfolio and the market returns between the first and the other three subperiods.[28] No overall difference was apparent among the other subperiods.

The Hotelling's T^2 statistic generated by the multivariate test of means suggested that there was generally no significant difference in the mean vectors, which included the portfolio returns and the market returns, over most of the subperiods. However, there were some indications that the mean return vectors were significantly different for the "lobbying" portfolios between the first and the third subperiods.

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[28] The Box test for the homogeneity of covariance matrices is very sensitive to non-normality. To provide some support for the use of this test, the univariate normality of the portfolio returns was examined. For each of the 12 portfolios, the Kolmogorov-Smirnov goodness of fit test was applied to the returns over each of the four subperiods as well as the full 105-week period. The null hypothesis of normality was not rejected at the 0.05 level in any of the cases examined.

TABLE 11

TESTS FOR THE STATIONARITY OF THE MEAN VECTORS AND THE COVARIANCE MATRICES BETWEEN THE MARKET INDEX PORTFOLIO AND THE "LOBBYING" AND THE "NO-LOBBYING" PORTFOLIOS (WITH WEEK 0 IN THE WEEK OF 11-FEB-85) ACROSS THE FOUR SUBPERIODS

Test for the homogeneity of the covariance matrices between all possible pairs of subperiods using the χ^2 approximation (d.f.= 3) of the Box's M statistic:†

Subperiods		1	2	3
2	NL	5.457 (0.141)		
	LA	3.675 (0.299)		
3	NL	14.[illegible]79 (0.002)	2.540 (0.468)	
	LA	17.083 (0.001)	6.12[illegible] (0.10[illegible])	
4	NL	6.447 (0.092)	1.637 (0.651)	2.761 (0.430)
	LA	1[illegible].548 (0.009)	3.033 (0.387)	0.702 (0.873)

Test for the equality of the mean vectors between all possible pairs of subperiods using the exact F transformation of the Hotelling's T^2 statistic:†

Subperiods		1	2	3
2	NL	0.432 (0.652)		
	LA	1.822 (0.173)		
3	NL	0.035 (0.966)	0.992 (0.378)	
	LA	3.205 (0.049)	0.346 (0.709)	
4	NL	0.276 (0.760)	0.278 (0.759)	[illegible].043 ([illegible].360)
	LA	0.979 (0.383)	0.393 (0.677)	1.411 (0.[illegible]4)

† p-values are shown in parentheses below the test statistic.

Regarding those cases in which the homogeneity assumption on the covariance matrices was violated, the use of the Hotelling's T^2 would not be appropriate. In this respect, the non-parametric Mann-Whitney test was also performed to provide additional information on the changes in the mean returns of the portfolios over the subperiods. The results of the Mann-Whitney test were, in general, very similar to those of the multivariate test using the Hotelling's T^2 statistic. There were generally indications of some changes in the mean portfolio returns for the "lobbying" portfolios between the first and the third subperiods.

3.6 Analyses of Abnormal Returns

The empirical relationships hypothesized in Table 7 were tested by examining the abnormal returns of the "lobbying" and the "no-lobbying" companies conditional on their liability levels. In this respect, attempts were made to classify and partition the 59 portfolios formed earlier in Section 3.4 into portfolios of relatively higher liability companies and portfolios of relatively lower liability companies.

Using information contained in the first-time OPEB disclosure, a proxy was developed to segregate the portfolio companies into high liabilit companies and low liability companies. The 1984 FASB Statement 81 required companies to make note disclosure about the amount of OPEB charges expensed in a year. At the data collection stage, steps were taken to record the amount of OPEB expense reported by each company in its first-time OPEB disclosure. The amount of OPEB expenditures, scaled by the number of employees the company had at the end of 1984, was used to represent the extent of OPEB liability of the company.[29] This measure, however, would at best be a rough proxy for a company's liability level because the amount expensed in a year might not fully reflect the extent of the company's OPEB liability.

Using the above proxy for the liability level, a company which reported an OPEB expense of at least $180 per employee was classified as a high OPEB company.[30] Conversely, a company which reported less than $180 of OPEB expense per employee was classified as a low OPEB company. As a result of the above procedures, the 59 "lobbying" and "no-lobbying" portfolios formed earlier in Section 3.4 were further divided into the following four groups: 22 portfolios representing 121 "no-lobbying/high OPEB" companies, 30 portfolios representing 139 "no-lobbying/low OPEB" companies, 12 portfolios representing 78 "lobbying/high OPEB" companies, and 18 portfolios representing 59 "lobbying/low OPEB" companies.

For each of the portfolios included in the above four groups, the parameters of the market model in (10) were estimated using weekly returns over a 26-week estimation period starting from Week -52 to Week -27.[31]

$$\tilde{R}_{i,t} = \alpha_i + \beta_i \tilde{R}_{m,t} + \tilde{\varepsilon}_{i,t} \tag{10}$$

where $\tilde{R}_{i,t}$ is the weekly return of Portfolio i during Week t calculated

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[29] This proxy is identical to the EXPENSE variable defined later in Section 3.8.4.

[30] The $180 cutoff was chosen so that roughly the same number of sample companies would be included in the high OPEB and the low OPEB categories.

[31] Companies with missing data in any of the weekly returns during the estimation period or the forecast period were eliminated from the sample.

based on the CRSP daily returns of the companies in the portfolio; $\tilde{R}_{m,t}$ is the weekly return of the market index portfolio during Week t calculated based on the CRSP value-weighted daily market returns of the NYSE and AMEX stocks; and $\tilde{\varepsilon}_{i,t}$ is a stochastic residual term satisfying the ordinary least squares assumptions.

Given the parameter estimates, $\hat{\alpha}_i$ and $\hat{\beta}_i$, the weekly abnormal returns were obtained from the market model residuals using (11) for each portfolio over a 79-week forecast period starting at Week -26.

$$e_{i,t} = R_{i,t} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{m,t}\right) \qquad (t = -26,\ldots,52) \qquad (11)$$

The average residuals were then calculated using (12) and cumulated week by week over a 79-week period starting at Week -26 for each of the four groups of portfolios using (13).

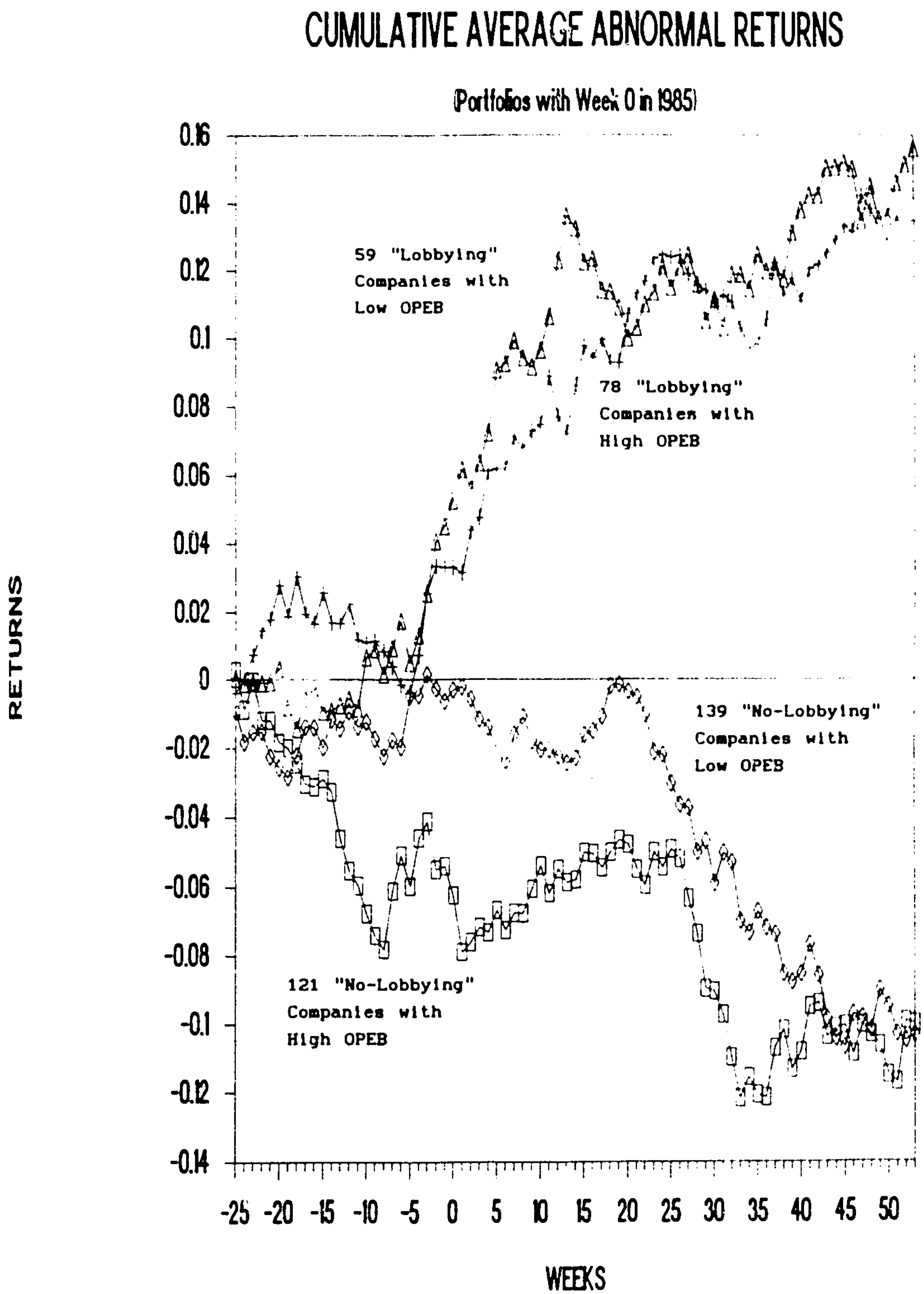
$$_{k}AR_{t} = \frac{1}{N_k}\sum_{i=1}^{N_k} e_{i,t} \qquad (t = -26,\ldots,52) \qquad (12)$$

$$_{k}CAR_{\ell} = \sum_{t=-26}^{\ell} {}_{k}AR_{t} \qquad (\ell = -26,\ldots,52) \qquad (13)$$

where k = 1, 2, 3, and 4 representing the "no-lobbying/high OPEB", "no-lobbying/low OPEB", "lobbying/high OPEB", and "lobbying/low OPEB" groups of portfolios respectively; Week ℓ is the last week of an accumulation period for which the cumulative average residual is calculated; and N_k is the number of portfolios included in group k.

The cumulative average residuals, $_{k}CAR_{\ell}$, for the four groups of portfolios are plotted and presented graphically in Figure 7.

FIGURE 7


CUMULATIVE AVERAGE ABNORMAL RETURNS
(Portfolios with Week 0 in 1985)
RETURNS
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
59 "Lobbying" Companies with Low OPEB
78 "Lobbying" Companies with High OPEB
139 "No-Lobbying" Companies with Low OPEB
121 "No-Lobbying" Companies with High OPEB
-25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50
WEEKS

The method developed by Patell (1976) was used in this study to test for the statistical significance of the market's reactions to the first-time OPEB disclosure. The standardized residuals were first calculated for each portfolio using (14) over each of the 79 weeks starting from Week -26 to Week 52.[32]

$$SR_{i,t} = \frac{e_{i,t}}{s_i \sqrt{C_{i,t}}} \qquad (t = -26,\ldots,52) \qquad (14)$$

where s_i^2 is an unbiased estimate of the residual variance in (10); and $C_{i,t}$ is a correction factor for predicting an observation outside the estimation period. Specifically,

$$s_i^2 = \frac{1}{(T-2)} \sum_{t=-52}^{-27} e_{i,t}^2$$

$$C_{i,t} = 1 + \frac{1}{T} + \frac{\left(R_{m,t} - \bar{R}_m\right)^2}{\sum_{\tau=-52}^{-27} \left(R_{m,\tau} - \bar{R}_m\right)^2}$$

$$\bar{R}_m = \frac{1}{T} \sum_{\tau=-52}^{-27} R_{m,\tau}$$

with T = 26, which is the number of weeks included in the estimation period. Under the null hypothesis of no abnormal return, assuming that the ordinary least squares assumptions continue to hold during the

[32] Description of the standardized residuals was given in Patell (1976)'s equation (8).

prediction period, the standardized residuals in (14) are distributed Student-t with (T-2) degrees of freedom.

If the sampl size is large, a test statistic could be constructed for each of the four groups over the 79 weeks using (15) by combining the standardized residuals across all portfolios in that group.[33] Under the null hypothesis of no abnormal returns, the test statistic in (15) will asymptotically approach a unit normal distribution.

$$_{k}Z_{SR,t} = \left[N_k \frac{(T-2)}{(T-4)} \right]^{-\frac{1}{2}} \sum_{i=1}^{N_k} SR_{i,t} \longrightarrow N(0,1) \qquad (15)$$

Results on the test of significance using this test statistic are summarized in Table 12.

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[33] This test statistic was described by Patell (1976, p.257) in his equation (10).

TABLE 12

SIGNIFICANCE OF STANDARDIZED ABNORMAL RETURNS IN EACH OF THE 79 WEEKS STARTING WEEK -26

TEST STATISTIC : $_{k}Z_{SR,t}$

WEEK	"NO-LOBBYING HIGH OPEB" GROUP	"NO-LOBBYING LOW OPEB" GROUP	"LOBBYING HIGH OPEB" GROUP	"LOBBYING LOW OPEB" GROUP
-26	-0.10	-0.96	-0.18	1.01
-25	-0.41	-0.93	0.25	0.35
-24	0.96	0.98	1.62	-0.21
-23	-1.38	-1.12	1.30	0.44
-22	0.00	-1.30	0.45	0.43
-21	-0.05	-0.42	1.83•	-0.15
-20	0.51	-0.74	-0.51	-0.55
-19	0.23	0.22	2.23••	-0.43
-18	-0.50	1.22	-1.25	0.53
-17	0.69	0.56	0.60	0.91
-16	0.39	-1.11	1.67•	-0.53
-15	0.35	1.07	-0.59	-0.53
-14	-1.59	0.08	0.69	0.94
-13	-1.49	0.73	0.80	-0.27
-12	-0.42	-0.81	-1.04	0.21
-11	-0.68	0.32	-0.05	2.41••
-10	0.41	-0.15	0.36	0.31
-9	0.33	-1.26	0.11	-0.82
-8	2.53••	0.63	-0.80	0.84
-7	1.54	-0.23	0.14	0.88
-6	-0.66	1.85•	0.05	-1.40
-5	2.96•••	-0.46	1.23	0.84
-4	1.07	1.73•	2.91•••	1.09
-3	-1.49	-0.31	0.75	2.12••
-2	0.72	0.66	0.41	0.81
-1	0.31	0.28	-0.03	0.88
0	-1.17	1.03	-0.15	0.78
1	0.74	-0.19	2.17••	-0.91
2	0.96	-0.43	0.35	1.00
3	0.06	-0.25	1.83•	1.63
4	0.51	-1.47	0.82	2.22••

• Significant at the 0.10 level in a two-tail test.

•• Significant at the 0.05 level in a two-tail test.

••• Significant at the 0.01 level in a two-tail test.

TABLE 12 (CONTINUED)

SIGNIFICANCE OF STANDARDIZED ABNORMAL RETURNS IN EACH OF THE 79 WEEKS STARTING WEEK -26

TEST STATISTIC : ${}_{k}Z_{SR,t}$

WEEK	"NO-LOBBYING HIGH OPEB" GROUP	"NO-LOBBYING LOW OPEB" GROUP	"LOBBYING HIGH OPEB" GROUP	"LOBBYING LOW OPEB" GROUP
5	-0.74	-0.92	0.07	0.40
6	0.85	0.61	1.14	0.13
7	-0.28	0.21	-0.28	-0.80
8	1.79•	-0.60	1.04	0.18
9	0.95	-0.53	0.95	0.97
10	-0.63	-0.34	1.41	1.73•
11	0.45	-0.28	-1.36	2.66•••
12	-0.19	-0.40	-0.73	1.27
13	-0.32	-0.44	1.77•	0.22
14	1.44	0.86	1.49	-1.26
15	0.43	-0.12	-0.17	0.41
16	-0.46	0.31	1.33	-1.69•
17	0.88	1.00	-0.44	-0.27
18	0.77	-0.32	0.16	0.12
19	0.62	0.79	1.90•	-0.86
20	-0.55	-0.23	0.89	0.43
21	-0.45	0.14	0.89	1.05
22	1.27	-1.34	0.79	0.16
23	-0.24	0.60	0.80	1.1[illegible]
24	1.10	-1.07	0.04	-0.93
25	-0.38	-0.48	0.38	1.09
26	-2.05••	-0.42	-0.59	0.67
27	-1.35	-1.87•	0.05	-0.52
28	-2.29••	0.27	0.00	-1.53
29	0.08	-1.66•	-0.64	1.00
30	-0.92	-0.11	0.87	-0.62
31	-0.99	-0.22	-0.[illegible]8	1.95•
32	-1.53	-2.89•••	-0.59	-0.11
33	0.82	-0.59	-1.19	-0.13
34	-0.45	0.28	-0.16	1.15
35	-0.30	-0.10	0.61	-0.64

• Significant at the 0.10 level in a two-tail test.

•• Significant at the 0.05 level in a two-tail test.

••• Significant at the 0.01 level in a two-tail test.

TABLE 12 (CONTINUED)

SIGNIFICANCE OF STANDARDIZED ABNORMAL RETURNS IN EACH OF THE 79 WEEKS STARTING WEEK -26

	TEST STATISTIC : $_{k}Z_{SR,t}$			
WEEK	"NO-LOBBYING HIGH OPEB" GROUP	"NO-LOBBYING LOW OPEB" GROUP	"LOBBYING HIGH OPEB" GROUP	"LOBBYING LOW OPEB" GROUP
36	0.50	0.31	2.04••	0.03
37	0.95	-1.71•	-1.57	-0.28
38	-1.32	-0.52	0.71	1.86•
39	0.79	0.25	-1.24	0.54
40	1.63	1.27	1.88•	0.39
41	-0.71	-0.29	0.35	0.38
42	-0.60	-1.22	0.84	1.17
43	1.86•	-1.29	-0.02	0.69
44	0.16	-0.52	1.19	-0.01
45	-0.38	0.92	-0.34	0.41
46	0.38	0.10	1.90•	-2.08••
47	-0.06	-0.46	-0.61	1.47
48	-0.12	1.29	-0.89	-1.01
49	0.08	-1.13	-0.18	0.10
50	0.11	-0.40	1.52	1.84•
51	2.20••	0.01	-0.38	1.43
52	-0.28	0.13	1.07	0.55

• Significant at the 0.10 level in a two-tail test.

•• Significant at the 0.05 level in a two-tail test.

••• Significant at the 0.01 level in a two-tail test.

Standardized cumulative residuals in (16) were also obtained for each portfolio using each of the second, third, and fourth subperiods as an accumulation period.[34]

$$SCR_{i,\ell_1\ell_2} = \sum_{t=\ell_1}^{\ell_2} \frac{e_{i,t}}{s_i \sqrt{\mathcal{L} C_{i,t}}} \qquad (16)$$

where $\mathcal{L}$ is the number of weeks included in an accumulation period which starts on Week ℓ_1 and ends on Week ℓ_2. If there is no abnormal return and the ordinary least squares assumptions continue to hold during the accumulation period, the cumulative residuals in (16) are distributed Student-*t* with (T-2) degrees of freedom.

The standardized cumulative residuals were then totalled across all portfolios in each group. If the sample size is large, another test statistic can be constructed for the four groups over each accumulation period.[35] Under the null hypothesis, in the absence of abnormal return, the test statistic in (17) asymptotically approaches the unit normal distribution.

$${}_kZ_{SCR,\ell_1\ell_2} = \left[N_k \frac{(T-2)}{(T-4)} \right]^{-\frac{1}{2}} \sum_{i=1}^{N_k} SCR_{i,\ell_1\ell_2} \longrightarrow N(0,1) \qquad (17)$$

Results on the test of significance using this test statistic are shown in Table 13.

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[34] The cumulative standardized residuals were described by Patell (1976, p.256) in his equation (9b).

[35] This test statistic was described by Patell (1976, p.257) in his equation (11).

TABLE 13

SIGNIFICANCE OF STANDARDIZED ABNORMAL RETURNS CUMULATED OVER EACH SUBPERIOD

ACCUMULATION PERIOD (Week ℓ_1 to ℓ_2)	TEST STATISTIC : ${}_kZ_{SCR,\ell_1\ell_2}$			
	"NO-LOBBYING HIGH OPEB" GROUP	"NO-LOBBYING LOW OPEB" GROUP	"LOBBYING HIGH OPEB" GROUP	"LOBBYING LOW OPEB" GROUP
Week -26 to -1	0.[illegible]	0.11	2.53•	1.99•
Week 0 to 26	1.03	-0.83	3.18•••	2.22•
Week 27 to 52	-0.35	-2.00•	0.97	1.58
Week -26 to 26	1.32	-0.51	4.04•••	2.97••
Week -26 to 52	0.88	-1.57	3.86•••	3.34•••

• Significant at the 0.05 level in a two-tail test.

•• Significant at the 0.01 level in a two-tail test.

••• Significant at the 0.001 level in a two-tail test.

3.7 Diagnostic Tests

To examine the behaviour of the residuals across the estimation period and the forecast period, the market model in (10) was estimated again for each portfolio using returns over the 105-week period starting at Week -52. The residuals were then extracted using (18) over this entire period.

$$e_{i,t} = R_{i,t} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{m,t}\right) \qquad (t = -52, \ldots 52) \qquad (18)$$

Several diagnostic tests were performed on the residuals obtained in (18) to check for first-order autocorrelation, non-normality of distribution, and the homogeneity of variances of the residuals across the subperiods over the 105 weeks. In the majority of cases, the tests were performed on all 59 portfolios formed earlier in Section 3.4.[36] In certain cases, to reduce the dimensionality of the data matrix and allow for the use of multivariate tests, the procedures were performed on only 12 portfolios which had Week 0 located within a six-week period starting 21-Jan-84. These were the same 12 portfolios used extensively earlier in Section 3.5 covering close to 67% of all the companies in the sample.

The Durbin-Watson test statistic was calculated on the residuals over the 105 weeks for each of the 59 portfolios. The Durbin-Watson upper and lower bounds test was then performed on the test statistic for each portfolio.[37] The null hypothesis of no autocorrelation was

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[36] These tests were also repeated on the portfolios formed after the sample companies had been partitioned into the high liability and the low liability categories. The results were very similar to those reported in this section.

