PROFIT SHARING IN AUDIT PARTNERSHIPS

by

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ABSTRACT

Academics call the problem that arises when individuals in a partnership take actions inconsistent with the partnership's collective interest the "moral hazard problem". This thesis examines how an audit partnership (i.e., partners as a whole) uses profit sharing rules to induce optimal partner behavior in performing various tasks, and thereby maximize the welfare of the partnership.

The analysis is undertaken in different market structures: a competitive market and an oligopolistic market, which are intended to capture the different markets for the non-Big Five audit firms and the Big Five audit firms. Non-cooperative game theory is used to analyze the strategic interaction of partners within a partnership, as well as the strategic interaction of firms when the market is an oligopoly.

In the oligopolistic market setting, it is assumed that clients are different in that the efficient audits of different types of clients require different effort profiles (i.e., different mix of auditors' effort-inputs); however, it is too costly, if not impossible, for an independent party like a court to verify each client's type, and thus client type cannot be used for partner compensation purposes. Under this assumption, I derive conditions under which there exists an equilibrium where audit firms strategically choose different profit sharing rules to specialize in different types of clients, and thereby earn positive economic profits. As a result of specialization, firms have different clienteles, and may provide audits of different quality and charge different audit fees for the same type of client. The analytical results help explain the observed differences in compensation plans among the Big Five audit firms, and provide insights into the differences in the audit services provided by the Big Five firms. This thesis also provides some empirical evidence consistent with the theory developed in this study.

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CHAPTER 1:

INTRODUCTION

1.1 Background and motivation of the study

This study examines incentives and profit sharing rules in audit partnerships and their implications for the audit market. This first chapter gives some background about audit firms and the auditing industry, explains the motivation of the study, and provides an overview of the thesis.

Auditors play an important role in the capital market. In corporations with separation of ownership and control, managers generally have superior information relative to investors about the financial conditions and profitability of the companies. When their self-interests conflict with the investors' interests, managers may provide fraudulent financial reports, resulting in socially wasteful investments and financial damages to investors. The information asymmetry and the conflicts of interest between investors and managers create a demand for audits performed by independent certified accountants (i.e., the auditors). In the U.S., Statement of Auditing Standard No. 82 (AICPA 1997), titled *Consideration of Fraud in a Financial Statement Audit*, states that auditors should "prepare a plan and perform an audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether caused by error or fraud." By detecting material misstatements in managers' financial reports, auditors help

improve investment decisions and the allocation of resources in the economy. The recognition of the value of audits can be found in regulations on mandatory audits. For example, the Securities Exchange Commission (SEC) in the U.S. requires that all the public companies appoint auditors to verify managers' financial reports. As a former SEC Commissioner Wallman (1995, 81) remarked, "Without accountants to ensure the quality and integrity of financial information, the markets for capital would be far less efficient, the cost of capital would be far higher, and our standard of living would be lower."

Auditors normally operate in audit firms organized as partnerships. Like other rational players in the economy, auditors make decisions to maximize their own economic interests, which are influenced by the reward and control systems of the firms in which they operate. Therefore, understanding the functioning, especially the compensation schemes, of audit firms is crucial to our understanding of auditors' behavior.

An audit firm, also called an accounting firm, is a partnership where professionally certified accountants work cooperatively as partners.[1] On the one hand, a partner performs his audits individually as an engagement auditor; on the other hand, partners provide help and consultation to each other in the performance of audits. The economic benefits from partner cooperation provide a rationale for auditors to form a partnership rather than to operate independently as sole proprietorships. In fact, the main reason cited by practitioners for the merger of auditors (and audit firms) is to exploit cooperation among auditors to appeal to larger and more complex clients.[2] van Breda (1997-98), in

[1]Partners and auditors are used interchangeably in this study.

[2] Clients and companies are used interchangeably in this study.

his review essay of Cypert's book on the merger that created KPMG, summarized Cypert's view about the motivation behind the merger and remarked: ". . . accountants have throughout history set up their firms near their clients. In recent years, clients have gone global forcing accounting firms to think globally and creating the climate for the mergers . . . ."

The profit of an audit firm is the difference between revenues and operating expenses, including expenses associated with legal liabilities. Audit fees are the main source of revenues.[3] Legal liabilities are a major deduction from revenues to determine profits. The magnitude of legal liability has become a great concern to audit firms in the past two decades. Mednick and Peck (1994) report that the (then) Big Six firms spent 7.7% of their revenues on litigation costs in 1990. This percentage increased to 9% and 10.9% in 1991 and 1992, respectively.