[37] The Durbin-Watson bounds test was described in Judge, Hill, Griffiths, Lütkepohl and Lee (1988, pp.394-399).

rejected in nine out of 59 cases at the 0.05 significance level. Another seven cases of inconclusive results were identified in this upper and lower bounds test. The rejection of nine cases out of 59 was more than what might be expected from random occurrence if there were in fact no autocorrelation. Under the presence of autocorrelation, any lost of efficiency in the ordinary least squares variance estimators would depend on the structure of the data matrix.[38] Nevertheless, the ordinary least squares estimators of the location parameters are still unbiased.[39]

For each portfolio, the Kolmogorov-Smirnov goodness of fit test was then performed to test the null hypothesis that the residuals came from a normal distribution. Of the 59 portfolios examined, the null hypothesis was rejected in a total of three cases at the 0.05 level of significance. Given the number of cases examined, the three cases of rejections were consistent with what might be expected from random occurrence even when the residuals were in fact normally distributed.

The multivariate Box test was then used to examine the homogeneity of the covariance matrices of the residuals across the four different subperiods. To avoid singularity of the cross-product matrix, this test was performed on the smaller data set of the 12 portfolios rather than on the full set of 59 portfolios. Of the six pairwise comparisons that could be made over the four subperiods, the multivariate Box test

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[38] Judge, Hill, Griffiths, Lütkepohl and Lee (1988, p.389) reported that, in a model with one explanatory variable, if the explanatory variable is positively autocorrelated and the autoregressive parameter is also positive, then the least squares variance estimator is biased downward and the bias can be substantial.

[39] A description of this unbiasedness property can be found in Judge, Hill, Griffiths, Lütkepohl and Lee (1988, p.329).

was not rejected in any of the cases at the 0.05 significance level.

At the univariate level, the Cochran test and the Bartlett homogeneity of variance test were also performed on the residuals of the 12 portfolios over each possible pair of subperiods. Out of the total 72 comparisons, the two univariate tests gave identical results and rejected the null hypothesis of equal variances in only 5 cases at the 0.05 significance level. Given the number of cases examined, the five rejections were considered consistent with what might be expected from random occurrence.

3.8 Discussion of Results and Additional Analyses

The graph of the cumulative average residuals shown in Figure 7 appears to portray different patterns of market response among the different groups of portfolios. Consistent with the empirical predictions outlined in Table 7, the market seemed to have responded positively to the first-time OPEB disclosure for the "lobbying/low OPEB" companies. For this group, the apparent strong positive returns started at about Week -5 and lasted until Week 10. Consistent with the hypothesized implications, there were also indications of negative market response for the group of "no-lobbying/high OPEB" companies. An apparent negative market response occurred at about Week -15 which was followed by a brief positive recovery and then another apparent negative response at around Week -5. In addition, there were some indications of another series of apparent negative market response starting at around Week 25 for this group of companies. The two extreme positions of the market response for the two groups of "no-lobbying/high OPEB" and "lobbying/low OPEB" companies were consistent with the empirical implications hypothesized earlier in Table 7.

However, contrary to the hypothesized relationships, the market seemed to have responded positively even for the "lobbying/high OPEB" companies. As for the "no-lobbying/low OPEB" companies, some small negative market responses were apparent around Week 0. Furthermore, there were also indications of strong negative market response starting at around Week 20 for this group of companies. The empirical results in Figure 7 did not seem to support the empirical relationships hypothesized for the "no-lobbying/low OPEB" and "lobbying/high OPEB" companies.

The similarities in the patterns of market response between the "no-lobbying/high OPEB" and the "no-lobbying/low OPEB" companies and between the "lobbying/high OPEB" and the "lobbying/low OPEB" companies suggested that the amount of OPEB expense per employee might be a poor proxy for partitioning the sample companies into the high liability and the low liability categories.[40]

The "lobbying" companies in general appear to have experienced large positive abnormal returns starting at around Week -5. This observation was supported by the statistical results presented in Tables 12 and 13. The significant test statistics found near Week 0 provided some evidence that significant positive abnormal returns were experienced by the "lobbying" companies during that period. For these companies, the market appeared to have anticipated the first-time OPEB

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[40] This could be related to the fact that Statement 81 required the disclosure of only the annual OPEB expense and not the actual OPEB liability level. Furthermore, companies were allowed to follow a variety of accounting methods in arriving at the annual OPEB expense.

disclosure and responded several weeks ahead of the actual disclosure time.

The statistical results on the "no-lobbying" companies, however, were in general not as strong as those on the "lobbying" companies. Test results in Tables 12 and 13 showed no significant negative abnormal returns for the "no-lobbying" companies around Week 0. The only indication of significant negative response started only after a long delay at around Week 24. The statistical results on the "no-lobbying" companies seemed to suggest that the market did not respond to the first-time OPEB disclosure of the "no-lobbying" companies until after the 24-week delay.[41] However, such a conclusion would not be consistent with the apparent efficient market response described earlier on the "lobbying" companies.

Other procedures were also carried out to provide more insights into the nature of the market reaction observed in the cumulative average residual analyses. First, for the apparent 24-week delay in the market's response with respect to the "no-lobbying" companies, considerations were given to the possibility of media attention on the "no-lobbying" companies at around the time of Week 24. Second, possible changes in the market model parameters were examined which might affect the interpretation of the results in the cumulative residual analyses. Third, an alternative approach to the event study

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[41] In a recent study, Landsman and Ohlson (1990) examined the pension information disclosed in the notes to companies' financial statements and concluded that the market was not efficient in terms of using such information. There is a possibility that, at the time when the market was first exposed to the new OPEB information, the market might not have had the experience to act immediately on the information contained in the OPEB note disclosure.

methodology was applied to provide a different perspective on the measure of the information content of management's lobbying position. Finally, additional procedures were carried out to explore the relationship between the market reaction and the accounting information. In this respect, cross-sectional regression was used to examine the associations between the abnormal return measures and the contents of the first-time OPEB disclosure. In addition, possible implications of the so-called "size effect" were also examined.

3.8.1 Possible Media Attention

For most companies included in the sample, Week 0 was in either January or February of 1985. With the 24-week delay observed in the market's reaction, the significant negative abnormal returns identified for the "no-lobbying" companies were likely related to returns which occurred at around July or August of 1985. A search of the *Wall Street Journal Index* was carried out for 1985 to identify articles reported in that year which might be related to the OPEB topic. A total of ten items were found. Only three dealt specifically with OPEB. The remaining seven were in the pension area.[42]

The OPEB article which appeared on August 20 was very short and factual in nature.[43] It was unlikely that this article had any major

[42] The OPEB articles were reported in the *Wall Street Journal* on January 8 (p.1), August 20 (p.31), and October 22 (p.1). The pension articles were reported on January 10 (p.1), March 22 (p.8), June 12 (p.2), July 22 (p.4), November 27 (p.52), December 6 (p.6), and December 27 (p.2).

[43] This article indicated briefly that many companies continued to offer medical coverage to their employees after their retirement. A small chart was also included showing a breakdown of the different types of medical benefits offered.

effect on the market. The October 22 article was a short note reporting on a study conducted by the Employee Benefit Research Institute. The article referred to the growing unfunded liability on retiree health benefits which was estimated at $125 billion with an annual growth rate of $5 billion. This article might potentially have some effects on the market if the large liability reported was not previously anticipated by the market.

Most of the pension articles appeared in the *Wall Street Journal* in 1985 dealt with the FASB's revised proposals on the pension project at that time. The June 12 article talked about the FASB proposed standard on recognizing the one-time profit when firms made withdrawals out of their over-funded plans. The July 22 article reported on the new FASB proposal which required a much smaller liability to be accrued than what was originally proposed in the 1982 preliminary views and 1983 discussion memorandum documents.

On the whole, nothing particularly striking was found in the *Wall Street Journal* in 1985 which might have drawn the market's attention to the "no lobbying" companies and contributed to their negative abnormal returns in mid-1985.

3.8.2 Changes in the Market Model Parameters

Larcker, Gordon and Pinches (1980) examined the potential problems associated with the traditional event study methodology of using cumulative average residuals. They pointed out that changes in the systematic risk (beta) of a firm could bias the residuals and lead to inappropriate conclusions about the information content of an event or market efficiency.[44]

As described previously in Section 3.5, there were indications of changing variances in the portfolio returns over the four subperiods used in this study. The changing variances would likely be reflected in changes in the beta parameter of the market model. To provide some evidence along this line, a modified market model was formed. In this model, necessary dummy variables and the slope shifters were included to identify each of the four subperiods covered in the analysis. The modified market model in (19) was then estimated for each of the 59 portfolios formed previously in Section 3.4.[45]

$$\tilde{R}_{i,t} = \alpha_i + \beta_i \tilde{R}_{m,t} + \delta_1 D_{1t} + \delta_2 D_{2t} + \delta_3 D_{3t} + \gamma_1 \left(D_{1t} \tilde{R}_{m,t}\right) + \gamma_2 \left(D_{2t} \tilde{R}_{m,t}\right) + \gamma_3 \left(D_{3t} \tilde{R}_{m,t}\right) + \tilde{\varepsilon}_{i,t} \quad (19)$$

where α_i, β_i, $\tilde{R}_{i,t}$, $\tilde{R}_{m,t}$ and $\tilde{\varepsilon}_{i,t}$ are defined in a similar way as in (10); D_{1t}, D_{2t} and D_{3t} are the dummy variables each coded with a value of one if the return $\tilde{R}_{i,t}$ was in the first, second and third subperiods respectively, and a value of zero otherwise; δ_1, δ_2, δ_3, γ_1, γ_2 and γ_3 are the corresponding parameters of the dummy variables and the slope shifter variables. The results showed that at the 0.05 level, out of

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[44] On the other hand, the recent study by Chandra, Moriarity and Willinger (1990) indicated that the problem might not be serious. They used analytical and simulation results to show that the power of the market model was not severely affected by estimation errors and nonstationarity in the parameters.

[45] These tests were also repeated on the portfolios formed after the sample companies had been partitioned into the high liability and the low liability categories. The results were very similar to those reported in this section.

the 59 portfolios, $\hat{\delta}_1$, $\hat{\delta}_2$, $\hat{\delta}_3$, $\hat{\gamma}_1$, $\hat{\gamma}_2$ and $\hat{\gamma}_3$ were significant in 3, 2, 4, 14, 7 and 5 cases respectively. Given the small number of rejected cases for the intercept dummies, the results suggested no significant movement in the intercept of the market model throughout the entire 105-week period. With the slightly larger number of cases rejected for the slope shifters, there were some indications of beta shifts during the first and the second subperiods.

The dummy variable model in (19), which is equivalent to the so-called Chow test, assumes equal disturbance variances across the different time periods. Johnston (1984, p.217) cited the work of Schmidt and Sickles (1977) and pointed out that departures from the equal variances assumption would increase the true significance level of the test over the nominal level. However, the increase is generally very small, especially when the sample sizes across the different time periods are equal.[46]

3.8.3 An Alternative Approach to Measuring Information Content

The cumulative average residuals obtained in Section 3.6 suggested that the market might have responded to the OPEB disclosure differently between the "lobbying" companies and the "no-lobbying" companies. To explore the significance of this difference, an alternative approach was used to examine the potential informational advantage of knowing

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[46] The market model in (10) was also estimated separately using returns over each of the four subperiods. This approach of separate regressions does not impose the assumption of equal variances across the subperiods. Paired t-tests on the differences in the intercepts and the betas over each possible pair of subperiods were then performed. The results showed no significant changes in both the intercept and the beta over all four subperiods even at the 0.30 level of significance.

management's lobbying position.

Many measures have been developed in the finance literature for comparing the performance of different stock portfolios.[47] Test statistics were also developed for hypothesis testing of some of these performance measures.[48] Based on the work of Treynor and Black (1973) and Jobson and Korkie (1984), Korkie and Laiss (1990) applied the performance measure model in an event study setting to measure the economic benefits of an information signal. The information content of the signal was summarized in an information measure which could be converted into a test statistic suitable for hypothesis testing. Under the assumptions of a normally distributed optimal portfolio return and the existence of a riskless asset, the information measure is a monotone function of the marginal utility value of the information in the event. Furthermore, this method does not require the use of an estimation period and therefore is not susceptible to the effects of changing parameters over different periods.

In the context of this study, the knowledge about management's lobbying position would constitute the information signal. On the basis of this information, portfolios of "lobbying" and "no-lobbying" firms with the same event date could be formed. Also required under this methodology is the inclusion of a market index portfolio formed over the same period. All these data were readily available on the 12 portfolios which were used previously in Sections 3.5 and 3.7. For the

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[47] Examples include the work of Treynor (1965), Sharpe (1964,1966), and Treynor and Black (1973).

[48] For example, test statistics for the Sharpe and Treynor measures were examined by Jobson and Korkie (1981).

purpose of this study, four event periods matching the four subperiods were used to capture the possible economic benefits of the information. The "lobbying", the "no-lobbying", and the market index portfolios were combined under the model in their optimal proportions to reflect the maximum information value of the signal.

Following the approach in Korkie and Laiss (1990), the information measure for this study was calculated using (20).

$$\Delta\hat{a}_f = \mathbf{r}'\mathbf{S}^{-1}\mathbf{r} - \frac{\bar{r}_1^2}{s_1^2} \tag{20}$$

where $\mathbf{r} = \begin{bmatrix} \bar{r}_1 \\ \bar{r}_2 \\ \bar{r}_3 \end{bmatrix}_{3\times1}$

$$\mathbf{S} = \begin{bmatrix} s_1^2 & s_{1,2} & s_{1,3} \\ s_{2,1} & s_2^2 & s_{2,3} \\ s_{3,1} & s_{3,2} & s_3^2 \end{bmatrix}_{3\times3}$$

and $\bar{r}_i$, $i=1,2,3$, are the excess mean returns of the three assets, consisting of the market index portfolio, the "no-lobbying" portfolio, and the "lobbying" portfolio respectively; s_i^2 is the return variance of asset i; and s_{ij} is the covariance between the returns on asset i and asset j.

The excess returns were calculated by taking the raw returns of each asset and subtracting from them the average return of a riskless asset over the event period. In this study, weekly returns of the riskless asset were computed using the weekly closing prices of the U.S. Treasury Bills obtained from the *Reuters* financial database on United States Bonds.

The optimal position in each of the three assets was then derived using (21).[49]

$$X_i = \frac{\sum_{j=1}^{3} v_{ij} \bar{r}_j}{\sum_{j=1}^{3}\sum_{k=1}^{3} v_{jk} \bar{r}_j} \quad , \quad i = 1,2,3 \qquad (21)$$

where X_i is the optimal position in asset i; and v_{ij} is the (i,j)th element of the inverse of S.

Following Korkie and Laiss (1990), the statistical significance of the information measure was tested using the test statistic in (22). Under the null hypothesis of no information value, this test statistic has an F distribution with (N-1) and (T-N) degrees of freedom.

$$\phi_f = \frac{(T-N)}{(N-1)} \left[\frac{\Delta \hat{a}_f}{1 + \frac{\bar{r}_1^2}{s_1^2}} \right] \qquad (22)$$

where T is the number of weeks included in an event period; and N = 3, which is the number of assets in this case. Results of the analyses are shown in Table 14.

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[49] According to Jobson and Korkie (1980), the estimated proportions in (21) are biased. These values are presented only for the ball park estimates of the optimal proportions.

TABLE 14

RESULTS ON TEST FOR SIGNIFICANCE OF THE INFORMATION MEASURE

Portfolios	Subperiods 1: Week -52 to -27	2: Week -26 to -1	3: Week 0 to 26	4: Week 27 to 52
Week 0 in week of 21-Jan-85				
$\Delta\hat{a}_f$	0.1234	0.1459	0.0084	0.0146
ϕ_f (F-statistic)	1.37	1.53	0.09	0.16
X_1 (market portfolio)	-0.98	-1.46	1.22	1.12
X_2 (NL portfolio)	6.48	1.55	0.12	0.59
X_3 (LA portfolio)	-4.50	0.92	-0.35	-0.70
Week 0 in week of 28-Jan-85				
$\Delta\hat{a}_f$	0.1979	0.3078	0.0233	0.0653
ϕ_f (F-statistic)	2.24†	3.16††	0.25	0.68
X_1 (market portfolio)	-20.76	-3.87	1.27	0.44
X_2 (NL portfolio)	-11.70	-5.40	-0.85	-0.79
X_3 (LA portfolio)	33.46	10.26	0.58	1.35
Week 0 in week of 04-Feb-85				
$\Delta\hat{a}_f$	0.0581	0.1939	0.0462	0.0914
ϕ_f (F-statistic)	0.67	2.05	0.52	0.91
X_1 (market portfolio)	-8.08	-1.90	1.23	-1.03
X_2 (NL portfolio)	-3.46	1.60	1.73	1.36
X_3 (LA portfolio)	12.54	1.29	-1.96	0.67
Degrees of freedom of the F-statistic	2,23	2,23	2,24	2,23

† significant at the 0.15 level.
†† significant at the 0.075 level.

TABLE 15 (CONTINUED)

RESULTS ON TEST FOR SIGNIFICANCE OF THE INFORMATION MEASURE

Portfolios	Subperiods 1	2	3	4
	Week -52 to -27	Week -26 to -1	Week 0 to 26	Week 27 to 52
Week 0 in week of 11-Feb-85				
$\Delta\hat{a}_f$	0.1880	0.0483	0.1795	0.0090
ϕ_f (F-statistic)	2.12†	0.51	2.11†	0.08
X_1 (market portfolio)	4.00	-1.18	-1.81	0.52
X_2 (NL portfolio)	0.84	1.12	-1.25	0.02
X_3 (LA portfolio)	-3.84	1.06	4.07	0.47
Week 0 in week of 19-Feb-85				
$\Delta\hat{a}_f$	0.0564	0.3097	0.1190	0.1035
ϕ_f (F-statistic)	0.64	3.23††	1.39	0.94
X_1 (market portfolio)	-1.92	-1.11	-1.83	1.87
X_2 (NL portfolio)	1.60	0.42	0.08	-0.80
X_3 (LA portfolio)	1.31	1.69	2.75	-0.07
Week 0 in week of 25-Feb-85				
$\Delta\hat{a}_f$	0.0980	0.1423	0.0772	0.0159
ϕ_f (F-statistic)	1.10	1.54	0.88	0.14
X_1 (market portfolio)	3.54	-0.86	-0.26	1.14
X_2 (NL portfolio)	1.57	1.66	0.94	0.14
X_3 (LA portfolio)	-4.11	0.20	0.32	-0.28
Degrees of freedom of the F-statistic	2,23	2,23	2,24	2,23

† significant at the 0.15 level.
†† significant at the 0.075 level.

The statistical results presented in Table 14 were, on the whole, not highly significant. The test statistics were clearly not significant in the fourth subperiod suggesting that the information signal had little economic value. By that time, effect of the information appeared to have been fully dissipated. Although the values of the test statistic were generally small in most cases over the other subperiods, there were some indications of activities in the first and the second subperiods. The test statistics were, on average, about ten times larger in these two subperiods than in the other periods. The slightly stronger results obtained in the second subperiod suggested possible economic benefits which might be related to the positive returns experienced by the "lobbying" companies during the second subperiod. Consistent with this observation, the proportions invested in the individual assets also showed that the optimal position was to go long in the "lobbying" portfolio during the second subperiod. This was indicated by the positive sign of X_3 in each of the portfolios covered in Table 14.

The overall results shown in Table 14, however, were generally poor suggesting that there might be little economic benefit in knowing the lobbying position of a company. One plausible explanation for the weak results was that the variances of the asset returns were so high that the magnitude of the information measure was greatly reduced. Another possible explanation is that perhaps the information signal about a company's lobbying position could explain only a very small portion of the variances among the returns of the different assets. In this respect, the benefits were so small that it might not be viable for a market trader to benefit significantly from the signal. Finally, the power of the test using the test statistic in (22) was probably also low when the number of time periods, T, was so small.

3.8.4 Cross-Sectional Regression of the Standardized Cumulative Residuals

Given the poor results obtained in the last section, concerns were shifted to the reliability of the abnormal returns measures obtained earlier in this study. If the apparent abnormal returns were purely artifacts of the procedures used in estimating the market model and deriving the residuals, then there should be no significant empirical relationship between the abnormal returns and the underlying accounting information revealed in the first-time OPEB disclosure.

Penman (1991) argued that capital market research over the last thirty years could at best only allow us to infer the information content of accounting numbers. Instead of turning to prices for the answer, Penman (1991) proposed that research should be directed towards understanding how accounting could affect the valuation of a firm.[50] Although the focus of this study was on the information content of the first-time OPEB disclosure, it would still be useful to understand the implications of the accounting disclosure and how the information might have affected prices.

To provide some evidence on the relationship between the market response and the accounting information, a cross-sectional regression model was formulated and tested in this study. The market model in

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[50] The work of Ou and Penman (1989a,1989b) and Ou (1990) suggested that the line items contained in the financial statements and the traditional ratio calculations could provide information useful for assessing the future earnings, and therefore also the valuation, of a firm.

(10) was estimated again on an individual company basis using returns over the first subperiod. The residuals were then extracted and the standardized abnormal returns were cumulated over the second, third and fourth subperiods using (16) for each company. The entire sample of 444 companies were included in this analysis. The cumulative standardized residuals were used as the dependent variable to capture the direction and the magnitude of the market's response. Three forms of the dependent variable were used to represent the standardized cumulative residuals calculated over the three subperiods covering Week -26 to -1, Week 0 to 26, and Week 27 to 52.

Since most of the "lobbying" companies were also large companies, it was conceivable that the market's reactions could be confounded by the "size effect". The size effect argument suggests that, for a larger company, there is more predisclosure information in the public domain and the market's response to the disclosure will therefore be smaller. To allow for this possibility, a size variable, SIZE, was included in the regression. This variable was measured by the total sales of a company during its 1984 fiscal year.[51]

Another independent variable used in the regression was a binary variable, GROUP, which was assigned a value of one if the company was in the "lobbying" group and zero if the company is in the "no-lobbying" group. For a "no-lobbying" company, negative market reaction was hypothesized at the time of the OPEB disclosure. On the other hand, the market's response to the OPEB information was hypothesized to be positive for a "lobbying" company. Therefore, if lobbying did have

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[51] Data on total sales were obtained from the COMPUSTAT database.

informational effect, the argument in the model would suggest that the GROUP variable itself should have a positive sign.

In the context of the lobbying model, the anticipated effects of the SIZE variable were expected to interact with those of the GROUP variable. For a "no-lobbying" firm, smaller size was hypothesized to be related to lower, more negative abnormal returns. This would suggest a positive relationship between abnormal returns and size. On the other hand, for a "lobbying" company, smaller size was hypothesized to be related to higher, more positive abnormal returns. This would suggest a negative relationship between abnormal returns and size. Therefore, an interaction variable, SIZE*GROUP, was needed to capture the different size effects depending on the lobbying position of a company. For a "no-lobbying" company, with GROUP = 0, the SIZE variable itself was hypothesized to have a positive sign. For a "lobbying" company, with GROUP = 1 and the SIZE variable having a positive sign, the interaction variable SIZE*GROUP was hypothesized to have a negative sign.

While the SIZE variable was intended to capture the effects of predisclosure information in the market, another size variable was used to capture the effects of the expected magnitude of the OPEB liability. In the context of OPEB obligations, it was decided that the size of a company's work force would be a reasonable proxy for the expected magnitude of its OPEB liability. The variable, EMPLOYEE, was used to measure the total number of employees a company had at the end of its 1984 fiscal year.[52] After controlling for the effect of SIZE, a larger

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[52] Data on number of employees were collected from the COMPUSTAT database.

expected OPEB liability was hypothesized to be related to a lower, more negative abnormal returns. Therefore, a negative sign was hypothesized for the EMPLOYEE variable.

If the abnormal returns were in fact a reflection of the market's reaction to the information contained in the company's first-time OPEB disclosure, then there should be some association between the magnitude of a company's abnormal returns and the contents of the company's OPEB disclosure.

The 1984 FASB Statement 81 required companies to indicate in the notes to their financial statements the amount of OPEB charges expensed in a year which were related to their retired employees.[53] For the purpose of this study, the OPEB expense reported by each company was used to capture part of the contents of its first-time OPEB disclosure. To be consistent across all companies, only the portion of OPEB expense related to retired employees was used.[54] The OPEB expenditures were then scaled by a size variable so that the relative impact of the expenditures on the company could be captured. The number of employees

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[53] This information was generally disclosed in one of the following three ways. First, many companies simply reported the amount they spent in the year on premiums or claims for OPEB provided to their retired employees. Second, some companies indicated that they could not separately identify their OPEB expenditures between active and retired employees. Following the FASB's suggestion, these companies disclosed the total expenditures and provided a breakdown on the number of their active and retired employees. Third, some companies reported that they offered OPEB to their employees but the expenditures in the year were not significant. No dollar amount of OPEB expense was disclosed by these companies.

[54] For a company which reported the combined OPEB expenditures, an allocation was made to estimate the retirees' portion using the number of active and retired employees disclosed by the company. The OPEB expense was treated as having a value of zero if a company described its OPEB expenditures as insignificant and provided no dollar amount in that respect.

in the company at the end of 1984 was used to scale the amount of the OPEB expense. The variable EXPENSE, representing the amount of OPEB expenditures per employee, was hypothesized to have a negative sign. This was based on the argument that a larger EXPENSE implied higher unrecorded OPEB liabilities.

To allow for possible differential effects the EXPENSE variable might have across the "lobbying" and the "no-lobbying" companies, an interaction variable EXPENSE*GROUP was added to the regression. If the disclosed amount of OPEB expenditures had a smaller impact on a "lobbying" company than on a "no-lobbying" company, then the variable EXPENSE*GROUP should have a positive sign to offset part of the effect of the EXPENSE variable.

Many companies also indicated in their OPEB disclosures that part or all of their OPEB obligations were funded or covered by insurance policies. Such information was disclosed in many different ways. Some companies indicated that they were funding their retirees' life insurance benefits but were on a pay-as-you-go basis for their health care benefits. Some companies indicated that they had been accruing the OPEB liability either after their employees retired or over the working lives of their employees. When insurance policies were used, they were likely short-term and had to be renewed on an annual basis. In this sense, expensing the insurance premiums would essentially have the same effect as using any pay-as-you-go method. The only potential difference was that the insurance premiums were assessed by a third party which might provide a more objective measure of the anticipated OPEB expenditures.

Two dummy variables were introduced to capture the effects of funded OPEB obligations and the use of insurance policies. The variable FUNDED was coded with a value 1 if there was any indication in the OPEB disclosure that the company was funding or accruing at least some of their OPEB obligations. The variable PREMIUM was coded with a value of 1 if the company indicated that at least part of their OPEB obligations were discharged through insurance policies. Both the FUNDED and the PREMIUM variables were hypothesized to have a positive relationship with abnormal returns.

Two more interaction variables were included in the regression. The variable EXPENSE*FUNDED was used to capture the possible different effects of the EXPENSE variable between a company that funded its OPEB obligations and another company that did not. Similarly, the variable EXPENSE*PREMIUM was also used. For each of these two interaction variables, a positive sign was hypothesized.

The regression model in (23) was used to test for the significance of the hypothesized relationships between the standardized cumulative residuals and the independent variables.

$$\begin{aligned} SCR_{\ell_1 \ell_2} = \; & b_0 + b_1(\text{SIZE}) + b_2(\text{EMPLOYEE}) + b_3(\text{GROUP}) \\ & + b_4(\text{EXPENSE}) + b_5(\text{PREMIUM}) + b_6(\text{FUNDED}) \\ & + b_7(\text{SIZE*GROUP}) + b_8(\text{EXPENSE*GROUP}) \\ & + b_9(\text{EXPENSE*PREMIUM}) + b_{10}(\text{EXPENSE*FUNDED}) + \varepsilon \end{aligned} \tag{23}$$

where $SCR_{\ell_1 \ell_2}$ is the standardized cumulative residuals of a company calculated in accordance with (16) over an accumulation period from Week ℓ_1 to Week ℓ_2;

SIZE is the total sales of the company for its 1984 fiscal year (expressed in $1 billion);

EMPLOYEE is the number of employees a company had at the end of it 1984 fiscal year (expressed in units of 1,000 employees);

GROUP is assigned a value of 1 if the company is in the "lobbying" group, and 0 if the company is in the "no-lobbying" group;

EXPENSE is the amount of OPEB expenditures charged to expense as revealed by the company in its first-time OPEB disclosure divided by the number of employees (expressed in units of $1,000 per employee);

PREMIUM is assigned a value of 1 if the company indicated in its first-time OPEB disclosure that its OPEB obligations were at least partially covered by insurance policies, and 0 otherwise;

FUNDED is assigned a value of 1 if the company indicated in its first-time OPEB disclosure that it had been funding or accruing at least portion of its OPEB obligations, and 0 otherwise;

SIZE*GROUP is the interaction variable between the SIZE variable and the GROUP variable;

EXPENSE*GROUP is the interaction variable between the EXPENSE variable and the GROUP variable;

EXPENSE*PREMIUM is the interaction variable between the EXPENSE variable and the PREMIUM variable; and

EXPENSE*FUNDED is the interaction variable between the EXPENSE variable and the FUNDED variable.

Descriptive statistics and the correlation matrix of the variables are presented in Tables 15 and 16 respectively. Regression results are shown in Table 17.

The correlations shown in Table 16 suggested that there might be a high degree of collinearity among some of the independent variables. It appeared that the EXPENSE*GROUP, EXPENSE*PREMIUM, and EXPENSE variables were highly correlated. Similarly, the SIZE*GROUP, SIZE and EMPLOYEE variables were also highly correlated.

TABLE 15

DESCRIPTIVE STATISTICS OF THE VARIABLES

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
$SCR_{-26,-1}$	0.0708	1.2113	-5.6022	4.7031
$SCR_{0,26}$	0.2252	1.2479	-5.2189	4.1735
$SCR_{27,52}$	0.0376	1.2419	-4.3103	3.5224
SIZE	3.9363	8.8351	0.0386	90.8500
EMPLOYEE	27.3440	50.5390	0.1510	450.0000
GROUP	0.3491	0.4772	0.0000	1.0000
EXPENSE	0.4028	2.6922	0.0000	56.5960
PREMIUM	0.2793	0.4492	0.0000	1.0000
FUNDED	0.0901	0.2866	0.0000	1.0000
SIZE*GROUP	2.7514	8.9551	0.0000	90.8500
EXPENSE*GROUP	0.2362	2.6933	0.0000	56.5960
EXPENSE*PREMIUM	0.2117	2.6911	0.0000	56.5960
EXPENSE*FUNDED	0.0414	0.2121	0.0000	1.9095

TABLE 16

CORRELATION MATRIX OF THE VARIABLES

	$SCR_{-26,-1}$	$SCR_{0,26}$	$SCR_{27,52}$	SIZE
$SCR_{0,26}$	0.5880			
$SCR_{27,52}$	0.4969	0.5850		
SIZE	-0.0622	-0.0594	-0.0710	
EMPLOYEE	-0.0777	-0.1329	-0.0440	0.6749
GROUP	0.0574	0.0198	0.0354	0.3274
EXPENSE	-0.0819	0.0095	-0.0051	0.4336
PREMIUM	0.0308	0.0668	-0.0082	-0.0188
FUNDED	0.0635	0.0494	0.2146	0.1085
SIZE*GROUP	-0.0654	-0.0546	-0.0598	0.9723
EXPENSE*GROUP	-0.0941	-0.0049	-0.0166	0.4511
EXPENSE*PREMIUM	-0.0881	0.0037	-0.0122	0.4294
EXPENSE*FUNDED	0.0825	0.0466	0.0805	0.0737

TABLE 16 (CONTINUED)

CORRELATION MATRIX OF THE VARIABLES

	EMPLOYEE	GROUP	EXPENSE	PREMIUM
$SCR_{0,26}$				
$SCR_{27,52}$				
SIZE				
EMPLOYEE				
GROUP	0.3356			
EXPENSE	-0.0147	0.0746		
PREMIUM	-0.0670	-0.0030	0.0822	
FUNDED	0.2134	0.0336	0.0066	-0.1959
SIZE*GROUP	0.6421	0.4200	0.4378	-0.0049
EXPENSE*GROUP	0.0062	0.1199	0.9950	0.7825
EXPENSE*PREMIUM	-0.0145	0.0675	0.9940	0.1265
EXPENSE*FUNDED	0.1026	0.0438	0.0525	-0.1217

TABLE 16 (CONTINUED)

CORRELATION MATRIX OF THE VARIABLES

	FUNDED	SIZE *GROUP	EXPENSE *GROUP	EXPENSE *PREMIUM
$SCR_{0,26}$				
$SCR_{27,52}$				
SIZE				
EMPLOYEE				
GROUP				
EXPENSE				
PREMIUM				
FUNDED				
SIZE*GROUP	0.0823			
EXPENSE*GROUP	-0.0031	0.4567		
EXPENSE*PREMIUM	-0.0248	0.4312	0.9946	
EXPENSE*FUNDED	0.6213	0.0835	0.0168	-0.0154

TABLE 17

REGRESSION RESULTS OF THE STANDARDIZED CUMULATIVE RESIDUALS

Independent Variables	Hypothesized Sign	Dependent Variable: $SCR_{-26,-1}$	$SCR_{0,26}$	$SCR_{27,52}$
		Coefficients of Independent Variables		
Intercept	+/-	-0.2541 (-2.04)**	-0.0740 (-0.58)	-0.1408 (-1.09)
SIZE	+	0.0722 (2.24)**	0.0416 (1.25)	-0.0146 (-0.43)
EMPLOYEE	-	-0.0048 (-2.71)***	-0.0058 (-3.15)****	-0.0003 (-0.17)
GROUP	+	0.7047 (4.10)****	0.5351 (3.01)***	0.4360 (2.43)**
EXPENSE	-	0.5777 (1.89)*	0.8102 (2.56)**	0.5676 (1.78)*
PREMIUM	+	-0.0246 (-0.16)	0.1144 (0.71)	-0.1181 (-0.73)
FUNDED	+	0.2485 (0.93)	0.4882 (1.77)*	0.3730 (1.34)
SIZE*GROUP	-	-0.0614 (-1.97)**	-0.0291 (-0.90)	0.0011 (0.03)
EXPENSE*GROUP	+	-1.1873 (-3.68)****	-1.1091 (-3.32)****	-0.9729 (-2.89)***
EXPENSE*PREMIUM	+	0.5458 (1.61)	0.2736 (0.78)	0.4157 (1.17)
EXPENSE*FUNDED	+	0.2737 (0.63)	-0.2928 (-0.65)	0.0442 (0.10)
R^2		0.0723	0.0653	0.0394
Adjusted R^2		0.0508	0.0438	0.0172
F-value		3.37†	3.03†	1.78
Degrees of freedom		10 & 433	10 & 433	10 & 433
Sample size		444	444	444

NOTE: t-ratios are shown in parentheses below the coefficients.

* Significant at the 0.10 level in a two-tail test.
** Significant at the 0.05 level in a two-tail test.
*** Significant at the 0.01 level in a two-tail test.
**** Significant at the 0.001 level in a two-tail test.
† Significant at the 0.001 level in a one-tail test.

Table 17 showed that the regressions using standardized residuals cumulated over the second and the third subperiods as the dependent variable were statistically significant at the 0.001 level. However, the regressions using standardized residuals cumulated over the fourth subperiod was not significant at the 0.05 level. This result was consistent with the earlier observation that the information contained in the first-time OPEB disclosure had been fully dissipated by the fourth subperiod. The result also suggested that the market was able to anticipate the first-time OPEB information and responded in the second subperiod prior to the OPEB disclosure.

With the exception of the EXPENSE and the EXPENSE*GROUP variables, the results showed that the independent variables had the hypothesized signs in almost all cases. The SIZE and the SIZE*GROUP variables were significant at the 0.05 level in the second subperiod suggesting the presence of the size effect only in this subperiod. The EMPLOYEE variable was highly significant in the second and the third subperiods. This result suggested that the market might have formed an expectation of the liability level as early as the second period based on the number of employees information. The GROUP variable was also highly significant in both the second and the third subperiods indicating the possible informational effect of lobbying. This result suggested that the market had responded differently depending on the lobbying position of a company.

While the EXPENSE variable was significant at the 0.05 level in the third subperiod and at the 0.10 level in the second subperiod, the EXPENSE*GROUP variable was highly significant at the 0.001 level in both subperiods. These two variables, however, had signs which were opposite to what was hypothesized. The results suggested that the market had actually responded positively to higher disclosed amounts of OPEB expenditures. One plausible explanation for this result was that the EXPENSE variable also captured some information about the maturity of a company.[55] A high EXPENSE could be an indication of a stable and mature work force which might provide a better basis for the market to assess the implications of the OPEB obligations. On the other hand, a low EXPENSE could imply insufficient information for the market to make the same kind of assessments.

The FUNDED variable had the hypothesized sign throughout and was significant only at the 0.10 level in the third subperiod. The PREMIUM and the EXPENSE*FUNDED variables were not statistically significant at any conventional level and their signs changed across the subperiods. This might be caused by presence of collinearity among the independent variables in the regression. To assess the possible effects of collinearity, a reduced version of the original regression was run by removing two of the highly correlated variables, namely EXPENSE*GROUP and EXPENSE*PREMIUM. The overall results were very similar to those presented in Table 17. For most of the variables, the coefficients remained stable after the removal of the two interaction variables. The only exception was the EXPENSE variable which now had a negative

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[55] Results of field tests conducted by Akresh, Bald and Dankner (1989) showed that the accrual basis OPEB expense could be less than 3 times the cash basis expense for highly matured companies but as high as 10 times for other companies. The amount of current OPEB expense reported by a company would clearly depend on the age or the maturity of the company. A young company which had promised its employees OPEB after their retirement might have no OPEB expense if none of its employees had retired. However, the amount of OPEB liabilities could be very high for this company.

sign in the reduced version of the regression. This change in the sign was not unexpected given the results shown earlier in Table 17. Since EXPENSE*GROUP was significantly negative in the original regression, the removal of this variable would force some of the negative effect to go through the EXPENSE variable in reduced version of the regression model. With the sufficiently strong negative effect, the sign of the EXPENSE variable could become negative in the reduced model.

To examine the possible implications of collinearity between the SIZE variable and the EMPLOYEE variable, another reduced model was run by also omitting the SIZE variable. Again, the coefficients and the signs of the independent variables remained stable in the new reduced model. The only exception was the SIZE*GROUP variable which had switched to a positive sign in the new reduced model. This change was not surprising given the positive sign of the SIZE variable and the negative sign of the SIZE*GROUP variable in the original model. It was likely that the stronger positive effect of the SIZE variable was forced through the SIZE*GROUP variable when SIZE was omitted from the new reduced model.

CHAPTER 4
SUMMARY AND CONCLUSION

This study explored the possibility that management's private information might be revealed through its lobbying position. In the first part of this study, a corporate lobbying model was formulated to illustrate how the informational effect might influence management's lobbying behaviour.

The model examined a type of proposed accounting standard which, if passed, would require the financial statement recording of some previously undisclosed liabilities. Because of proprietary cost, the company as well as management would certainly be worse off if this proposed standard were passed. In this setting, management had the incentive to lobby against the standard. However, lobbying against the standard would reveal to the market information about the level of the company's liabilities. If possible, management would try to avoid this informational effect by "free-riding" on the other company's lobbying effort. However, management did not know the liability level of the other company and therefore could not rely totally on the "free-riding" alternative. Under these circumstances, the lobbying model identified the conditions for different equilibrium lobbying strategies that might be used by management.

The results showed that the informational effect would come into play when the proprietary cost for a low liability firm was at a moderate level. At one extreme, if such proprietary cost was too low, the low liability firm might have incentive to lobby in favour of the proposed standard or reveal its liability level through voluntary disclosure. At the other extreme, if the proprietary cost for a low liability firm was too high, then all companies would have incentive to lobby against the proposed standard, providing that the out-of-pocket cost of lobbying was not too high. This situation was described as Case 1 in Chapter 2 in which management would follow an "always lobby" strategy to avoid the informational effect.

With a moderate level of proprietary cost for the low liability firm, the informational effect might affect management's lobbying decision. Different equilibrium outcomes could be achieved depending on the level of the proprietary cost for a high liability firm, on whether the potential informational effect was strong, and on how likely the standard setter might change its position on the proposed standard.

When the proprietary cost for a high liability firm was high, the result was a separating equilibrium in which management would lobby against the standard only if the company has a high liability level (Case 2). When the proprietary cost for a high liability firm was not too high, a company might follow a "never lobby" strategy if the potential informational effect was strong and if management believed that being the only company to lobby had little effect on the standard setter (Case 3). If the potential informational effect was strong for one company and not for the other, then only one company might lobby against the standard and the other would "free-ride" on the lobbying company's effort (Case 4). When both companies had potentially strong informational effect, management might follow a strategy to randomize between lobbying and not lobbying (Case 6). The analytical results of this part of the study indicated that using the anticipated financial statement effects of the proposed standard alone was not sufficient to explain the many possible variations in management's lobbying decision.

In the second half of this study, empirical data were collected to provide some evidence on the hypothesized implications of the informational effect. The FASB's 1982/1983 proposal on the OPEB area required the financial statement accrual of the OPEB liabilities. If management's lobbying against this standard did in fact reveal some information about the existence of the liabilities, then different market reactions to the first-time OPEB disclosure might be detected between the groups of "lobbying" and "no-lobbying" companies conditional on their liability levels.

A total of 444 companies which disclosed OPEB information in the notes to their financial statements were identified and included in the final sample. For each company, the time of its first-time OPEB disclosure was identified. Week 0 was used to identify the date of the auditor's report on the set of financial statements which contained the first-time OPEB disclosure of each company.

The lobbying positions of all companies included in the sample were obtained using the comment letters received by the FASB on the OPEB project. On the basis of their lobbying positions and the timing of Week 0, portfolios of the sample companies were formed. Using only companies which had Week 0 in 1985, a total of 137 companies were included 21 "lobbying" portfolios and 260 companies were placed in 38 "no lobbying" portfolios. The amount of OPEB expense disclosed by each company was then used as a proxy to partition the portfolios into the high liability and the low liability categories.

The market model parameters were estimated and several measures of abnormal returns were computed on a portfolio basis to capture the market's reaction to the first-time OPEB disclosure. The results, represented by the cumulative average residuals for the two groups of companies, were shown in Figure 7. Consistent with the predicted implications of the informational effect, positive abnormal returns were found for the "lobbying/low OPEB" group. There were also indications of negative abnormal returns for the "no-lobbying/high OPEB" group. However, contrary to the hypothesized relationships, positive abnormal returns were also found for the "lobbying/high OPEB" group. The results suggested that the amount of OPEB expense might be a poor proxy for separating the high liability companies from the low liability companies.

Statistical tests were also performed to confirm the results observed in Figure 7. The positive abnormal returns were highly significant for the portfolios of "lobbying" companies. However, the negative abnormal returns were generally not statistically significant for the "no-lobbying" companies.

The empirical implications hypothesized in this study were formed based on the lobbying model which dealt with the proposal of accruing the OPEB liability. The empirical data collected in this study, on the other hand, were related to only the disclosure of OPEB information and not the actual accrual of the OPEB liability. Furthermore, companies were allowed to use a variety of accounting and actuarial methods in disclosing their OPEB information. These apparent differences might have introduced noise into the empirical analyses and contributed to the overall unsatisfactory results in this study.

In the empirical study, no particular assumption was made to restrict the type of equilibrium strategies that might be played by the companies. In reality, a particular mixture of equilibria might have existed in such a way that some of the relationships hypothesized in Table 7 became more dominant than the others. It might even be the case that the only equilibrium strategy played by all companies was that of a fully revealing equilibrium. In this case, all informational effects would have been realized at the time of lobbying and no market reaction could be expected at the time of the first OPEB disclosure.

Furthermore, in the empirical analyses, only companies which actually disclosed the OPEB information were included in the sample. Other companies which did not make the OPEB disclosure were excluded. It is plausible that some companies did not make the disclosure because their OPEB expenditures were below the materiality level. It might also be the case that some of these companies were able to convince their auditors that such disclosure was not necessary. The existence of such companies might also have introduced noise into the analyses and contributed to the overall unsatisfactory results.