In the U.S., driven by the liability crisis in the 1990's, many accounting partnerships, including the Big Five, have changed their organization forms to limited liability partnerships (LLPs). LLP laws shield a partner's *personal* wealth from claims related to other partners' clients. That is, an auditor is not personally liable for the wrongful acts and omissions of his partners who are not under his direct supervision and control, but he remains personally liable for his own wrongful acts and omissions.[4] However, the limited liability shields apply only when the partnership is liquidated. In other words, the LLP laws do not protect the firm's assets and the partners' capital from legal claims. Moreover, in the U.S., states generally require that the LLPs maintain "security" for

[3] Traditionally, audit firms also provide consulting services. However, in this thesis, I restrict my analysis to audit services.

[4] For reference about LLP statutes in the U.S., please see Thompson 1997.

future liabilities through insurance[5] or a trust or bank escrow containing cash or cash equivalents. In California, for example, an audit firm must maintain a security of $100,000 multiplied by the number of licensed professionals in the firm, up to $5 million. In many states, an audit firm may satisfy the security requirements by certifying that its net worth is above the required amount.[6] The security requirements serve as a safeguard for claims brought against a firm. In addition to satisfying the security requirements, a firm usually voluntarily allocates a percentage of the firm's profit to the firm's capital every year to keep the firm financially strong (see MaCann 2000).

The LLP laws and security requirements imply that all the partners of a firm are liable for the firm's legal liabilities until the firm is liquidated and its capital and security funds are used up. How does the firm (i.e., partners as a whole) allocate the legal liabilities among partners to ensure that individual partners expend adequate effort – which cannot be contracted on directly – in the performance of audits? If, for example, the legal liabilities associated with an audit are shared among firmwide partners, the engagement partner's effort level can be expected to fall short of the optimal level from the firm's perspective because he does not fully bear the consequences of his effort choice. This is where the so-called "moral hazard problem" in partnerships arises (Holmstrom 1982). In a single task setting, the moral hazard manifests itself as the shirking problem (or the free-riding problem), which is caused by the situation that each partner fully bears the pain of his own effort yet shares the benefit of his effort with others. More generally, a moral hazard problem in a partnership refers to the problem that

[5] The insurance company generally asks for personal guarantees.

[6] For a detailed discussion of the security requirements, please see Wood (1997, 99-105).

individual partners take actions inconsistent with the partnership's collective interests due to the conflicts of interest between the individuals and the partnership as a whole.

The main objective of this study is to analyze moral hazard problems in an audit firm, and investigate how the firm (i.e., partners as a whole) uses profit sharing rules, which base individual partners' compensation on their performance – as reflected by audit fee revenues and liabilities from lawsuits – to induce optimal partner behavior from the firm's point of view, and thereby maximize the firm's welfare.

In the auditing industry, audit firms have been divided into two groups according to brand name or size: the Big Five[7] versus non-Big Five. The Big Five control the majority of services for publicly held companies. In the U.S., they together audit about 80% of publicly held companies and a large percentage of large publicly held companies. On the other hand, in the U.S., there are about 50,000 local and regional audit firms (see McCann 2000), which mainly audit small local companies. Given that the number of non-Big Five firms is large, it is reasonable to assume that the market for these firms is competitive. However, since there are only five firms that have a brand name reputation and dominate the market for the audits of publicly held companies, it is unlikely that the competition of the Big Five is perfect competition, and that each firm earns zero economic profits.

The strategic competition of the Big Five has not been extensively analyzed or well understood. What prevents perfect competition? What instruments do firms use to compete? This study explores the possibility that firms use compensation plans as

[7] The Big Five audit firms include Arthur Andersen (AA), KPMG, Ernst & Young (EY), Deloitte Touche Tohmatsu (DTT), and PricewaterhouseCoopers (PWC). The number of "Big" audit firms has shrunk from eight to five through mergers in the 1980s and 1990s, with the possible elimination of Arthur Andersen from the group due to the recent Enron debacle.

strategic instruments to compete in an oligopolistic market, and provides an explanation for the observed differences in the compensation plans of the Big Five firms.