Additional procedures were also performed in this study to gain further insights into the observed differences in the market's response between the "lobbying" and the "no-lobbying" companies. An alternative approach to the event study methodology was used to measure the information content of the management's lobbying position. This approach did not require the specification of an estimation period and was therefore not susceptible to some of the problems associated with the traditional event study methodology. The results of the alternative approach were generally poor suggesting that there might not be sufficient gains for a market trader to act on and benefit from the information.

Regression analysis was then used to investigate the relationships between the market response and the accounting disclosure of the OPEB information. Cross-sectional regressions were performed to examine the variations in the standardized cumulative residuals across the individual companies. All 444 companies in the sample were included in this analysis. The results showed that the abnormal returns were significantly related to the lobbying position of a firm, the amount of OPEB expenditures reported in its first-time OPEB disclosure, and to a lesser extent, the size of the company.

On the whole, the empirical results provided some evidence that the market was able to differentiate between the "lobbying" and the "no-lobbying" firms and responded differently to the OPEB disclosure made by these companies. Although the economic gains might not be sufficiently high to benefit a market trader, there were indications of significant association between the abnormal returns and the lobbying position of management. The results provided some evidence on the existence of the informational effect of lobbying.

Future Research

Future research can be directed towards gathering more empirical evidence on the existence of the informational effect. One possibility is to design other procedures that can capture some of the changes in the stock price at different points in time as described in Tables 1 and 2. Specifically, additional evidence on possible market reactions at the time of lobbying will provide further support for the existence of the informational effect.

The implications of the informational effect can also be examined in the context of positive research by focusing on better proxies that measure the effects of proprietary cost and the informational effect of lobbying.

The corporate lobbying model may be modified to apply to other accounting standards, such as the recent FASB proposal on the disclosure of off-balance sheet credit risks. The model can also be extended by including the standard setter as another strategic player in the lobbying game. Another way to improve the model is to incorporate the possibility of management lobbying in favour of the accounting standard. In this case, it may be possible to allow other strategic interactions in the game. For example, a company may lobby in favour of a standard to increase the likelihood that its competitors will eventually be forced to disclose certain sensitive information under the new standard. Another possible extension of the model is to consider a repeated game setting in which potential reputational effects of management's lobbying behaviour can be examined.

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APPENDIX A

SUMMARY OF PRIOR RESEARCH ON CORPORATE LOBBYING ACTIVITIES

Previous work in accounting on corporate lobbying activities can generally be grouped into the following five major categories:

1. Positive studies on corporate lobbying behaviour.
2. Studies on the economic consequences of accounting standards and the lobbying position of management.
3. Studies on the lobbying position and influence among special interest groups.
4. Studies on the modelling of corporate lobbying behaviour.
5. Studies on corporate lobbying activities in a policy making context.

The first category of studies used the positive research approach to identify observable firm-specific variables and examine their empirical relationships with corporate lobbying positions. Proxy variables were commonly used in these studies to capture different aspects of the motivation behind management's lobbying decision. The intent of these studies was to identify firm characteristics that could be used to predict the lobbying position of the firm. The second category of studies focused on the economic consequence of management's reaction to proposed accounting standards. A firm's lobbying position was used as an indication of management's preferences over alternative accounting methods. These studies examined how management's future actions might be different as a result of having lobbied on proposed accounting standards. The third category of studies examined the similarities and differences in the lobbying positions taken by various special interest groups. These studies focused on identifying possible influences or domination one special interest group might have over another in the accounting standard setting process. The fourth category of studies focused explicitly on the modelling of factors that might explain management's lobbying position. These studies attempted to use analytical methods to capture some of the important features of the lobbying environment and their effects on management's lobbying decision. The fifth category of lobbying studies focused on the informational effects of changes in accounting standards and examined how the stock market might react to such changes. Major studies included in these five categories will be described in more detail in the following sections.

1. Positive Accounting Research on Corporate Lobbying Activities

Watts and Zimmerman (1978) conducted the first accounting study which explicitly recognized the motivation behind management's decision to lobby the accounting standard setting body. They argued that anticipated effects on managerial wealth could explain management's accounting preferences and its lobbying position on proposed accounting standards. According to Watts and Zimmerman (1978), there were two ways accounting choices could affect managerial wealth. For any company, the choice of accounting method might have direct cash flow effects. Taxes, regulatory procedures, political exposure, and information production costs could be different for a company under alternative accounting methods. The potential cash flow effects would affect the share price of the company which in turn could have an indirect effect on management's wealth. Another way the choice of accounting methods might affect managerial wealth was through the anticipated effects on reported accounting numbers, which formed the basis for determining managerial bonuses and other rewards under similar incentive compensation arrangements.

Watts and Zimmerman (1978)'s model suggested that management's lobbying position on a proposed accounting standard could be explained by several factors, which included the anticipated tax effect of the standard, the political exposure of the firm, and the existence of managerial incentive compensation plans. The political exposure of a firm was captured using firm size as a proxy variable. Watts and Zimmerman (1978) tested their model using data on the 52 firms which responded to the Financial Accounting Standards Board (FASB)'s 1974 discussion memorandum on general price level adjustment. Their results showed that firm size was the single most important factor affecting managerial lobbying position. The existence of incentive compensation plans was not a significant variable in this study.

Dhaliwal (1982) extended Watts and Zimmerman (1978)'s model to include capital structure as an additional variable that might also affect management's lobbying position. In this study, capital structure of a firm was proxied by the debt-equity ratio. Dhaliwal (1982) tested the model using data on the 44 firms which responded to the 1978 FASB discussion memorandum on the capitalization of interest costs. Results of the discriminant analysis in this study showed that, in addition to firm size, capital structure was also significant in explaining management's lobbying position. Similar to Watts and Zimmerman (1978)'s results, adding the variable on the existence of management compensation plans did not provide any significant improvement to Dhaliwal (1982)'s model.

McKee, Bell and Boatsman (1984) replicated the Watts and Zimmerman (1978) study and included a number of refinements in the use of statistical techniques and the measurement of proxy variables. In addition, they also tested Watts and Zimmerman (1978)'s model using data on a larger sample of 70 firms which responded to the 1974 FASB exposure draft on general price level adjustment. The Watts and Zimmerman (1978) procedures were criticized for having assumed prior knowledge of the sample population and for not having used holdout observations in assessing the statistical models. These problems were addressed by McKee, Bell and Boatsman (1984) using equal prior probability beliefs and the jackknife holdout technique. With exactly the same data base as Watts and Zimmerman (1978) on the FASB discussion memorandum on general price level adjustment, the more sophisticated procedures of McKee, Bell and Boatsman (1984) showed that the error rate of the model should be 29.4% instead of the 5.8% reported by Watts and Zimmerman (1978). McKee, Bell and Boatsman (1984) also showed that results obtained from the discussion memorandum sample were generally quite different from those obtained from the exposure draft sample. The lack of stability across the two samples suggested that firms which responded to the discussion memorandum and firms which responded to the exposure draft might come from different populations. With respect to the management compensation variable, the results were again not significant for this variable.

Kelly (1985) tested the lobbying positions taken by firms on the 1974 FASB exposure draft on foreign currency translation. In addition to firm leverage, the degree of management ownership was included in this model as another possible determinant of the firms' lobbying position. Alternative procedures such as the use of nonparametric tests and the application of the match-paired design were employed in this study. Kelly (1985)'s results showed that, after controlling for firm size, the degree of management ownership was still a significant determinant of the firms' lobbying positions.

O'Keefe and Soloman (1985) studied the intensity of the lobbying positions taken by firms which responded to the 1977 FASB exposure draft on oil and gas accounting. Management's belief about the efficient market hypothesis was also used as a possible determinant of how intense management would lobby against the proposed "successful efforts" accounting method. Using the method of content analysis, O'Keefe and Soloman (1985) examined the comment letters submitted by management and applied various "form-oriented" and "meaning-oriented" measures to assess the intensity of management's lobbying position and the degree of management's belief in efficient market hypothesis. They also controlled for the possible effects of contracting and political costs which were proxied by firm size, debt-equity ratio, percentage change in owner's equity, and the existence of managerial bonus plan.

Consistent with the literature, the results of O'Keefe and Soloman (1985) showed that firm size and leverage were significant determinants of the intensity of the firms' lobbying positions. The managerial incentive plan variable was again not significant in this study. Management's belief about the efficient market hypothesis was also significant when the "meaning-oriented" measures were used. O'Keefe and Soloman (1985) concluded that a large proportion of managers who submitted comment letters did not believe in the efficient market hypothesis.

Francis (1987) examined the lobbying positions taken by firms on the 1982 FASB document of preliminary views on pension accounting. Firm size and the potential for adverse financial statement effects were hypothesized in this study as possible determinants of the firms' lobbying positions. The financial statement effects of the proposed accounting standard were measured in terms of the anticipated additional pension expense on the income statement and the additional pension liability on the balance sheet. Using a matched-pairs design based on industry membership and firm size, Francis (1987)'s analyses showed that both the anticipated income statement effect and the balance sheet effect of the lobbying firms were significantly different from those of the non-lobbying firms. On this basis, Francis (1987) suggested that the comment letters received by the FASB might not be representative of the companies affected by the proposed accounting standard.

Sutton (1988) examined the comment letters received by the U.K. Inflation Accounting Steering Group on the 1976 exposure draft which proposed the standard of current cost accounting. Sutton (1988) hypothesized that management's lobbying position was a function of the tax effect, the political exposure, the effect of recontracting, and the costs of compliance. Different degrees of opposition and support from 112 respondents were measured and used as the dependent variable in a polychotomous probit model. For the independent variables, the tax effect was measured in terms of whether or not the firm was in the service sector; the political exposure was proxied by the extent of allowable profit margin under price control legislation, whether or not the firm had been investigated for monopolistic pricing, and a size variable based on the sales level; the effect of recontracting was measured by a ratio of interest on secured debts to operating profit; and the costs of compliance were proxied by the portion of the firm's fixed assets already valued at market and whether or not the firm had voluntarily disclosed current cost data. Sutton (1988)'s results showed that the service sector variable, the size variable, and the two compliance costs variables were significant in explaining management's lobbying position.

Watts and Zimmerman (1978) tested their theory with lobbying data collected on the 1974 FASB proposal of price level adjustment. Some critics had suggested that the data used by Watts and Zimmerman (1978) were not appropriate for testing their model. It was argued that contracting usually involved the use of primary financial statements and the price level information proposed in 1974 was intended for supplemental disclosure only. Therefore, the required disclosure might not have the same impact on management's incentives as it could otherwise have if the proposed accounting standard would actually change some of the dollar balances on the financial statements.

To deal with the above problem, Deakin (1989) used lobbying data on the FASB's proposal of requiring the "successful efforts" method in oil and gas accounting. The study focused only on the lobbying positions of firms which had previously been using the "full cost" accounting method. The data included the positions of these firms over three different stages of lobbying on the oil and gas accounting standard: the 1975 FASB discussion memorandum, the 1977 FASB exposure draft, and the 1978 appeal to the Securities and Exchange Commission

(SEC) to overturn the FASB decision. Logistic regression was used to predict lobbying positions using debt contract costs, existence of bonus plans, expenditures on oil and gas activities, and regulatory environment as the independent variables.

Deakin (1989)'s results showed that every independent variable had the correct hypothesized sign in all the regressions. Oil and gas expenditures and incentive plans were significant determinants of lobbying position at the discussion memorandum stage. Oil and gas expenditures and debt contract costs were significant at the exposure draft stage. All four variables, except oil and gas expenditures, were significant at the SEC appeal stage. Deakin (1989) suggested that the unstable significance levels of the variables were due to collinearity among some variables. Results of the logistic regression for each lobbying stage were also used to predict lobbying positions at the other two stages. The results generally showed that in all cases the classification accuracy of the logistic regression could perform significantly better than by chance.

2. Economic Consequence Studies on Corporate Lobbying Activities

Kelly (1982) examined the relationship between the lobbying positions taken by firms on the 1974 FASB exposure draft on foreign currency translation and the subsequent changes in the financing and operating activities of these firms in response to the accounting standard. This study also controlled for the effects of firm size, leverage, degree of management ownership, and existence of incentive remuneration plans. Firm size, leverage, and degree of management ownership were found to be significantly related to firms' lobbying positions. However, the results showed no significant relationship between lobbying position and changes in financing or operating activities. On this basis, Kelly (1982) suggested that the comment letters might have no informational value in terms of revealing the economic consequence of proposed accounting standards.

King and O'Keefe (1986) studied the lobbying positions taken by management on the 1977 FASB exposure draft on oil and gas accounting. Following Watts and Zimmerman (1978), previous studies of positive research on corporate lobbying activities typically examined the relationship between management's lobbying position and the effects of the proposed accounting standard, relying on the maintained hypothesis that management's lobbying decision was driven by anticipated changes in managerial wealth. In this study, King and O'Keefe (1986) took a different approach and examined the relationship between management's lobbying position and the insider trading activities of management, relying on the maintained hypothesis that management's insider trading decision was driven by the effect of the proposed accounting standard. The focus of this study was on the link between accounting numbers and the anticipated changes in managerial wealth.

King and O'Keefe (1986) hypothesized that, on average, for firms using the "full cost" accounting method, insiders of the lobbying firms would sell and insiders of the non-lobbying firms would buy. On the other hand, for firms using the "successful efforts" method, insiders of the lobbying firm would buy and insiders of the non-lobbying firm would sell. Their results showed a significant relationship between management's lobbying position and insider trading activities for the 15-day period after the exposure draft was released. No such relationship was found for the period prior to the release of the exposure draft. King and O'Keefe (1986) concluded that management traded upon their private information about the specific effect of the proposed accounting standard on their firms and not upon private information about the content of the forthcoming exposure draft. The relationship between insider trading and lobbying position also indicated that the comment letters had informational value. Furthermore, the results suggested that the economic consequence of proposed accounting standards might also be inferred from insider trading activities.

3. Studies on Influences of Special Interest Groups and Corporate Lobbying Activities

Haring (1979) examined the empirical association between the FASB's positions on its proposed accounting standards and the lobbying positions taken by accounting firms and other sponsoring organizations of the FASB. The focus of his study was to identify possible influences or even domination accounting firms and the sponsoring organizations might have over the FASB's decisions. Similarly, Haring (1979) also examined the empirical association between the lobbying positions of accounting firms and the positions taken by their clients. The purpose was to identify possible influences the clients might have on the accounting firms' lobbying positions.

The lobbying positions of the various special interest groups on a total of 20 accounting issues addressed by the FASB were included in Haring (1979)'s study. The results showed no significant association between the lobbying positions of the accounting firms and those of their clients. On the other hand, the associations between the positions taken by the FASB and those of its constituents were all empirically significant. Specifically, the FASB's position were positively related to the preferences of the accounting firms and the sponsoring organizations; but were negatively related to the preferences of academics and business enterprises. Haring (1979)'s results suggested that the accounting firms were not dominated by their clients and the FASB was not dominated by business interests.

Brown (1981) examined the comment letters received by the FASB on nine different agenda projects. A total of 27 respondents commented on at least seven of the projects. In this study, Brown (1981) developed 51 policy questions to capture the accounting preferences of these 27 respondents. Using multidimensional scaling methods and discriminant analysis, Brown (1981) compared the similarities in the positions of the respondents and the FASB. The results showed that the FASB's position was generally quite "far away" from those of the respondents. The FASB's position was nevertheless closest to that of the Financial Analysts Federation. Furthermore, there was no indication that the "Big Eight" accounting firms were able to impose their preferences on the FASB.

To address the issue of whether or not the FASB's deliberations were dominated by the large accounting firms, Puro (1985) examined the lobbying positions taken by the Big-Eight firms on a total of seven FASB exposure drafts released between 1975 and 1977. Puro (1985)'s results showed that the Big-Eight accounting firms often disagreed among themselves on the proposed accounting standards and were not as homogeneous a group as many critics had alleged. Furthermore, there was little evidence that the lobbying positions of the Big-Eight firms were influenced by the preferences of their audit clients. Puro (1985)'s results also indicated that the opinions of the Big-Eight firms were not consistently out of step with those of the other special interest groups.

4. Studies on the Modelling of Corporate Lobbying Activities

Using a simple voting model originally suggested by Downs (1957) to describe the behaviour of individuals in an election, Sutton (1984) indicated that some features of the voting model might be applicable to the lobbying scenario in the accounting standard setting process. According to the Downs (1957), an individual would vote for one of the two parties in an election only if

$$P (U_A - U_B) - C > 0$$

where U_A is the expected utility the individual could derived from Party A, if elected, during its term of office

U_B is the expected utility the individual could derived from Party B, if elected, during its term of office

P is the probability that the individual's vote will change the result of the election

C is the cost of voting

Sutton (1984) recognized several aspects of the lobbying scenario which were different from voting in an election. For example, the lobbyist is not forced to express his preference in one occasion as in an election. Furthermore, the lobbyist's vote is revocable. The lobbyist votes with money and he does not respond passively to the proposed policies, he tries to shape them. He can create new alternatives. The lobbyist also believes that he can alter the likelihood of the adoption of his favoured proposal. In general, there are few rules to the game in the lobbying scenario and the stakes are often high. Sutton (1984) also suggested that lobbying could be achieved by subsidizing information flowing to the standard setter at a stage when the standard setter was forming its own views. Although Sutton (1984) discussed the importance of these unique features of the lobbying scenario, he did not proceed further to develop a lobbying model that could incorporate these features and their implications in the description of the lobbyists' behaviour.

Referring to the accounting standard setting process, Sutton (1984) made some generalizations about the lobbyist's characteristics. According to his arguments, producers of financial statements are more likely to lobby than consumers of financial statements. A producer is also more likely to lobby if it is larger in size or less diversified or if the cost of noncompliance of the proposed standard is higher. Sutton (1984) did produce some evidence on one of the generalizations he made. Using comment letters received by the Inflation Accounting Steering Group in the U.K. on its 1976 exposure draft on current cost accounting, Sutton (1984) showed that there were in fact considerably more financial statement producers than financial statement consumers lobbying on the proposed accounting standard. The same data set was later used by Sutton (1988) in a positive study to examine the economic determinants of management's lobbying position.[56]

Amershi, Demski and Wolfson (1982) used the game theoretic approach to illustrate that the single-period perspective used in most empirical studies of lobbying activities might produce misleading results about the true preferences and rewards of the lobbying party. This study used a three-person voting game in which the players had to vote on a sequence of two motions. The outcome of each vote was determined by majority rule. With two alternative choices in each motion, there were four possible combinations of outcomes in the voting game representing different payoffs to each player. Each player had his own preference ranking of the four possible outcomes. Under different assumptions used in the study, these preference rankings could be either known or unknown to the other players.

Amershi, Demski and Wolfson (1982) complied specific numerical examples of the voting game to examine the rational voting behaviour of the players under the Nash equilibrium concept. They showed that a player might vote strategically in the first round in order to ensure that the other players would vote in a certain manner in the second round. In such a case, only looking at a player's voting behaviour and the outcome in the first round could be misleading because the player did not actually vote in accordance with his true preferences on this particular motion. In fact, this player could still turn out to be a winner in the overall game even though he might appear to have lost in his first vote. Amershi, Demski and Wolfson (1982) therefore argued

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[56] Sutton (1988) was previously described under the first category as one of the positive studies on corporate lobbying behaviour.

that results of empirical studies on single-period lobbying behaviour might be misleading because they overlooked the possibility of the lobbyists acting strategically in a multiperiod horizon.

Although Amershi, Demski and Wolfson (1982) pointed out the possibility of strategic lobbying behaviour, the potential applications of their results to actual lobbying situations may be limited. Their results were derived from numerical examples with specific payoff and individual preference structures. A real life lobbying situation may not possess all the characteristics of these specifications. Essentially what drives the results of Amershi, Demski and Wolfson (1982)'s study is the dependency of payoffs on the outcomes of the two related votes. It is necessary for their results that, from the first player's perspective, the second vote is more important than the first vote in terms of affecting his overall payoff; and from the second player's perspective, the first vote is more important than the second vote. The first player therefore can afford to lose a little in the first round and use his first vote to entice the second player to vote in a way favourable to him in the second round. As the outcome is determined by majority rule, the first player is not concerned about the votes of the third player as long as the votes of the second player are assured. However, in the accounting standard setting process, such strict dependency among the payoff structures and the votes of the lobbyists in a series of lobbying issues would be rare.

5. Studies on Corporate Lobbying Activities in a Policy-Making Context

Hope and Briggs (1982) examined the number of comment letters received by the U.K. Accounting Standards Committee since its inception up to November 1980. A total of 27 exposure drafts covering 24 different accounting issues were included in their analysis. Focusing on those cases in which an exposure draft was not immediately followed by an accounting standard within the expected normal one-year period, Hope and Briggs (1982) presented evidence of self-interested groups trying to pressure the Accounting Standards Committee into changing its positions on several proposed accounting standards. A more in-depth review was then carried out on the deferred tax issue. Responses and opposition to the 1973 exposure draft, the 1975 statement, and the subsequent 1976 exposure draft on the deferred tax topic were examined. Given the existence of political pressure, Hope and Briggs (1982) argued for the acceptance of a policy making strategy which would explicitly recognize the limitations of accounting theory and allow for a more open and participatory standard setting process.

Hope and Gray (1982) suggested an alternative approach to the study of accounting standard setting. A framework of power borrowed from the sociology and political science literature was used in their study. Under this framework, three different views could be taken to examine any situation in which power was exerted. The one-dimensional view dealt only with the observable elements of the conflict. The two-dimensional view also considered the ways in which decisions on potential issues could be used to prevent the occurrence of the observable conflict. The three-dimensional view further allowed for the consideration that potential issues might even be kept out of politics entirely.

In the context of accounting standard setting, the study of management's lobbying position through the contents of their comment letters was an example of the one-dimensional perspective. The study of the decisions to limit discussions on certain accounting issue within the traditional accrual framework would be an example of the two-dimensional approach. The three-dimensional view, on the other hand, would also consider how a certain accounting issue could be kept totally off the agenda of the standard setting body. Hope and Gray (1982) used the U.K. experience in the setting of the research and development standard between 1975 and 1977 to illustrate the many facets of lobbying and the different approaches that could be used to study the policy making behaviour. Apparently, the lack of reliable evidence was a major problem facing the two- and three-dimensional perspectives.

In 1978, the U.S. Securities and Exchange Commission (SEC) decided to hold its own public hearings regarding the acceptability of the 1977 FASB standard which eliminated the "full cost" method in oil and gas accounting. The SEC subsequently rejected the FASB standard and proposed the new method of "reserve recognition accounting". To study the circumstances behind this rare step taken by the SEC, Gorton (1991) conducted extensive interviews with some of the key players, including members of the SEC and the FASB, who were involved in the standard setting process at that time. Gorton (1991) suggested that the strong opposition from the "full cost" firms and their intense lobbying efforts, the accounting profession's fear of direct Congressional control over the setting of accounting standards, and the SEC's underlying dissatisfaction with the historical cost framework could probably explain many of the events occurred in that period. Through the lobbying activities of many different groups, including those of the FASB itself, Gorton (1991) illustrated the highly political nature of the accounting standard setting process.

APPENDIX B

DERIVATION OF RESTRICTIONS ON PROPRIETARY COST

The lobbying model assumes that none of the two companies will lobby in favour of the proposed accounting standard. This assumption requires that the proprietary cost is sufficiently high even for a low liability firm.

If Company i has a low liability and lobbying in favour of the standard will signal the low liability level to the market, the effects on the stock price of this firm are derived as follows.

At t = 1, the market's assessments of $\tilde{L}$ and $\tilde{M}$ are

$$E[\tilde{L}|\Omega_1] = p_i \bar{L} + (1 - p_i) \underline{L}$$

$$E[\tilde{M}|\Omega_1] = \hat{q} \left[p_i \bar{m} + (1 - p_i) \underline{m} \right]$$

At t = 2, if Company i lobbies in favour of the proposed standard,

$$E[\tilde{L}|\Omega_2] = \underline{L}$$

$$E[\tilde{M}|\Omega_2] = q_j \underline{m}$$

At t = 3, if the proposed accounting standard is passed,

$$E[\tilde{L}|\Omega_3] = \underline{L}$$

$$E[\tilde{M}|\Omega_3] = \underline{m}$$

At t = 3, if the proposed accounting standard is rejected,

$$E[\tilde{L}|\Omega_3] = \underline{L}$$

$$E[\tilde{M}|\Omega_3] = 0$$

At t = 4, if the proposed accounting standard was passed,

$$E[\tilde{L}|\Omega_4] = \underline{L}$$

$$E[\tilde{M}|\Omega_4] = \underline{m}$$

Let c_f denote the out-of-pocket costs of lobbying in favour of the standard. For the low liability company, total changes in the market price of the firm between t = 1 and t = 4 are:

	If Company i has Low Liability and does not lobby	If Company i has Low Liability and lobbies in favour
If the proposed accounting standard is passed	$p_i(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_i(\bar{m}-\underline{m}) - \underline{m}$	$p_i(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_i(\bar{m}-\underline{m}) - \underline{m} - c_f$
If the proposed accounting standard is rejected	$(p_i-p_i')(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_i(\bar{m}-\underline{m})$	$p_i(\bar{L}-\underline{L}) + \hat{q}\underline{m} + \hat{q}p_i(\bar{m}-\underline{m}) - c$

Subtracting the common term $\left(p_i(\bar{L}-\underline{L}) + \hat{q}p_i(\bar{m}-\underline{m}) + \hat{q}\underline{m}\right)$ from each payoff calculation above, the payoffs to management becomes

	If Company i has Low Liability and does not lobby	If Company i has Low Liability and lobbies in favour
If the proposed standard is passed	$-\underline{m}$	$-\underline{m} - c_f$
If the proposed standard is rejected	$-p_i''\underline{L}$	$-c_f$

Further assume that having one more company lobbying in favour of the proposed standard has exactly the same effect on the standard setter as having one less company lobbying against the standard. In this case, the low liability company will prefer not lobbying to lobbying in favour of the standard if

$$-\underline{m}q_{j+1} - p_i'\mathbb{L}(1 - q_{j+1}) \geq -(\underline{m} + c_f)q_j - c_f(1 - q_j)$$

$$\Rightarrow \quad \underline{m} \geq \left[\frac{(1 - q_{j+1})}{(q_j - q_{j+1})}\right]p_i'\mathbb{L} - \frac{c_f}{(q_j - q_{j+1})} \quad , \; j = 0,1$$

This restriction on the proprietary cost is presented as an assumption of the model in (4) in Chapter 2.

APPENDIX C

DERIVATION OF EQUILIBRIUM CONDITIONS AND PROOFS OF PROPOSITIONS

Let cell(x,y) denote one possible combination of management's strategies in the lobbying game, with x = 1, 2, 3, or 4 representing Company A management's use of (LA,LA), (LA,NL), (NL,LA), (NL,NL) respectively; and y = 1, 2, 3, or 4 representing Company B management's use of (la,la), (la,nl), (nl,la), (nl,nl) respectively. The possible combinations of management's lobbying strategies are shown in matrix form as follows:

A \ B	(la,la)	(la,nl)	(nl,la)	(nl,nl)
(LA,LA)	cell(1,1)	cell(1,2)	cell(1,3)	cell(1,4)
(LA,NL)	cell(2,1)	cell(2,2)	cell(2,3)	cell(2,4)
(NL,LA)	cell(3,1)	cell(3,2)	cell(3,3)	cell(3,4)
(NL,NL)	cell(4,1)	cell(4,2)	cell(4,3)	cell(4,4)

Let ${}_{i}W_{x,y}$ represent the expected payoffs to Company i management in cell(x,y). Using Figure 1 and Tables 4 to 7, the expected payoffs to management in each cell were derived. On the basis of these expected payoffs, the conditions required for a Bayesian equilibrium in each cell could then be examined. To facilitate cross-referencing, the following is an index to the topics covered in this appendix.

<u>Derivation of Expected Payoffs to Management</u>

$$\begin{aligned}
{}_AW_{1,1} &= p_A p_B\big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&\quad + p_A(1-p_B)\big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&\quad + (1-p_A)p_B\big(-q_2(\underline{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&\quad + (1-p_A)(1-p_B)\big(-q_2(\underline{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&= -q_2p_A\mathbb{L} - q_2p_A\bar{m} + q_2p_A\underline{m} - p_A''\mathbb{L} + q_2p_A''\mathbb{L} - q_2\underline{m} - c
\end{aligned}$$

$$\begin{aligned}
{}_BW_{1,1} &= p_A p\ \text{[illegible]}\ \bar{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&\quad + p_A\ \text{[illegible]}\ (\underline{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&\quad + (1-\ \text{[illegible]}\ {}_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&\quad +\ \text{[illegible]}\ {}_B)\big(-q_2(\underline{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&= -q_2p_B\mathbb{L} - q_2p_B\bar{m} + q_2p_B\underline{m} - p_B''\mathbb{L} + q_2p_B''\mathbb{L} - q_2\underline{m} - c
\end{aligned}$$

$$\begin{aligned}
{}_AW_{1,2} &= p_A p_B\big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&\quad + p_A(1-p_B)\big(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p_A''\mathbb{L}+c)\big) \\
&\quad + (1-p_A)p_B\big(-q_2(\underline{m}+c)-(1-q_2)(p_A''\mathbb{L}+c)\big) \\
&\quad + (1-p_A)(1-p_B)\big(-q_1(\underline{m}+c)-(1-q_1)(p_A''\mathbb{L}+c)\big) \\
&= q_1p_Ap_B\mathbb{L} - q_2p_Ap_B\mathbb{L} + q_1p_Ap_B\bar{m} - q_2p_Ap_B\bar{m} - q_1p_Ap_B\underline{m} + q_2p_Ap_B\underline{m} \\
&\quad + q_1p_B\underline{m} - q_2p_B\underline{m} - q_1p_A\bar{m} + q_1p_A\underline{m} - q_1p_A\mathbb{L} - p_A''\mathbb{L} + q_1p_A''\mathbb{L} \\
&\quad - q_1\underline{m} + q_2p_Bp_A''\mathbb{L} - q_1p_Bp_A''\mathbb{L} - c
\end{aligned}$$

$$\begin{aligned}
{}_BW_{1,2} &= p_A p_B\big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&\quad + p_A(1-p_B)\big(-q_2\underline{m}-(1-q_2)p_B'\mathbb{L}\big) \\
&\quad + (1-p_A)p_B\big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p_B''\mathbb{L}+c)\big) \\
&\quad + (1-p_A)(1-p_B)\big(-q_2\underline{m}-(1-q_2)p_B'\mathbb{L}\big) \\
&= -q_2p_B\mathbb{L} - q_2p_B\bar{m} + q_1p_B\underline{m} - p_B'\mathbb{L} + q_1p_B'\mathbb{L} - q_1\underline{m} - p_Bc - p_Bp_B''\mathbb{L} \\
&\quad + p_Bp_B'\mathbb{L} - q_1p_Bp_B'\mathbb{L} + q_2p_Bp_B''\mathbb{L}
\end{aligned}$$

$$
\begin{aligned}
{}_{A}W_{1,3} = {} & p_A p_B\Big(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
& + p_A(1-p_B)\Big(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\Big) \\
& + (1-p_A)p_B\Big(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
& + (1-p_A)(1-p_B)\Big(-q_2(\underline{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\Big) \\
= {} & -p_1 p_A p_B\mathbb{L} + q_2 p_A p_B\mathbb{L} - q_1 p_A p_B\bar{m} + q_2 p_A p_B\bar{m} + q_1 p_A p_B\underline{m} - q_2 p_A p_B\underline{m} \\
& - q_1 p_B\underline{m} + q_2 p_B\underline{m} + q_2 p_A\underline{m} - p''_A\mathbb{L} + q_2 p''_A\mathbb{L} - q_2\underline{m} + q_1 p_B p''_A\mathbb{L} \\
& - q_2 p_B p''_A\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{1,3} = {} & p_A p_B\Big(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\Big) \\
& + p_A(1-p_B)\Big(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\Big) \\
& + (1-p_A)p_B\Big(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\Big) \\
& + (1-p_A)(1-p_B)\Big(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\Big) \\
= {} & -q_1 p_B\mathbb{L} - q_1 p_B\bar{m} + q_2 p_B\underline{m} - p''_B\mathbb{L} + q_2 p''_B\mathbb{L} - q_2\underline{m} + p_B c + p_B p''_B\mathbb{L} \\
& - p_B p'_B\mathbb{L} + q_1 p_B p'_B\mathbb{L} - q_2 p_B p''_B\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{1,4} = {} & p_A p_B\Big(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
& + p_A(1-p_B)\Big(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
& + (1-p_A)p_B\Big(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
& + (1-p_A)(1-p_B)\Big(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\Big) \\
= {} & -q_1 p_A\mathbb{L} - q_1 p_A\bar{m} + q_1 p_A\underline{m} - p''_A\mathbb{L} + q_1 p''_A\mathbb{L} - q_1\underline{m} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{1,4} = {} & p_A p_B\Big(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\Big) \\
& + p_A(1-p_B)\Big(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\Big) \\
& + (1-p_A)p_B\Big(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\Big) \\
& + (1-p_A)(1-p_B)\Big(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\Big) \\
= {} & q_1 p_B\mathbb{L} - q_1 p_B\bar{m} + q_1 p_B\underline{m} - p'_B\mathbb{L} + q_1 p'_B\mathbb{L} - q_1\underline{m}
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{2,1} = {} & p_A p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_2\underline{m}-(1-q_2)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_2\underline{m}-(1-q_2)p'_A\mathbb{L}\right) \\
= {} & -q_2p_A\mathbb{L} - q_2p_A\bar{m} + q_1p_A\underline{m} - p'_A\mathbb{L} + q_1p'_A\mathbb{L} - q_1\underline{m} - p_Ac - p_Ap''_A\mathbb{L} \\
& + p_Ap'_A\mathbb{L} - q_1p_Ap'_A\mathbb{L} + q_2p_Ap''_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{2,1} = {} & p_A p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
= {} & q_1p_Ap_B\mathbb{L} - q_2p_Ap_B\mathbb{L} + q_1p_Ap_B\bar{m} - q_2p_Ap_B\bar{m} - q_1p_Ap_B\underline{m} + q_2p_Ap_B\underline{m} \\
& + q_1p_A\underline{m} - q_2p_A\underline{m} - q_1p_B\bar{m} + q_1p_B\underline{m} - q_1p_B\mathbb{L} - p''_B\mathbb{L} + q_1p''_B\mathbb{L} \\
& - q_1\underline{m} + q_2p_Ap''_B\mathbb{L} - q_1p_Ap''_B\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{2,2} = {} & p_A p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
= {} & q_1p_Ap_B\mathbb{L} - q_2p_Ap_B\mathbb{L} + q_1p_Ap_B\bar{m} - q_2p_Ap_B\bar{m} - q_0p_Ap_B\underline{m} + q_1p_Ap_B\underline{m} \\
& + q_0p_B\underline{m} - q_1p_B\underline{m} - q_1p_A\bar{m} + q_0p_A\underline{m} - q_1p_A\mathbb{L} - p'_A\mathbb{L} + q_0p'_A\mathbb{L} \\
& - q_0\underline{m} + q_1p_Bp'_A\mathbb{L} - q_0p_Bp'_A\mathbb{L} - p_Ap''_A\mathbb{L} + q_1p_Ap''_A\mathbb{L} + p_Ap'_A\mathbb{L} - p_Ac \\
& - q_0p_Ap'_A\mathbb{L} + q_0p_Ap_Bp'_A\mathbb{L} - q_1p_Ap_Bp'_A\mathbb{L} - q_1p_Ap_Bp''_A\mathbb{L} + q_2p_Ap_Bp''_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{2,2} = {} & p_A p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
= {} & q_1p_Ap_B\mathbb{L} - q_2p_Ap_B\mathbb{L} + q_1p_Ap_B\bar{m} - q_2p_Ap_B\bar{m} - q_0p_Ap_B\underline{m} + q_1p_Ap_B\underline{m} \\
& + q_0p_A\underline{m} - q_1p_A\underline{m} - q_1p_B\bar{m} + q_0p_B\underline{m} - q_1p_B\mathbb{L} - p'_B\mathbb{L} + q_0p'_B\mathbb{L} \\
& - q_0\underline{m} + q_1p_Ap'_B\mathbb{L} - q_0p_Ap'_B\mathbb{L} - p_Bp''_B\mathbb{L} + q_1p_Bp''_B\mathbb{L} + p_Bp'_B\mathbb{L} - p_Bc \\
& - q_0p_Bp'_B\mathbb{L} + q_0p_Ap_Bp'_B\mathbb{L} - q_1p_Ap_Bp'_B\mathbb{L} - q_1p_Ap_Bp''_B\mathbb{L} + q_2p_Ap_Bp''_B\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{2,3} = \; & p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right) \\
= \; & -q_1p_Ap_B\mathbb{L} + q_2p_Ap_B\mathbb{L} - q_1p_Ap_B\bar{m} + q_2p_Ap_B\bar{m} + q_0p_Ap_B\underline{m} - q_1p_Ap_B\underline{m} \\
& - q_0p_B\underline{m} + q_1p_B\underline{m} - q_2p_A\bar{m} + q_1p_A\underline{m} - q_2p_A\mathbb{L} - p'_A\mathbb{L} + q_1p'_A\mathbb{L} \\
& - q_1\underline{m} - q_1p_Bp'_A\mathbb{L} + q_0p_Bp'_A\mathbb{L} - p_Ap''_A\mathbb{L} + q_2p_Ap''_A\mathbb{L} + p_Ap'_A\mathbb{L} - p_Ac \\
& - q_1p_Ap'_A\mathbb{L} + q_1p_Ap_Bp'_A\mathbb{L} - q_0p_Ap_Bp'_A\mathbb{L} + q_1p_Ap_Bp''_A\mathbb{L} - q_2p_Ap_Bp''_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{2,3} = \; & p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
= \; & q_0p_Ap_B\mathbb{L} - q_1p_Ap_B\mathbb{L} + q_0p_Ap_B\bar{m} - q_1p_Ap_B\bar{m} - q_1p_Ap_B\underline{m} + q_2p_Ap_B\underline{m} \\
& + q_1p_A\underline{m} - q_2p_A\underline{m} - q_0p_B\bar{m} + q_1p_B\underline{m} - q_0p_B\mathbb{L} - p''_B\mathbb{L} + q_1p''_B\mathbb{L} - c \\
& - q_1\underline{m} + q_2p_Ap''_B\mathbb{L} - q_1p_Ap''_B\mathbb{L} + p_Bp''_B\mathbb{L} - q_1p_Bp''_B\mathbb{L} - p_Bp'_B\mathbb{L} + p_Bc \\
& + q_0p_Bp'_B\mathbb{L} - q_0p_Ap_Bp'_B\mathbb{L} + q_1p_Ap_Bp'_B\mathbb{L} + q_1p_Ap_Bp''_B\mathbb{L} - q_2p_Ap_Bp''_B\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{2,4} = \; & p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
= \; & -q_1p_A\mathbb{L} - q_1p_A\bar{m} + q_0p_A\underline{m} - p'_A\mathbb{L} + q_0p'_A\mathbb{L} - q_0\underline{m} - p_Ac - p_Ap''_A\mathbb{L} \\
& + p_Ap'_A\mathbb{L} - q_0p_Ap'_A\mathbb{L} + q_1p_Ap''_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{2,4} = \; & p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
= \; & q_0p_Ap_B\mathbb{L} - q_1p_Ap_B\mathbb{L} + q_0p_Ap_B\bar{m} - q_1p_Ap_B\bar{m} - q_0p_Ap_B\underline{m} + q_1p_Ap_B\underline{m} \\
& + q_0p_A\underline{m} - q_1p_A\underline{m} - q_0p_B\bar{m} + q_0p_B\underline{m} - q_0p_B\mathbb{L} - q_0\underline{m} + q_1p_Ap'_B\mathbb{L} \\
& - q_0p_Ap'_B\mathbb{L} - p'_B\mathbb{L} + q_0p'_B\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{3,1} = {} & p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_2(\underline{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
= {} & -q_1 p_A\mathbb{L} - q_1 p_A\bar{m} + q_2 p_A\underline{m} - p''_A\mathbb{L} + q_2 p''_A\mathbb{L} - q_2\underline{m} + p_A c + p_A p''_A\mathbb{L} \\
& - p_A p'_A\mathbb{L} + q_1 p_A p'_A\mathbb{L} - q_2 p_A p''_A\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{3,1} = {} & p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
= {} & -p_1 p_A p_B\mathbb{L} + q_2 p_A p_B\mathbb{L} - q_1 p_A p_B\bar{m} + q_2 p_A p_B\bar{m} + q_1 p_A p_B\underline{m} - q_2 p_A p_B\underline{m} \\
& - q_1 p_A\underline{m} + q_2 p_A\underline{m} + q_2 p_B\underline{m} - p''_B\mathbb{L} + q_2 p''_B\mathbb{L} - q_2\underline{m} + q_1 p_A p''_B\mathbb{L} \\
& - q_2 p_A p''_B\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{3,2} = {} & p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_2(\underline{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
= {} & q_0 p_A p_B\mathbb{L} - q_1 p_A p_B\mathbb{L} + q_0 p_A p_B\bar{m} - q_1 p_A p_B\bar{m} - q_1 p_A p_B\underline{m} + q_2 p_A p_B\underline{m} \\
& + q_1 p_B\underline{m} - q_2 p_B\underline{m} - q_0 p_A\bar{m} + q_1 p_A\underline{m} - q_0 p_A\mathbb{L} - p''_A\mathbb{L} + q_1 p''_A\mathbb{L} - c \\
& - q_1\underline{m} + q_2 p_B p''_A\mathbb{L} - q_1 p_B p''_A\mathbb{L} + p_A p''_A\mathbb{L} - q_1 p_A p''_A\mathbb{L} - p_A p'_A\mathbb{L} + p_A c \\
& + q_0 p_A p'_A\mathbb{L} - q_0 p_A p_B p'_A\mathbb{L} + q_1 p_A p_B p'_A\mathbb{L} + q_1 p_A p_B p''_A\mathbb{L} - q_2 p_A p_B p''_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{3,2} = {} & p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + p_A(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_2(\mathbb{L}+\bar{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\right) \\
= {} & -q_1 p_A p_B\mathbb{L} + q_2 p_A p_B\mathbb{L} - q_1 p_A p_B\bar{m} + q_2 p_A p_B\bar{m} + q_0 p_A p_B\underline{m} - q_1 p_A p_B\underline{m} \\
& - q_0 p_A\underline{m} + q_1 p_A\underline{m} - q_2 p_B\bar{m} + q_1 p_B\underline{m} - q_2 p_B\mathbb{L} - p'_B\mathbb{L} + q_1 p'_B\mathbb{L} \\
& - q_1\underline{m} - q_1 p_A p'_B\mathbb{L} + q_0 p_A p'_B\mathbb{L} - p_B p''_B\mathbb{L} + q_2 p_B p''_B\mathbb{L} + p_B p'_B\mathbb{L} - p_B c \\
& - q_1 p_B p'_B\mathbb{L} + q_1 p_A p_B p'_B\mathbb{L} - q_0 p_A p_B p'_B\mathbb{L} + q_1 p_A p_B p''_B\mathbb{L} - q_2 p_A p_B p''_B\mathbb{L}
\end{aligned}
$$

$$\begin{aligned}
{}_AW_{3,3} = {} & p_Ap_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_A\mathbb{L}+c)\right) \\
= {} & -q_0p_Ap_B\mathbb{L} + q_1p_Ap_B\mathbb{L} - q_0p_Ap_B\bar{m} + q_1p_Ap_B\bar{m} + q_1p_Ap_B\underline{m} - q_2p_Ap_B\underline{m} \\
& - q_1p_B\underline{m} + q_2p_B\underline{m} - q_1p_A\bar{m} + q_2p_A\underline{m} - q_1p_A\mathbb{L} - p''_A\mathbb{L} + q_2p''_A\mathbb{L} - c \\
& - q_2\underline{m} + q_1p_Bp''_A\mathbb{L} - q_2p_Bp''_A\mathbb{L} + p_Ap''_A\mathbb{L} - q_2p_Ap''_A\mathbb{L} - p_Ap'_A\mathbb{L} + p_Ac \\
& + q_1p_Ap'_A\mathbb{L} + q_0p_Ap_Bp'_A\mathbb{L} - q_1p_Ap_Bp'_A\mathbb{L} - q_1p_Ap_Bp''_A\mathbb{L} + q_2p_Ap_Bp''_A\mathbb{L}
\end{aligned}$$