The differences in the compensation schemes of the Big Five firms have been documented in a number of studies. Based on his survey in the late 1980's, Trompeter (1988) classifies the compensation plans of the (then) Big Eight audit firms into "small pool" and "large pool" plans according to the importance of "Local Office Profitability" in determining partner compensation. He reports:

> *For Local Office Profitability, there is an interesting dichotomy in the responses. Office managing partners from three of the firms deemed this component unimportant in determining partner compensation. These firms base partner compensation on firmwide profitability as opposed to officewide profitability. Partners from the other firms rated this factor very important.* (Trompeter 1988, 85)

Burrow and Black (1998, 524) also report differences in compensation schemes of the (then) Big Six audit firms, based on their interviews with partners from the Melbourne offices of the Big Six in 1995. In particular, they find that, in KPMG, partners from the Melbourne office share only in the Melbourne office profit pool, while in Arthur Andersen partners from the Melbourne office share in the worldwide profit pool.

Why do the Big Five audit firms, generally viewed as a homogenous group, use different compensation schemes? How do different compensation plans affect individual partners' behavior and the outcome of competition? By addressing these questions, this study sheds light on competition and the differences among the Big Five firms.

1.2 Literature review

In this section, I review the studies on incentive problems in (audit) partnerships in the economics literature and in the accounting literature. In the economics literature, moral hazard in partnerships was first formally analyzed by Holmstrom (1982). He illustrates that, when effort is not contractible, each partner will free ride on other partners' effort. As a result, Pareto efficiency cannot be attained in equilibrium. Most of the work on this subject following Holmstrom (1982) has focused on searching for technical conditions under which Pareto efficiency can be attained or approximated, with limited attention paid to economic reality. I now briefly review a few papers that are examples of this literature.

Rasmusen (1987) examines a deterministic partnership, i.e., the relation between the outcome of the partnership and partners' effort-inputs is deterministic. He shows that if partners are risk averse, Pareto efficiency may be restored by using a "massacre" contract, which punishes all but one *randomly* chosen partner when the outcome implies that someone shirks.

Legros and Matthews (1993) also examine a deterministic partnership. They find that Pareto efficiency may be approximated through a penalty contract if the distribution of the outcome is such that, when one partner uses mixed strategies, the identity of the partner who shirks will be revealed with positive probability.

Legros and Matsushima (1991) study a stochastic partnership. They provide necessary and sufficient conditions under which Pareto efficiency can be sustained through a penalty contract, assuming that each partner's action space is finite, and that

partners are not symmetric, i.e., their actions have sufficiently different effects on the distribution of the outcome.

Radner (1991) analyzes a deterministic partnership in a repeated game. He shows that if the outcome fully reveals the identity of the partner who shirks, and if the discount rate is sufficiently low, then the Pareto efficient outcome can be sustained for the repeated partnership in an equilibrium composed of the so-called "trigger strategies". Specifically, each partner uses the Pareto efficient effort strategy until the first period when some partners deviate; then partners will use the inefficient one-period equilibrium strategy forever. The change to the inefficient strategy merely serves as a threat and will not be carried out in equilibrium.

Green and Porter (1984) construct a model to explain "price wars" between oligopolistic firms. I review their study here because the model has often been applied to contractual problems in partnerships (see Narayanan 1995). They model a repeated Cournot game in a stochastic setting. In the model, each firm's payoff depends on its own output and the market price, which is determined by the total output and the consumers' stochastic demand. The equilibrium is characterized by "trigger-price strategies", which consist of the output x, the "trigger price" y, and the number of punishment periods T. Specifically, each firm produces output x until the period when the price is less than the "trigger price" y. Then, firms will start a punishment phase in which they each produce the inefficient one-period equilibrium output for T periods. They will switch back to producing x after the T periods end. Unlike the "trigger strategies" in the deterministic case, here the "punishment phase" will be realized in equilibrium. The equilibrium

outcome is an improvement over the inefficient one-period equilibrium outcome, although it is worse than the Pareto efficient outcome.

These models have limited usefulness in addressing incentive problems in audit firms, because they do not capture the real world features of audit firms. First, and most importantly, these studies do not model the production process and partners' activities in real life partnerships, such as law firms, audit firms, and consulting firms. Second, these models assume that only the total outcome is contractible. Yet, in an audit firm not only is the total outcome contractible, but also revenues and legal liabilities associated with individual partners' audits are contractible. Third, these models are mainly concerned with single action decision settings, but auditors engage in multiple tasks, such as exerting effort in performing audits and assisting each other in the performance of audits. Lastly, these models treat partnerships in an isolated manner, without considering the structure of the market in which they operate. However, in an oligopoly, we expect that a firm will consider other firms' compensation strategies when selecting its own compensation plans. Nevertheless, the general idea and methodology developed in prior studies have laid the foundation for this study. As in these studies, I view a partnership as a nexus of contracts (Coase 1937) among self-interest maximizing individuals, and use non-cooperative game theory to analyze individual partners' behavior.