$$\begin{aligned}
{}_BW_{3,3} = {} & p_Ap_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_2(\underline{m}+c)-(1-q_2)(p''_B\mathbb{L}+c)\right) \\
= {} & -q_0p_Ap_B\mathbb{L} + q_1p_Ap_B\mathbb{L} - q_0p_Ap_B\bar{m} + q_1p_Ap_B\bar{m} + q_1p_Ap_B\underline{m} - q_2p_Ap_B\underline{m} \\
& - q_1p_A\underline{m} + q_2p_A\underline{m} - q_1p_B\bar{m} + q_2p_B\underline{m} - q_1p_B\mathbb{L} - p''_B\mathbb{L} + q_2p''_B\mathbb{L} - c \\
& - q_2\underline{m} + q_1p_Ap''_B\mathbb{L} - q_2p_Ap''_B\mathbb{L} + p_Bp''_B\mathbb{L} - q_2p_Bp''_B\mathbb{L} - p_Bp'_B\mathbb{L} + p_Bc \\
& + q_1p_Bp'_B\mathbb{L} + q_0p_Ap_Bp'_B\mathbb{L} - q_1p_Ap_Bp'_B\mathbb{L} - q_1p_Ap_Bp''_B\mathbb{L} + q_2p_Ap_Bp''_B\mathbb{L}
\end{aligned}$$

$$\begin{aligned}
{}_AW_{3,4} = {} & p_Ap_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
& + (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_A\mathbb{L}+c)\right) \\
= {} & -q_0p_A\mathbb{L} - q_0p_A\bar{m} + q_1p_A\underline{m} - p''_A\mathbb{L} + q_1p''_A\mathbb{L} - q_1\underline{m} + p_Ac + p_Ap''_A\mathbb{L} \\
& - p_Ap'_A\mathbb{L} + q_0p_Ap'_A\mathbb{L} - q_1p_Ap''_A\mathbb{L} - c
\end{aligned}$$

$$\begin{aligned}
{}_BW_{3,4} = {} & p_Ap_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_B\mathbb{L}\right) \\
= {} & -p_0p_Ap_B\mathbb{L} + q_1p_Ap_B\mathbb{L} - q_0p_Ap_B\bar{m} + q_1p_Ap_B\bar{m} + q_0p_Ap_B\underline{m} - q_1p_Ap_B\underline{m} \\
& - q_0p_A\underline{m} + q_1p_A\underline{m} - q_1p_B\bar{m} + q_1p_B\underline{m} - q_1p_B\mathbb{L} - q_1\underline{m} + q_0p_Ap'_B\mathbb{L} \\
& - q_1p_Ap'_B\mathbb{L} - p'_B\mathbb{L} + q_1p'_B\mathbb{L}
\end{aligned}$$

$$
\begin{aligned}
{}_{A}W_{4,1} = \;& p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right)\\
&+ p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right)\\
&+ (1-p_A)p_B\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right)\\
&+ (1-p_A)(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right)\\
= \;& q_1 p_A\mathbb{L} - q_1 p_A\bar{m} + q_1 p_A\underline{m} - p'_A\mathbb{L} + q_1 p'_A\mathbb{L} - q_1\underline{m}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{4,1} = \;& p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
&+ p_A(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
&+ (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
&+ (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
= \;& -q_1 p_B\mathbb{L} - q_1 p_B\bar{m} + q_1 p_B\underline{m} - p''_B\mathbb{L} + q_1 p''_B\mathbb{L} - q_1\underline{m} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{4,2} = \;& p_A p_B\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right)\\
&+ p_A(1-p_B)\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right)\\
&+ (1-p_A)p_B\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right)\\
&+ (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right)\\
= \;& q_0 p_A p_B\mathbb{L} - q_1 p_A p_B\mathbb{L} + q_0 p_A p_B\bar{m} - q_1 p_A p_B\bar{m} - q_0 p_A p_B\underline{m} + q_1 p_A p_B\underline{m}\\
&+ q_0 p_B\underline{m} - q_1 p_B\underline{m} - q_0 p_A\bar{m} + q_0 p_A\underline{m} - q_0 p_A\mathbb{L} - q_0\underline{m} + q_1 p_B p'_A\mathbb{L}\\
&- q_0 p_B p'_A\mathbb{L} - p'_A\mathbb{L} + q_0 p'_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{4,2} = \;& p_A p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
&+ p_A(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right)\\
&+ (1-p_A)p_B\left(-q_1(\mathbb{L}+\bar{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right)\\
&+ (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right)\\
= \;& -q_1 p_B\mathbb{L} - q_1 p_B\bar{m} + q_0 p_B\underline{m} - p'_B\mathbb{L} + q_0 p'_B\mathbb{L} - q_0\underline{m} - p_B c - p_B p''_B\mathbb{L}\\
&+ p_B p'_B\mathbb{L} - q_0 p_B p'_B\mathbb{L} + q_1 p_B p''_B\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{4,3} = {} & p_A p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1(\mathbb{L}+\bar{m})-(1-q_1)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_1\underline{m}-(1-q_1)p'_A\mathbb{L}\right) \\
= {} & -p_0 p_A p_B\mathbb{L} + q_1 p_A p_B\mathbb{L} - q_0 p_A p_B\bar{m} + q_1 p_A p_B\bar{m} + q_0 p_A p_B\underline{m} - q_1 p_A p_B\underline{m} \\
& - q_0 p_B\underline{m} + q_1 p_B\underline{m} - q_1 p_A\bar{m} + q_1 p_A\underline{m} - q_1 p_A\mathbb{L} - q_1\underline{m} + q_0 p_B p'_A\mathbb{L} \\
& - q_1 p_B p'_A\mathbb{L} - p'_A\mathbb{L} + q_1 p'_A\mathbb{L}
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{4,3} = {} & p_A p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
& + (1-p_A)p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_1(\underline{m}+c)-(1-q_1)(p''_B\mathbb{L}+c)\right) \\
= {} & -q_0 p_B\mathbb{L} - q_0 p_B\bar{m} + q_1 p_B\underline{m} - p''_B\mathbb{L} + q_1 p''_B\mathbb{L} - q_1\underline{m} + p_B c + p_B p''_B\mathbb{L} \\
& - p_B p'_B\mathbb{L} + q_0 p_B p'_B\mathbb{L} - q_1 p_B p''_B\mathbb{L} - c
\end{aligned}
$$

$$
\begin{aligned}
{}_{A}W_{4,4} = {} & p_A p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_A\mathbb{L}\right) \\
= {} & q_0 p_A\mathbb{L} - q_0 p_A\bar{m} + q_0 p_A\underline{m} - p'_A\mathbb{L} + q_0 p'_A\mathbb{L} - q_0 m
\end{aligned}
$$

$$
\begin{aligned}
{}_{B}W_{4,4} = {} & p_A p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + p_A(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)p_B\left(-q_0(\mathbb{L}+\bar{m})-(1-q_0)p'_B\mathbb{L}\right) \\
& + (1-p_A)(1-p_B)\left(-q_0\underline{m}-(1-q_0)p'_B\mathbb{L}\right) \\
= {} & q_0 p_B\mathbb{L} - q_0 p_B\bar{m} + q_0 p_B\underline{m} - p'_B\mathbb{L} + q_0 p'_B\mathbb{L} - q_0\underline{m}
\end{aligned}
$$

Derivation of Equilibrium Conditions

The expected payoffs to management in each of the sixteen cells were then examined to identify the related equilibrium conditions.

Cell(1,1)

Cell(1,1) would be a Bayesian equilibrium point if ${}_{A}W_{1,1} > {}_{A}W_{r,1}$, $r = 2,3,4$, and ${}_{B}W_{1,1} > {}_{B}W_{1,s}$, $s = 2,3,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$${}_{A}W_{1,1} > {}_{A}W_{2,1} \Rightarrow \underline{m} > \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A1}$$

$${}_{A}W_{1,1} > {}_{A}W_{3,1} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A2}$$

$${}_{A}W_{1,1} > {}_{A}W_{4,1} \Rightarrow p_A(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} > \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A3}$$

$${}_{B}W_{1,1} > {}_{B}W_{1,2} \Rightarrow \underline{m} > \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A4}$$

$${}_{B}W_{1,1} > {}_{B}W_{1,3} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A5}$$

$${}_{B}W_{1,1} > {}_{B}W_{1,4} \Rightarrow p_B(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} > \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \tag{A6}$$

The lobbying game assumes that $1 \ge q_0 \ge q_1 \ge q_2 \ge 0$, $\mathbb{L} > 0$, $\bar{m} \ge m \ge 0$, and $1 \ge p''_i \ge p_i \ge p'_i \ge 0$, $i=A,B$. Under these assumptions, conditions (A1) and (A4) above give the binding conditions for the Bayesian equilibrium in cell(1,1). Therefore, management of the two companies will both follow the "always lobby" strategy of (LA,LA) and the (la,la) if:

$$\underline{m} > \left[\frac{(1-q_{j+1})(p_i''-p_i')}{(q_j-q_{j+1})}\right]\mathbb{L} + p_i'\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \; j=1, \; i=A,B \qquad \text{(A7)}$$

<u>**Cell(1,2)**</u>

Cell(1,2) would be a Bayesian equilibrium point if ${}_AW_{1,2} > {}_AW_{r,2}$, $r = 2,3,4$, and ${}_BW_{1,2} > {}_BW_{1,s}$, $s = 1,3,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$$\begin{aligned}{}_AW_{1,2} > {}_AW_{2,2} \Rightarrow\ & (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_A''-p_A')}{(q_0-q_1)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} \\ & +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p_A''-p_A')}{(q_1-q_2)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A8)}\end{aligned}$$

$$\begin{aligned}{}_AW_{1,2} > {}_AW_{3,2} \Rightarrow\ & (1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p_A''-p_A')}{(q_0-q_1)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} \\ & +p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p_A''-p_A')}{(q_1-q_2)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A9)}\end{aligned}$$

$$\begin{aligned}{}_AW_{1,2} > {}_AW_{4,2} \Rightarrow\ & (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_A''-p_A')}{(q_0-q_1)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} \\ & +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p_A''-p_A')}{(q_1-q_2)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} \\ & +p_A(1-p_B)(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) + p_Ap_B(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) > 0 \qquad \text{(A10)}\end{aligned}$$

$$ {}_{B}W_{1,2} > {}_{B}W_{1,1} \Rightarrow \underline{m} < \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A11)} $$

$$ {}_{B}W_{1,2} > {}_{B}W_{1,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A12)} $$

$$ {}_{B}W_{1,2} > {}_{B}W_{1,4} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A13)} $$

Conditions (A8), (A11), (A12) and (A13) give the binding conditions for the Bayesian equilibrium in cell(1,2). As for Company A, according to (A8), the condition for using the "always lobby" strategy, (LA,LA), is:

$$ \underline{m} > \left[\frac{(1-q_{j+1})(p''_A-p'_A)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_A\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \; j = 0,1 \qquad \text{(A14)} $$

Cell(1,3)

Cell(1,3) would be a Bayesian equilibrium point if ${}_{A}W_{1,3} > {}_{A}W_{r,3}$, $r = 2,3,4$, and ${}_{B}W_{1,3} > {}_{B}W_{1,s}$, $s = 1,2,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$$ {}_{A}W_{1,3} > {}_{A}W_{2,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A15)} $$

$$ {}_{A}W_{1,3} > {}_{A}W_{3,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A16)} $$

$$ {}_{A}W_{1,3} > {}_{A}W_{4,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(1-p_B)(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) + p_A p_B(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) > 0 \qquad \text{(A17)} $$

$$ {}_{B}W_{1,3} > {}_{B}W_{1,1} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A18)} $$

$$ {}_{B}W_{1,3} > {}_{B}W_{1,2} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A19)} $$

$$ {}_{B}W_{1,3} > {}_{B}W_{1,4} \Rightarrow \underline{m} > \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A20)} $$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A18) and (A20) are contradictory and cannot be both satisfied at the same time. Therefore, cell(1,3) can never be a Bayesian equilibrium point.

Cell(1,4)

Cell(1,4) would be a Bayesian equilibrium point if ${}_AW_{1,4} > {}_AW_{r,4}$, $r = 2,3,4$, and ${}_BW_{1,4} > {}_BW_{1,s}$, $s = 1,2,3$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$$ {}_AW_{1,4} > {}_AW_{2,4} \Rightarrow \underline{m} > \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad (A21)$$

$$ {}_AW_{1,4} > {}_AW_{3,4} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad (A22)$$

$$ {}_AW_{1,4} > {}_AW_{4,4} \Rightarrow p_A(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} > \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad (A23)$$

$$ {}_BW_{1,4} > {}_BW_{1,1} \Rightarrow p_B(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} < \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad (A24)$$

$$ {}_BW_{1,4} > {}_BW_{1,2} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad (A25)$$

$$ {}_BW_{1,4} > {}_BW_{1,3} \Rightarrow \underline{m} < \left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad (A26)$$

Conditions (A21), (A24) and (A25) above give the binding conditions for the Bayesian equilibrium in cell(1,4). As for Company A, according to (A21), the condition for using the "always lobby" strategy, (LA,LA), is:

$$ \underline{m} > \left[\frac{(1-q_{j+1})(p''_A-p'_A)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_A\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \ j = 0 \qquad (A27)$$

Cell(2,1)

Cell(2,1) would be a Bayesian equilibrium point if ${}_AW_{2,1} > {}_AW_{r,1}$, $r = 1,3,4$, and ${}_BW_{2,1} > {}_BW_{2,s}$, $s = 2,3,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$$ {}_AW_{2,1} > {}_AW_{1,1} \Rightarrow \underline{m} < \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A28)} $$

$$ {}_AW_{2,1} > {}_AW_{3,1} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A29)} $$

$$ {}_AW_{2,1} > {}_AW_{4,1} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A30)} $$

$$ {}_BW_{2,1} > {}_BW_{2,2} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A31)} $$

$$ {}_BW_{2,1} > {}_BW_{2,3} \Rightarrow (1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A32)} $$

$$ {}_BW_{2,1} > {}_BW_{2,4} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$+p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_B(1-p_A)(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) + p_A p_B(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) > 0 \quad \text{(A33)}$$

Conditions (A28) and (A31) above give the binding conditions for the Bayesian equilibrium in cell(2,1). As for Company B, according to (A31), the condition for using the "always lobby" strategy, (la,la), is:

$$\underline{m} > \left[\frac{(1-q_{j+1})(p''_B-p'_B)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_B\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \; j = 0,1 \qquad \text{(A34)}$$

Cell(3,1)

Cell(3,1) would be a Bayesian equilibrium point if ${}_AW_{3,1} > {}_AW_{r,1}$, $r = 1,2,4$, and ${}_BW_{3,1} > {}_BW_{3,s}$, $s = 2,3,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$${}_AW_{3,1} > {}_AW_{1,1} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A35)}$$

$${}_AW_{3,1} > {}_AW_{2,1} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A36)}$$

$${}_AW_{3,1} > {}_AW_{4,1} \Rightarrow \underline{m} > \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \qquad \text{(A37)}$$

$$
{}_BW_{3,1} > {}_BW_{3,2} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
+p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \tag{A38}
$$

$$
{}_BW_{3,1} > {}_BW_{3,3} \Rightarrow (1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
+p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \tag{A39}
$$

$$
{}_BW_{3,1} > {}_BW_{3,4} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
+p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}
$$

$$
+p_B(1-p_A)(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) + p_Ap_B(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) > 0 \tag{A40}
$$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A35) and (A37) are contradictory and cannot be both satisfied at the same time. Therefore, cell(3,1) can never be a Bayesian equilibrium point.

Cell(4,1)

Cell(4,1) would be a Bayesian equilibrium point if ${}_AW_{4,1} > {}_AW_{r,1}$, $r = 1,2,3$, and ${}_BW_{4,1} > {}_BW_{4,s}$, $s = 2,3,4$. Using the expected payoffs derived previously, these conditions could be expressed as follows:

$$ {}_{A}W_{4,1} > {}_{A}W_{1,1} \Rightarrow p_{A}(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} < \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \quad \text{(A41)} $$

$$ {}_{A}W_{4,1} > {}_{A}W_{2,1} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \quad \text{(A42)} $$

$$ {}_{A}W_{4,1} > {}_{A}W_{3,1} \Rightarrow \underline{m} < \left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_1-q_2)} \quad \text{(A43)} $$

$$ {}_{B}W_{4,1} > {}_{B}W_{4,2} \Rightarrow \underline{m} > \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A44)} $$

$$ {}_{B}W_{4,1} > {}_{B}W_{4,3} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A45)} $$

$$ {}_{B}W_{4,1} > {}_{B}W_{4,4} \Rightarrow p_{B}(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} > \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A46)} $$

Conditions (A41), (A42) and (A44) above give the binding conditions for the Bayesian equilibrium in cell(4,1). As for Company B, according to (A44), the condition for using the "always lobby" strategy, (la,la), is:

$$ \underline{m} > \left[\frac{(1-q_{j+1})(p''_B-p'_B)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_B\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \; j = 0 \quad \text{(A47)} $$

Proof of Proposition 1:

The cases covered so far in this appendix show that the "always lobby" strategy of (LA,LA) or (la,la) can result in an equilibrium strategy for management of either company. A Bayesian equilibrium may exist in cell(1,1), cell(1,2), cell (1,4), cell(2,1), or cell(4,1) allowing the use of the (LA,LA) and/or (la,la) strategy. Using the results in (A7), (A14), (A27), (A34), and (A47), a necessary condition for the existence of a Bayesian equilibrium involving the use of the "always lobby" strategy by Company i management is

$$\underline{m} > \left[\frac{(1-q_{j+1})(p''_i-p'_i)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_i\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \ j = 0 \text{ or } 1 \qquad \text{(A48)}$$

If (A48) is satisfied for both companies with $j = 0$, the conditions are equivalent to (A7). In this case, $\big((LA,LA),(la,la)\big)$ is a Bayesian equilibrium. ∎

<u>**Derivation of Equilibrium Conditions (continued)**</u>

For the remaining cases covered in this appendix, the following assumption is made to exclude the possible use of the "always lobby" strategy in the equilibrium solution:

$$\underline{m} < \left[\frac{(1-q_{j+1})(p''_i-p'_i)}{(q_j-q_{j+1})}\right]\mathbb{L} + p'_i\mathbb{L} + \frac{c}{(q_j-q_{j+1})} \quad , \ j=0,1, \ i=A,B \qquad \text{(A49)}$$

Cell(2,2)

Cell(2,2) would be a Bayesian equilibrium point if ${}_AW_{2,2} > {}_AW_{r,2}$, $r = 1,3,4$, and ${}_BW_{2,2} > {}_BW_{2,s}$, $s = 1,3,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$ {}_AW_{2,2} > {}_AW_{2,1} \Rightarrow (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A50)} $$

$$ {}_AW_{2,2} > {}_AW_{3,2} \Rightarrow p_A(1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ -(1-p_A)(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ -p_B(1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$
$$ +p_Ap_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A51)} $$

$$ {}_AW_{2,2} > {}_AW_{4,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ +p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A52)} $$

$$ {}_BW_{2,2} > {}_BW_{2,1} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$+p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad (A53)$$

$${}_BW_{2,2} > {}_BW_{2,3} \Rightarrow p_B(1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-(1-p_A)(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-p_A(1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_Ap_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \quad (A54)$$

$${}_BW_{2,2} > {}_BW_{2,4} \Rightarrow (1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$+p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad (A55)$$

Conditions (A52) and (A55) give the binding conditions for the Bayesian equilibrium in cell(2,2). Using the notation ${}_i\mathbb{E}_j$ as defined in (9) in Chapter 2, the necessary conditions for cell(2,2) to be a Bayesian equilibrium point are

$$\begin{cases} (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 > 0 \\ (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 > 0 \end{cases} \qquad (A56)$$

<u>**Cell(2,3)**</u>

Cell(2,3) would be a Bayesian equilibrium point if ${}_AW_{2,3} > {}_AW_{r,3}$, $r = 1,3,4$, and ${}_BW_{2,3} > {}_BW_{2,s}$, $s = 1,2,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$ {}_AW_{2,3} > {}_AW_{1,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_0-q_1)\left\{\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad \text{(A57)} $$

$$ {}_AW_{2,3} > {}_AW_{3,3} \Rightarrow p_A(1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ -(1-p_A)(1-p_B)(q_1-q_2)\left\{\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ -p_B(1-p_A)(q_0-q_1)\left\{\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_Ap_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A58)} $$

$$ {}_AW_{2,3} > {}_AW_{4,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A59)} $$

$$ {}_BW_{2,3} > {}_BW_{2,1} \Rightarrow (1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$+p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \quad \text{(A60)}$$

$$_BW_{2,3} > {}_BW_{2,2} \Rightarrow p_B(1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-(1-p_A)(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-p_A(1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_Ap_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \quad \text{(A61)}$$

$$_BW_{2,3} > {}_BW_{2,4} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$+p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \quad \text{(A62)}$$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A60) and (A62) are contradictory and cannot be both satisfied at the same time. Therefore, cell(2,3) can never be a Bayesian equilibrium point.

Cell(2,4)

Cell(2,4) would be a Bayesian equilibrium point if $_AW_{2,4} > {}_AW_{r,4}$, $r = 1,3,4$, and $_BW_{2,4} > {}_BW_{2,s}$, $s = 1,2,3$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$ {}_{A}W_{2,4} > {}_{A}W_{1,4} \Rightarrow \underline{m} < \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad \text{(A63)} $$

$$ {}_{A}W_{2,4} > {}_{A}W_{3,4} \Rightarrow p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ -(1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A64)} $$

$$ {}_{A}W_{2,4} > {}_{A}W_{4,4} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad \text{(A65)} $$

$$ {}_{B}W_{2,4} > {}_{B}W_{2,1} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_B(1-p_A)(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) + p_A p_B(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) < 0 \qquad \text{(A66)} $$

$$ {}_{B}W_{2,4} > {}_{B}W_{2,2} \Rightarrow (1-p_A)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A67)} $$

$$ {}_{B}W_{2,4} > {}_{B}W_{2,3} \Rightarrow (1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_A(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A68)} $$

Conditions (A65) and (A67) give the binding conditions for the Bayesian equilibrium in cell(2,4). Using the notation ${}_{i}\mathbb{E}_{j}$ as defined in (9) in Chapter 2, the necessary conditions for cell(2,4) to be a Bayesian equilibrium point are

$$\begin{cases} {}_{A}\mathbb{E}_{0} > 0 \\ (1-p_A)(q_0-q_1)_{\Gamma}\mathbb{E}_{2} + p_A(q_1-q_2)_{B}\mathbb{E}_{1} < 0 \end{cases} \qquad \text{(A69)}$$

Cell(3,2)

Cell(3,2) would be a Bayesian equilibrium point if ${}_{A}W_{3,2} > {}_{A}W_{r,2}$, $r = 1,2,4$, and ${}_{B}W_{3,2} > {}_{B}W_{3,s}$, $s = 1,3,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$${}_{A}W_{3,2} > {}_{A}W_{1,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$
$$+p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A70)}$$

$${}_{A}W_{3,2} > {}_{A}W_{2,2} \Rightarrow p_A(1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$
$$-(1-p_A)(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$
$$-p_B(1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$
$$+p_Ap_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A71)}$$

$$ {}_{A}W_{3,2} > {}_{A}W_{4,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \qquad \text{(A72)} $$

$$ {}_{B}W_{3,2} > {}_{B}W_{3,1} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad \text{(A73)} $$

$$ {}_{B}W_{3,2} > {}_{B}W_{3,3} \Rightarrow p_B(1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ -(1-p_A)(1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ -p_A(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_Ap_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A74)} $$

$$ {}_{B}W_{3,2} > {}_{B}W_{3,4} \Rightarrow (1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A75)} $$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A70) and (A72) are contradictory and cannot be both satisfied at the same time. Therefore, cell(3,2) can never be a Bayesian equilibrium point.

Cell(3,3)

Cell(3,3) would be a Bayesian equilibrium point if ${}_{A}W_{3,3} > {}_{A}W_{r,3}$, $r = 1,2,4$, and ${}_{B}W_{3,3} > {}_{B}W_{3,s}$, $s = 1,2,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$
{}_{A}W_{3,3} > {}_{A}W_{1,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
+p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad \text{(A76)}
$$

$$
{}_{A}W_{3,3} > {}_{A}W_{2,3} \Rightarrow p_A(1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
-(1-p_A)(1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
-p_B(1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}
$$

$$
+p_Ap_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad \text{(A77)}
$$

$$
{}_{A}W_{3,3} > {}_{A}W_{4,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$
+p_B(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \qquad \text{(A78)}
$$

$$
{}_{B}W_{3,3} > {}_{B}W_{3,1} \Rightarrow (1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}
$$

$$+p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \quad \text{(A79)}$$

$$_BW_{3,3} > {}_BW_{3,2} \Rightarrow p_B(1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p_B''-p_B')}{(q_1-q_2)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$-(1-p_A)(1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p_B''-p_B')}{(q_1-q_2)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$-p_A(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$+p_Ap_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \quad \text{(A80)}$$

$$_BW_{3,3} > {}_BW_{3,4} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p_B''-p_B')}{(q_1-q_2)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \quad \text{(A81)}$$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A76) and (A78) are contradictory and cannot be both satisfied at the same time. Similarly, conditions (A79) and (A81) are also contradictory. Therefore, cell(3,3) can never be a Bayesian equilibrium point.

<u>**Cell(3,4)**</u>

Cell(3,4) would be a Bayesian equilibrium point if $_AW_{3,4} > {}_AW_{r,4}$, $r = 1,2,4$, and $_BW_{3,4} > {}_BW_{3,s}$, $s = 1,2,3$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$ {}_AW_{3,4} > {}_AW_{1,4} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad (A82) $$

$$ {}_AW_{3,4} > {}_AW_{2,4} \Rightarrow p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ -(1-p_A)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad (A83) $$

$$ {}_AW_{3,4} > {}_AW_{4,4} \Rightarrow \underline{m} > \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad (A84) $$

$$ {}_BW_{3,4} > {}_BW_{3,1} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$

$$ +p_B(1-p_A)(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) + p_Ap_B(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) < 0 \qquad (A85) $$

$$ {}_BW_{3,4} > {}_BW_{3,2} \Rightarrow (1-p_A)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad (A86) $$

$$ {}_BW_{3,4} > {}_BW_{3,3} \Rightarrow (1-p_A)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_B-p'_B)}{(q_1-q_2)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$

$$ +p_A(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \qquad (A87) $$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A82) and (A84) are contradictory and cannot be both satisfied at the same time. Therefore, cell(3,4) can never be a Bayesian equilibrium point.

<u>Cell(4,2)</u>

Cell(4,2) would be a Bayesian equilibrium point if ${}_{A}W_{4,2} > {}_{A}W_{r,2}$, $r = 1,2,3$, and ${}_{B}W_{4,2} > {}_{B}W_{4,s}$, $s = 1,3,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$$ {}_{A}W_{4,2} > {}_{A}W_{1,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} $$
$$ +p_A(1-p_B)(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) + p_A p_B(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) < 0 \qquad \text{(A88)} $$

$$ {}_{A}W_{4,2} > {}_{A}W_{2,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ +p_B(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A89)} $$

$$ {}_{A}W_{4,2} > {}_{A}W_{3,2} \Rightarrow (1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} $$
$$ +p_B(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} < 0 \qquad \text{(A90)} $$

$$ {}_{B}W_{4,2} > {}_{B}W_{4,1} \Rightarrow \underline{m} < \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \qquad \text{(A91)} $$

$${}_B W_{4,2} > {}_B W_{4,3} \Rightarrow p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}-p_B'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} > 0 \quad \text{(A92)}$$

$${}_B W_{4,2} > {}_B W_{4,4} \Rightarrow \mathbb{L}+\bar{m} > \left[\frac{(1-q_1)(p_B''-p_B')}{(q_0-q_1)}\right]\mathbb{L}+p_B'\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A93)}$$

Conditions (A89) and (A93) give the binding conditions for the Bayesian equilibrium in cell(4,2). Using the notation ${}_i\mathbb{E}_j$ as defined in (9) in Chapter 2, the necessary conditions for cell(4,2) to be a Bayesian equilibrium point are

$$\begin{cases} (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 < 0 \\ {}_B\mathbb{E}_0 > 0 \end{cases} \quad \text{(A94)}$$

<u>**Cell(4,3)**</u>

Cell(4,3) would be a Bayesian equilibrium point if ${}_A W_{4,3} > {}_A W_{r,3}$, $r = 1,2,3$, and ${}_B W_{4,3} > {}_B W_{4,s}$, $s = 1,2,4$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$${}_A W_{4,3} > {}_A W_{1,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p_A''-p_A')}{(q_1-q_2)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_B(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p_A''-p_A')}{(q_0-q_1)}\right]\mathbb{L}-p_A'\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$+p_A(1-p_B)(q_1-q_2)(\mathbb{L}+\bar{m}-\underline{m}) + p_Ap_B(q_0-q_1)(\mathbb{L}+\bar{m}-\underline{m}) < 0 \quad (A95)$$

$${}_AW_{4,3} > {}_AW_{2,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \quad (A96)$$

$${}_AW_{4,3} > {}_AW_{3,3} \Rightarrow (1-p_B)(q_1-q_2)\left\{\underline{m}-\left[\frac{(1-q_2)(p''_A-p'_A)}{(q_1-q_2)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_1-q_2)}\right\}$$

$$+p_B(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}-p'_A\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \quad (A97)$$

$${}_BW_{4,3} > {}_BW_{4,1} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad (A98)$$

$${}_BW_{4,3} > {}_BW_{4,2} \Rightarrow p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\}$$

$$-(1-p_B)(q_0-q_1)\left\{\underline{m}-\left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}-p'_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} < 0 \quad (A99)$$

$${}_BW_{4,3} > {}_BW_{4,4} \Rightarrow \underline{m} > \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad (A100)$$

With $\bar{m} \geq \underline{m}$ and $\mathbb{L} > 0$, conditions (A99) and (A100) are contradictory and cannot be both satisfied at the same time. Therefore, cell(4,3) can never be a Bayesian equilibrium point.

Cell(4,4)

Cell(4,4) would be a Bayesian equilibrium point if ${}_{A}W_{4,4} > {}_{A}W_{r,4}$, $r = 1,2,3$, and ${}_{B}W_{4,4} > {}_{B}W_{4,s}$, $s = 1,2,3$. Using the expected payoffs previously calculated, these conditions could be expressed as follows:

$${}_{A}W_{4,4} > {}_{A}W_{1,4} \Rightarrow p_A(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} < \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A101)}$$

$${}_{A}W_{4,4} > {}_{A}W_{2,4} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A102)}$$

$${}_{A}W_{4,4} > {}_{A}W_{3,4} \Rightarrow \underline{m} < \left[\frac{(1-q_1)(p''_A-p'_A)}{(q_0-q_1)}\right]\mathbb{L}+p'_A\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A103)}$$

$${}_{B}W_{4,4} > {}_{B}W_{4,1} \Rightarrow p_B(\mathbb{L}+\bar{m}-\underline{m})+\underline{m} < \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A104)}$$

$${}_{B}W_{4,4} > {}_{B}W_{4,2} \Rightarrow \mathbb{L}+\bar{m} < \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A105)}$$

$${}_{B}W_{4,4} > {}_{B}W_{4,3} \Rightarrow \underline{m} < \left[\frac{(1-q_1)(p''_B-p'_B)}{(q_0-q_1)}\right]\mathbb{L}+p'_B\mathbb{L}+\frac{c}{(q_0-q_1)} \quad \text{(A106)}$$

Conditions (A102) and (A105) give the binding conditions for the Bayesian equilibrium in cell(4,4). Using the notation ${}_{i}\mathbb{E}_{j}$ as defined in (9) in Chapter 2, the necessary conditions for cell(4,4) to be a Bayesian equilibrium point are

$$\begin{cases} {}_{A}\mathbb{E}_{0} < 0 \\ {}_{B}\mathbb{E}_{0} < 0 \end{cases} \quad \text{(A107)}$$

Impossibility of Equilibrium in Some Cells

Proof of Proposition 2:

Previous results on the derivation of equilibrium conditions show that it is not possible to have a Bayesian equilibrium point in cell(1,3), cell(3,1), cell(2,3), cell(3,2), cell(3,3), cell(3,4), and cell(4,3). Each of these cells involve the use of either (NL,LA) or (nl,la). The impossibility of a Bayesian equilibrium in these cells shows that it is never optimal for management to use the (NL,LA) or the (nl,la) strategy. ∎

Proof of Proposition 3:

The following analysis will show that, given $p_A \le p_B$, it is also not possible for cell(2,4) to be a unique Bayesian equilibrium point. The necessary conditions for a Bayesian equilibrium in cell(2,4) are listed in (A69). However, for cell(2,4) to be a unique equilibrium, it is also necessary that at least one of the conditions in (A94) is not satisfied. Otherwise, the result will be the multiple equilibria of cell(2,4) and cell(4,2) identified as Case 6 in Chapter 2. Therefore, a unique equilibrium in cell(2,4) requires that

$$\begin{cases} {}_A\mathbb{E}_0 > 0 , \\ (1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1 < 0 \text{ , and} \\ \text{at least one of } {}_B\mathbb{E}_0 < 0 \text{ and} \\ \quad (1-p_B)(q_0-q_1)\,{}_A\mathbb{E}_0 + p_B(q_1-q_2)\,{}_A\mathbb{E}_1 > 0 \text{ is satisfied.} \end{cases} \tag{A108}$$

Using the consistency requirements stated in (5) and (6) in Chapter 2, a unique equilibrium in cell(2,4) would mean that $p''_A = 1$, $p'_A = 0$, $p''_B = p_B$, and $p'_B = p_B$. Substituting these values into ${}_i\mathbb{E}_j$ as defined in (9), the requirements in (A108) become

$$\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)}{(q_0-q_1)}\right]\mathbb{L}-\frac{c}{(q_0-q_1)} > 0 \text{ , and}$$

$$p_A(q_0-q_1)\left[\mathbb{L}+\bar{m}-p_B\mathbb{L}-\frac{c}{(q_0-q_1)}\right] + (1-p_A)(q_1-q_2)\left[\mathbb{L}+\bar{m}-p_B\mathbb{L}-\frac{c}{(q_1-q_2)}\right] < 0 \text{ , and at least one of}$$

$$\mathbb{L}+\bar{m}-p_B\mathbb{L}-\frac{c}{(q_0-q_1)} < 0 \text{ , and}$$

$$p_B(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_1)}{(q_0-q_1)}\right]\mathbb{L}-\frac{c}{(q_0-q_1)}\right\} + (1-p_B)(q_0-q_1)\left\{\mathbb{L}+\bar{m}-\left[\frac{(1-q_2)}{(q_1-q_2)}\right]\mathbb{L}-\frac{c}{(q_1-q_2)}\right\} > 0 \text{ is satisfied.}$$

Using the notations that

$$\mathbb{D}_1 = \mathbb{L}+\bar{m}-\left[\frac{(1-q_1)}{(q_0-q_1)}\right]\mathbb{L}-\frac{c}{(q_0-q_1)}$$

$$\mathbb{D}_2 = \mathbb{L}+\bar{m}-p_B\mathbb{L}-\frac{c}{(q_0-q_1)}$$

$$\mathbb{D}_3 = \mathbb{L}+\bar{m}-p_B\mathbb{L}-\frac{c}{(q_1-q_2)}$$

$$\mathbb{D}_4 = \mathbb{L}+\bar{m}-\left[\frac{(1-q_2)}{(q_1-q_2)}\right]\mathbb{L}-\frac{c}{(q_1-q_2)}$$

The requirements in (A108) can then be written as follows:

$$\begin{cases} \mathbb{D}_1 > 0 & \text{(A109)} \\ (1-p_A)(q_0-q_1)\mathbb{D}_2 + p_A(q_1-q_2)\mathbb{D}_3 < 0 & \text{(A110)} \\ \text{with at least one of} & \\ \quad \mathbb{D}_2 < 0 & \text{(A111)} \\ \quad (i-p_B)(q_0-q_1)\mathbb{D}_1 + p_B(q_1-q_2)\mathbb{D}_4 > 0 & \text{(A112)} \end{cases}$$

As $\left[\dfrac{(1-q_1)}{(q_0-q_1)}\right] \geq 1$ and $p_B \leq 1$, it follows that $\mathbb{D}_1 > 0$ implies

$$\mathbb{D}_2 > 0 \tag{A113}$$

Therefore, given the condition in (A109), (A111) can never be true. If cell(2,4) is a unique equilibrium, the three conditions in (A109), (A110), and (A112) would all have to be satisfied. Now, using (A110), $\mathbb{D}_2 > 0$ implies that

$$\mathbb{D}_3 < 0 \tag{A114}$$

Again, as $\left[\dfrac{(1-q_1)}{(q_0-q_1)}\right] \geq 1$ and $p_B \leq 1$, it follows that $\mathbb{D}_3 < 0$ implies

$$\mathbb{D}_4 < 0 \tag{A115}$$

Substituting $\mathbb{D}_2 = \mathbb{D}_1 + \left[\dfrac{(1-q_1)}{(q_0-q_1)}\right]\mathbb{L} - p_B\mathbb{L}$ and $\mathbb{D}_3 = \mathbb{D}_4 + \left[\dfrac{(1-q_2)}{(q_1-q_2)}\right]\mathbb{L} - p_B\mathbb{L}$, (A110) can be expressed as

$$(1-p_A)(q_0-q_1)p_B\mathbb{L} - (1-p_A)(1-q_1)\mathbb{L} + p_A(q_1-q_2)p_B\mathbb{L}$$
$$- p_A(1-q_2)\mathbb{L} - (1-p_A)(q_0-q_1)\mathbb{D}_1 - p_A(q_1-q_2)\mathbb{D}_4 > 0 \qquad \text{(A116)}$$

Now, adding the left hand sides of the two inequalities (A116) and (A112) gives

$$(1-p_A)\mathbb{L}\Big[(q_0-q_1)p_B-(1-q_1)\Big] + p_A\Big[(q_1-q_2)p_B-(1-q_2)\Big]$$
$$+ (q_0-q_1)(p_A- p_B)\mathbb{D}_1 + (q_1-q_2)(p_B-p_A)\mathbb{D}_4 \qquad \text{(A117)}$$

The lobbying game assumes that $1 \geq q_0 \geq q_1 \geq q_2 \geq 0$, $\mathbb{L} > 0$, and $1 \geq p_i \geq 0$, i=A,B. It follows that $(1-p_A) \geq 0$, $(q_0-q_1) \geq 0$, and $(q_1-q_2) \geq 0$. Since $(q_0-q_1) \leq (1-q_1)$, it is clear that $(q_0-q_1)p_B-(1-q_1) \leq 0$. Similarly, as $(q_1-q_2) \leq (1-q_2)$, it follows that $(q_1-q_2)p_B-(1-q_2) \leq 0$. Also, conditions in (A109) and (A115) indicate that $\mathbb{D}_1 > 0$ and $\mathbb{D}_4 < 0$.

Therefore, given that $p_A \leq p_B$, each of the four terms in (A117) will be non-positive. The sum of all the terms in (A117) will also be non-positive, which contradicts the sign on the right hand side of the inequality obtained from adding (A116) and (A112). This shows that the requirements in (A109), (A110) and (A112) are not consistent and cannot be satisfied all at the same time. Therefore, the conditions in (A108) are not possible and cell(2,4) cannot be a unique Bayesian equilibrium point. ∎

Existence of Multiple Equilibria and Unique Equilibrium

From the results of the previous section, the conditions for a Bayesian equilibrium in cell(2,2), cell(2,4), cell(4,2), and cell(4,4) are described in (A56), (A69), (A94), and (A107) respectively.

Proof of Proposition 6:

Conditions in (A56) and (A107) can all be satisfied at the same time. The result is the existence of multiple equilibria or a mixed strategy equilibrium in cell(2,2) and cell(4,4). Combining the conditions in (A56) and (A107) gives

$$\begin{cases} {}_{A}\mathbb{E}_{0} < 0 \,, \\ {}_{B}\mathbb{E}_{0} < 0 \,, \\ (1-p_B)(q_0-q_1)\,{}_{A}\mathbb{E}_{0} + p_B(q_1-q_2)\,{}_{A}\mathbb{E}_{1} > 0 \,, \text{ and} \\ (1-p_A)(q_0-q_1)\,{}_{B}\mathbb{E}_{0} + p_A(q_1-q_2)\,{}_{B}\mathbb{E}_{1} > 0 \,. \end{cases} \tag{A118}$$

■

Proof of Proposition 8:

Similarly, conditions in (A69) and (A94) can all be satisfied at the same time. The result is the existence of multiple equilibria or a mixed strategy equilibrium in cell(2,4) and cell(4,2). Combining the conditions in (A69) and (A94) gives

$$\begin{cases} {}_{A}\mathbb{E}_{0} > 0 \,, \\ {}_{B}\mathbb{E}_{0} > 0 \,, \\ (1-p_B)(q_0-q_1)\,{}_{A}\mathbb{E}_{0} + p_B(q_1-q_2)\,{}_{A}\mathbb{E}_{1} < 0 \,, \text{ and} \\ (1-p_A)(q_0-q_1)\,{}_{B}\mathbb{E}_{0} + p_A(q_1-q_2)\,{}_{B}\mathbb{E}_{1} < 0 \,. \end{cases} \tag{A119}$$

■

Proof of Proposition 4:

Cell(2,2) is a unique Bayesian equilibrium point if all conditions in (A56) are satisfied and at least one of the conditions in (A107) is not satisfieu. Combining these requirements gives

$$\begin{cases} (1-p_B)(q_0-q_1)_A\mathbb{E}_0 + p_B(q_1-q_2)_A\mathbb{E}_1 > 0 \ , \\ (1-p_A)(q_0-q_1)_B\mathbb{E}_0 + p_A(q_1-q_2)_B\mathbb{E}_1 > 0 \ , \text{ and} \\ \text{at least one of } {}_A\mathbb{E}_0>0 \text{ and } {}_B\mathbb{E}_0>0 \text{ is satisfied.} \end{cases} \tag{A120}$$

■

Proof of Proposition 5:

Cell(4,4) is a unique Bayesian equilibrium point if all conditions in (A107) are satisfied and at least one of the conditions in (A56) is not satisfied. Combining these requirements gives

$$\begin{cases} {}_A\mathbb{E}_0 < 0 \ , \\ {}_B\mathbb{E}_0 < 0 \ , \text{ and} \\ \text{at least one of } (1-p_B)(q_0-q_1)_A\mathbb{E}_0 + p_B(q_1-q_2)_A\mathbb{E}_1 < 0 \text{ and} \\ \qquad (1-p_A)(q_0-q_1)_B\mathbb{E}_0 + p_A(q_1-q_2)_B\mathbb{E}_1 < 0 \text{ is satisfied.} \end{cases} \tag{A121}$$

■

Proof of Proposition 7:

Cell(4,2) is a unique Bayesian equilibrium point if all conditions in (A94) are satisfied and at least one of the conditions in (A69) is not satisfied. Combining these requirements give

$$\begin{cases} (1-p_B)(q_0-q_1)_A\mathbb{E}_0 + p_B(q_1-q_2)_A\mathbb{E}_1 < 0 \ , \\ {}_B\mathbb{E}_0 > 0 \ , \text{ and} \\ \text{at least one of } {}_A\mathbb{E}_0 < 0 \text{ and} \\ \qquad (1-p_A)(q_0-q_1)_B\mathbb{E}_0 + p_A(q_1-q_2)_B\mathbb{E}_1 > 0 \text{ is satisfied.} \end{cases} \tag{A122}$$

■

Payoff-Dominance in Multiple Equilibria

Proof of Proposition 9:

The requirements in (A118) describe the conditions for Case 4 under which both cell(2,2) and cell(4,4) can be Bayesian equilibrium points. The following analysis will show that, even though multiple equilibria are possible, cell(2,2) will always payoff-dominate cell(4,4).

Cell(2,2) will payoff-dominate cell(4,4) if ${}_{A}W_{2,2} > {}_{A}W_{4,4}$ and ${}_{B}W_{2,2} > {}_{B}W_{4,4}$. Using the expected payoffs derived previously at the beginning of this appendix,

$$
\begin{aligned}
{}_{A}W_{2,2} - {}_{A}W_{4,4} = \; & q_1 p_A p_B \mathbb{L} - q_2 p_A p_B \mathbb{L} + q_1 p_A p_B \bar{m} - q_2 p_A p_B \bar{m} - q_0 p_A p_B \underline{m} \\
& + q_1 p_A p_B \underline{m} + q_0 p_B \underline{m} - q_1 p_B \underline{m} - q_1 p_A m + q_0 p_A \underline{m} - q_1 p_A \mathbb{L} \\
& - p'_A \mathbb{L} + q_0 p'_A \mathbb{L} - q_0 \underline{m} + q_1 p_B p'_A \mathbb{L} - q_0 p_B p'_A \mathbb{L} - p_A p''_A \mathbb{L} \\
& + q_1 p_A p''_A \mathbb{L} + p_A p'_A \mathbb{L} - p_A c - q_0 p_A p'_A \mathbb{L} + q_0 p_A p_B p'_A \mathbb{L} \\
& - q_1 p_A p_B p'_A \mathbb{L} - q_1 p_A p_B p''_A \mathbb{L} + q_2 p_A p_B p''_A \mathbb{L} \\
& - q_0 p_A \mathbb{L} + q_0 p_A \bar{m} - q_0 p_A \underline{m} + p'_A \mathbb{L} - q_0 p'_A \mathbb{L} + q_0 \underline{m}
\end{aligned}
$$

$$
\begin{aligned}
= \; & p_A p_B (q_1 - q_2) \left\{ \mathbb{L} + \bar{m} - \left[\frac{(1-q_2)(p''_A - p'_A)}{(q_1 - q_2)} \right] \mathbb{L} - p'_A \mathbb{L} - \frac{c}{(q_1 - q_2)} \right\} \\
& - p_A p_B (q_0 - q_1) \left\{ \underline{m} - \left[\frac{(1-q_1)(p''_A - p'_A)}{(q_0 - q_1)} \right] \mathbb{L} - p'_A \mathbb{L} - \frac{c}{(q_0 - q_1)} \right\} \\
& + p_A (q_0 - q_1) \left\{ \mathbb{L} + \bar{m} - \left[\frac{(1-q_1)(p''_A - p'_A)}{(q_0 - q_1)} \right] \mathbb{L} - p'_A \mathbb{L} - \frac{c}{(q_0 - q_1)} \right\} \\
& + p_B (q_0 - q_1) \underline{m} - p_B (q_0 - q_1) p'_A \mathbb{L}
\end{aligned}
$$

$$= p_A p_B (q_1 - q_2)\left\{\mathbb{L} + \bar{m} - \left[\frac{(1-q_2)(p''_A - p'_A)}{(q_1 - q_2)}\right]\mathbb{L} - p'_A\mathbb{L} - \frac{c}{(q_1 - q_2)}\right\}$$

$$- p_A p_B (q_0 - q_1)\left\{\mathbb{L} + \bar{m} - \left[\frac{(1-q_1)(p''_A - p'_A)}{(q_0 - q_1)}\right]\mathbb{L} - p'_A\mathbb{L} - \frac{c}{(q_0 - q_1)}\right\}$$

$$+ p_A (q_0 - q_1)\left\{\mathbb{L} + \bar{m} - \left[\frac{(1-q_1)(p''_A - p'_A)}{(q_0 - q_1)}\right]\mathbb{L} - p'_A\mathbb{L} - \frac{c}{(q_0 - q_1)}\right\}$$

$$+ p_B (q_0 - q_1)\underline{m} - p_B (q_0 - q_1) p'_A \mathbb{L} - p_A p_B (q_0 - q_1)\underline{m}$$

$$+ p_A p_B (q_0 - q_1)\mathbb{L} + p_A p_B (q_0 - q_1)\bar{m} \tag{A123}$$

Using the notation ${}_i\mathbb{E}_j$ as defined in (9) in Chapter 2, the expression in (A123) becomes

$${}_AW_{2,2} - {}_AW_{4,4} = p_A\Big((1-p_B)(q_0 - q_1)\,{}_A\mathbb{E}_0 + p_B(q_1 - q_2)\,{}_A\mathbb{E}_1\Big)$$

$$+ p_B(1-p_A)(q_0 - q_1)\underline{m} + p_B(q_0 - q_1)(p_A - p'_A)\mathbb{L}$$

$$+ p_A p_B (q_0 - q_1)\bar{m} \tag{A124}$$

Under Case 4, according to the conditions in (A118), the first term on the right hand side of (A124) is positive. With $1 \geq q_0 \geq q_1 \geq q_2 \geq 0$, $\mathbb{L} > 0$, $\bar{m} \geq m \geq 0$, and $1 \geq p''_i \geq p_i \geq p'_i \geq 0$, $i = A, B$, it follows that each of the remaining three terms on the right hand side of (A124) is also non-negative. Therefore,

$${}_AW_{2,2} - {}_AW_{4,4} > 0 \tag{A125}$$

Similarly, regarding the payoffs to Company B management,

$$ {}_BW_{2,2} - {}_BW_{4,4} = p_B\Big((1-p_A)(q_0-q_1)\,{}_B\mathbb{E}_0 + p_A(q_1-q_2)\,{}_B\mathbb{E}_1\Big) $$
$$ + p_A(1-p_B)(q_0-q_1)\underline{m} + p_A(q_0-q_1)(p_B-p_B')\mathbb{L} $$
$$ + p_Ap_B(q_0-q_1)\bar{m} \qquad \text{(A126)} $$

and using the same arguments applied to (A125), it follows that, under the conditions for Case 4,

$$ {}_BW_{2,2} - {}_BW_{4,4} > 0 \qquad \text{(A127)} $$

Therefore, under Case 4, based on the results in (A125) and (A127), the Bayesian equilibrium in cell(2,2) will always payoff-dominate the equilibrium in cell(4,4). ■

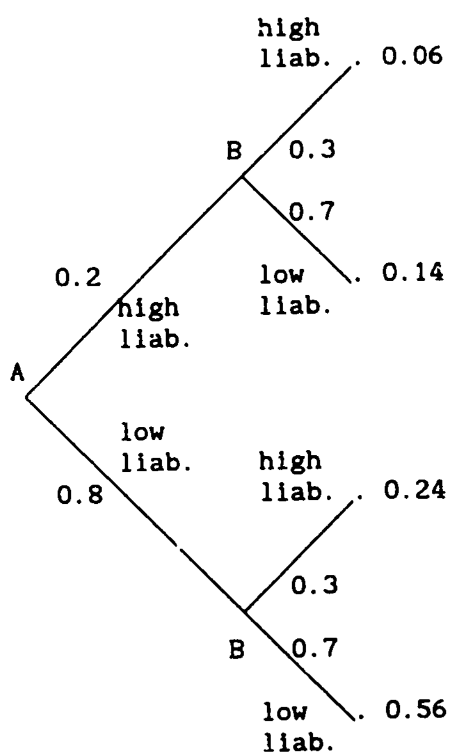
APPENDIX D

NUMERICAL EXAMPLES OF THE LOBBYING GAME

Numerical Example for Case 1

Major feature: High proprietary cost even for low liability company

q_0	=	0.9	L	=	20	p''_A	=	0.2000
q_1	=	0.8	$\bar{m}$	=	15	p''_B	=	0.3000
q_2	=	0.1	$\underline{m}$	=	12	p'_A	=	0.2000
p_A	=	0.2	c	=	1	p'_B	=	0.3000
p_B	=	0.3						



0.06 (high liab., high liab.):

	la		nl	
LA	-8.10	-9.90	-29.80	-29.20
NL	-28.80	-30.20	-31.90	-32.10

0.14 (high liab., low liab.):

	la		nl	
LA	-8.10	-7.60	-29.80	-10.80
NL	-28.80	-11.80	-31.90	-11.40

0.24 (low liab., high liab.):

	la		nl	
LA	-5.80	-9.90	-11.40	-29.20
NL	-10.40	-30.20	-11.20	-32.10

0.56 (low liab., low liab.):

	la		nl	
LA	-5.80	-7.60	-11.40	-10.80
NL	-10.40	-11.80	-11.20	-11.40

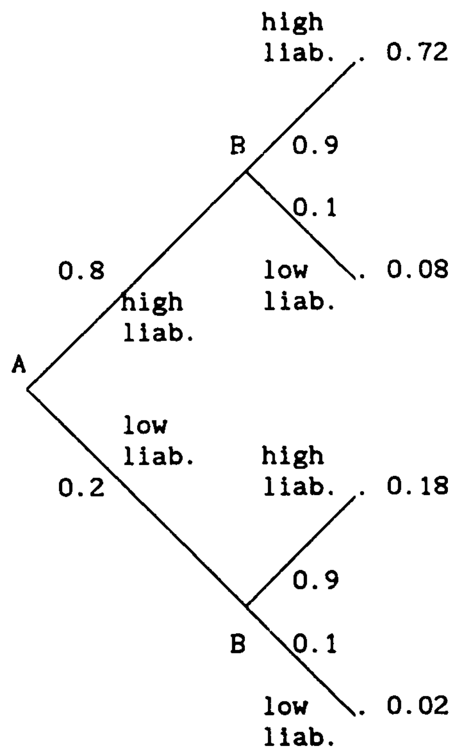
		B							
		(la,la)		(la,nl)		(nl,la)		(nl,nl)	
	(LA,LA)	-6.26	-8.29	-12.43	-10.53	-8.91	-14.08	-15.08	-16.32
A	(LA,NL)	-9.94	-15.51	-13.43	-15.74	-11.43	-17.13	-14.92	-17.35
	(NL,LA)	-10.40	-10.10	-13.97	-11.83	-11.93	-14.84	-15.50	-16.58
	(NL,NL)	-14.08	-17.32	-14.96	-17.04	-14.46	-17.89	-15.34	-17.61

Bayesian Equilibrium Point: ((LA,LA),(la,la))

Numerical Example for Case 2

Major features: Weak informational effect
High proprietary cost for high liability company

q_0 = 0.9		$\mathbb{L}$ = 20		p''_A = 1.0000	
q_1 = 0.7		$\bar{m}$ = 16		p''_B = 1.0000	
q_2 = 0.1		$\underline{m}$ = 4		p'_A = 0.0000	
p_A = 0.8		c = 1		p'_B = 0.0000	
p_B = 0.9					



High liab. (A) / high liab. (B): 0.72

	la		nl	
LA	-22.60	-22.60	-32.20	-25.20
NL	-25.20	-32.20	-32.40	-32.40

High liab. (A) / low liab. (B): 0.08

	la		nl	
LA	-22.60	-19.40	-32.20	-2.80
NL	-25.20	-9.80	-32.40	-3.60

Low liab. (A) / high liab. (B): 0.18

	la		nl	
LA	-19.40	-22.60	-9.80	-25.20
NL	-2.80	-32.20	-3.60	-32.40

Low liab. (A) / low liab. (B): 0.02

	la		nl	
LA	-19.40	-19.40	-9.80	-2.80
NL	-2.80	-9.80	-3.60	-3.60

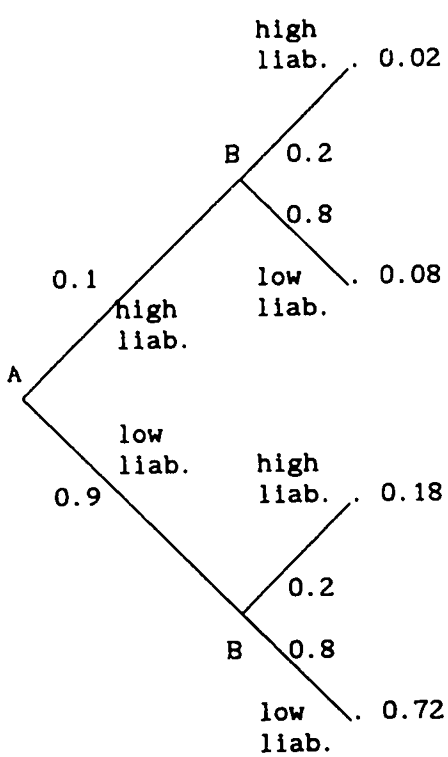
	B: (la,la)		(la,nl)		(nl,la)		(nl,nl)	
A (LA,LA)	-21.96	-22.28	-22.54	-20.62	-27.14	-24.62	-27.72	-22.96
A (LA,NL)	-18.64	-23.82	-19.42	-22.36	-25.70	-25.72	-26.48	-24.27
A (NL,LA)	-24.04	-28.42	-24.42	-27.60	-27.50	-29.04	-27.88	-28.21
A (NL,NL)	-20.72	-29.96	-21.31	-29.34	-26.05	-30.14	-26.64	-29.52

Bayesian Equilibrium Point: ((LA,NL),(la,nl))

<u>Numerical Example for Case 3</u>

Major features: Strong informational effect
Moderate proprietary cost
Obstinate standard setter

q_0	=	0.9	$\mathbb{L}$	=	20	p''_A	=	1.0000
q_1	=	0.7	$\bar{m}$	=	8	p''_B	=	1.0000
q_2	=	0.5	$\underline{m}$	=	6	p'_A	=	0.1000
p_A	=	0.1	c	=	1	p'_B	=	0.2000
p_B	=	0.2						



	la		nl	
LA	-25.00	-25.00	-26.60	-20.80
NL	-20.20	-26.60	-25.40	-25.60

	la		nl	
LA	-25.00	-14.00	-26.60	-5.40
NL	-20.20	-11.20	-25.40	-5.80

	la		nl	
LA	-14.00	-25.00	-11.20	-20.80
NL	-4.80	-26.60	-5.60	-25.60

	la		nl	
LA	-14.00	-14.00	-11.20	-5.40
NL	-4.80	-11.20	-5.60	-5.80

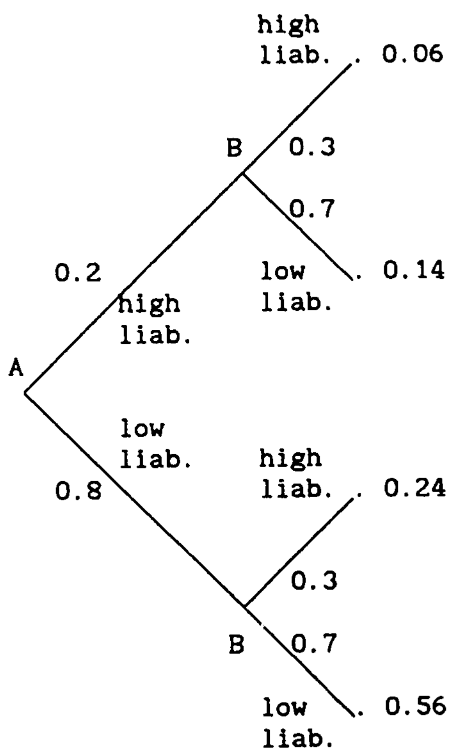
		B							
		(la,la)		(la,nl)		(nl,la)		(nl,nl)	
	(LA,LA)	-15.10	-16.20	-13.21	-9.32	-14.63	-15.36	-12.74	-8.48
A	(LA,NL)	-6.82	-14.47	-7.52	-9.90	-7.00	-14.21	-7.70	-9.63
	(NL,LA)	-14.62	-16.01	-13.02	-9.38	-14.22	-15.23	-12.62	-8.61
	(NL,NL)	-6.34	-14.28	-7.33	-9.96	-6.59	-14.08	-7.58	-9.76

Bayesian Equilibrium Point: ((NL,NL),(nl,nl))

Numerical Example for Case 4

Major features: Strong informational effect
High proprietary cost

q_0	= 0.9	L	= 20	p''_A	= 1.0000
q_1	= 0.8	$\bar{m}$	= 15	p''_B	= 1.0000
q_2	= 0.1	$\underline{m}$	= 6	p'_A	= 0.0320
p_A	= 0.2	c	= 1	p'_B	= 0.1214
p_B	= 0.3				



	la		nl	
LA	-22.50	-22.50	-33.00	-28.49
NL	-28.13	-33.00	-31.56	-31.74

	la		nl	
LA	-22.50	-19.60	-33.00	-5.29
NL	-28.13	-9.80	-31.56	-5.64

	la		nl	
LA	-19.60	-22.50	-9.80	-28.49
NL	-4.93	-33.00	-5.46	-31.74

	la		nl	
LA	-19.60	-19.60	-9.80	-5.29
NL	-4.93	-9.80	-5.46	-5.64

		B							
		(la,la)		(la,nl)		(nl,la)		(nl,nl)	
	(LA,LA)	-20.18	-20.47	-16.16	-10.45	-18.46	-22.27	-14.44	-12.25
A	(LA,NL)	-8.44	-17.50	-10.21	-13.17	-9.20	-17.56	-10.97	-13.23
	(NL,LA)	-21.31	-19.73	-16.30	-11.13	-19.16	-21.09	-14.15	-12.49
	(NL,NL)	-9.57	-16.76	-10.35	-13.85	-9.90	-16.38	-10.68	-13.47

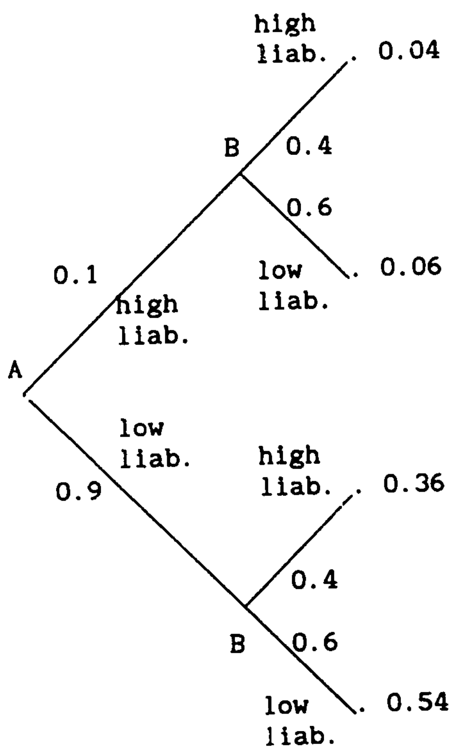
Bayesian Equilibrium Points: ((LA,NL),(la,nl)) and ((NL,NL),(nl,nl))

Note: ((LA,NL),(la,nl)) payoff-dominates ((NL,NL),(nl,nl))

Numerical Example for Case 5

Major features: Strong informational effect for one company
Moderate proprietary cost

q_0	= 0.9	L	= 20	p''_A	= 1.0000		
q_1	= 0.3	$\dot{m}$	= 8	p''_B	= 1.0000		
q_2	= 0.1	$\underline{m}$	= 6	p'_A	= 0.1000		
p_A	= 0.1	c	= 1	p'_B	= 0.0000		
p_B	= 0.4						



	la		nl	
LA	-21.80	-21.80	-23.40	-8.40
NL	-9.80	-23.40	-25.40	-25.20

	la		nl	
LA	-21.80	-19.60	-23.40	-1.80
NL	-9.80	-16.80	-25.40	-5.40

	la		nl	
LA	-19.60	-21.80	-16.80	-8.40
NL	-3.20	-23.40	-5.60	-25.20

	la		nl	
LA	-19.60	-19.60	-16.80	-1.80
NL	-3.20	-16.80	-5.60	-5.40

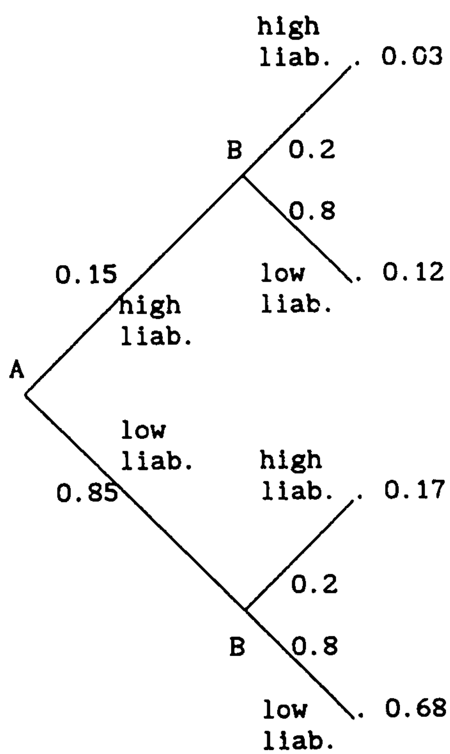
	B								
		(la,la)		(la,nl)		(nl,la)		(nl,nl)	
A	(LA,LA)	-19.82	-20.48	-18.40	-9.80	-18.88	-15.12	-17.46	-4.44
	(LA,NL)	-5.06	-19.54	-6.45	-12.32	-5.99	-19.66	-7.38	-12.43
	(NL,LA)	-18.62	-20.38	-18.04	-10.08	-18.24	-15.62	-17.66	-5.33
	(NL,NL)	-3.86	-19.44	-6.09	-12.60	-5.35	-20.16	-7.58	-13.32

Bayesian Equilibrium Point: ((NL,NL),(la,nl))

Numerical Example for Case 6

Major features: Strong informational effect
Moderate proprietary cost

q_0	= 0.9	L	= 20	p''_A	= 1.0000
q_1	= 0.3	$\bar{m}$	= 8	p''_B	= 1.0000
q_2	= 0.1	$\underline{m}$	= 6	p'_A	= 0.0114
p_A	= 0.15	c	= 1	p'_B	= 0.0899
p_B	= 0.2				



	la		nl	
LA	-21.80	-21.80	-23.40	-9.66
NL	-8.56	-23.40	-25.22	-25.38

	la		nl	
LA	-21.80	-19.60	-23.40	-3.06
NL	-8.56	-16.80	-25.22	-5.58

	la		nl	
LA	-19.60	-21.80	-16.80	-9.66
NL	-1.96	-23.40	-5.42	-25.38

	la		nl	
LA	-19.60	-19.60	-16.80	-3.06
NL	-1.96	-16.80	-5.42	-5.58

		B							
		(la,la)		(la,nl)		(nl,la)		(nl,nl)	
	(LA,LA)	-19.93	-20.04	-18.22	-6.81	-19.50	-17.61	-17.79	-4.38
A	(LA,NL)	-4.94	-18.41	-7.48	-8.79	-5.57	-18.38	-8.12	-8.77
	(NL,LA)	-17.94	-19.75	-18.04	-7.16	-17.97	-17.75	-18.06	-5.15
	(NL,NL)	-2.95	-18.12	-7.30	-9.14	-4.04	-18.52	-8.39	-9.54

Bayesian Equilibrium Points

in pure strategies: ((LA,NL),(nl,nl)) and ((NL,NL),(la,nl))

in mixed strategies: A randomizes between (LA,NL) and (NL,NL) at (0.935,0.065); B randomizes between (la,nl) and (nl,nl) at (0.605,0.395); generating expected payoffs of (-7.73,-8.82)