In the accounting literature, an audit firm is normally treated as if it were a single person (i.e. "the auditor"), not a partnership organization. There are very few studies on the functioning of audit firms. Two theoretical papers examining audit firms as partnerships are by Balachandran and Ramakrishnan (1987) and Narayanan (1995).

Balachandran and Ramakrishnan (1987) study the effects of the merger of auditors on audit fees. They view the client and the auditor as the principal and the agent, respectively, and focus on the agency problem between the principal and the agent. In particular, they study how the audit fee structure changes in response to improved risk sharing after the merger of two auditors. Three assumptions on which the theory is based may lack a real-world basis. First, they assume the audit fee is contingent on ex post audit outcomes. That is, the principal can use an audit fee schedule contingent on different combinations of the audit opinion and the nature of the company, which is revealed ex post. In the real world, however, the audit fee does not depend on the outcomes of an audit. Second, they assume that the only benefit from the merger is improved risk sharing. In other words, there are no technological benefits from the merger, which does not seem to be consistent with the reasons cited by practitioners for mergers. Third, they assume there is no moral hazard problem between partners within the firm. This seems to conflict with the real world observation that auditors' effort is private information and is not contractible.

Narayanan (1995) investigates moral hazard problems in an audit partnership. His analysis is based on the model developed by Green and Porter (1984). The author assumes that only the total outcome of the audit firm is contractile, and that partners receive *exogenously determined* shares of the outcome. The equilibrium is characterized by "trigger strategies": an outcome below a certain level triggers a punishment phase in which all the partners shirk. All the partners shirking in the punishment phase has dire litigation consequences, and does not seem to reflect the real-world situation in an audit firm. Recognizing this unappealing feature of the equilibrium, in the second part of the

paper, the author considers costly investigation and expulsion. However, binary effort levels and the investigation technology that generates no wrongful expulsion are crucial to his results.

There are two experimental/empirical studies examining the relation between the compensation schemes of the (then) Big Eight audit firms and auditors' reporting decisions. Based on the "large pool" and "small pool" classification, Trompeter (1994) and Carcello, Hermanson, and Huss (2000) investigate the effects of the different compensation schemes on the reporting decisions of partners from different firms. Both studies hypothesize that partners from "small pool" firms are more likely to compromise independence, compared with partners from "large pool" firms. In his *experimental* study, Trompeter (1994) finds that partners from "small pool" firms are less likely to require clients to make income decreasing adjustments than partners from "large pool" firms. Carcello, Hermanson, and Huss (2000) examine the effects of different compensation plans on partners' going-concern opinions. They find that when client size is relatively large, partners from "small pool" firms are less likely to issue going-concern opinions to stressed clients than partners from "large pool" firms. In both studies, the authors do not contemplate the effects of compensation plans on partners' effort choices. Furthermore, they do not attempt to explain why the Big Eight firms use different compensation schemes.

The review of the economics and accounting literature shows that very little research has been done in exploring the incentives and contracting issues in audit firms. Consequently, we have little understanding of the functioning of audit firms and the

effects of the firms' reward and control systems on auditors' behavior. This study seeks to provide insights into this topic.

1.3 Overview of the thesis

In Chapter 2, I consider a competitive audit market and investigate moral hazard problems and contractual problems –i.e., how partners optimally choose profit sharing rules – in a competitive audit firm.

For expositional convenience, I consider two-partner audit firms. The model has the following ingredients. First, to capture the real world situation wherein the performance of an audit often involves cooperation among partners in the firm, I assume the efficient provision of an audit requires teamwork. In particular, I assume that the quality of an audit, represented by the likelihood of detecting material misstatements in the manager's financial report, is a function of partners' joint effort-inputs in the audit, with the engagement partner's effort being the essential effort.

Second, the production in an audit firm is viewed as a two-stage process. In the first stage (i.e., the soliciting stage), each auditor solicits clients individually. It is assumed that the number of engagements an auditor obtains depends only on his selling effort. In the second stage (i.e., the auditing stage), auditors expend effort in performing audits and helping each other in the performance of audits. In addition, before the production begins, partners jointly choose profit sharing rules.

Third, I assume a fixed audit fee contract, i.e., the audit fee is determined before the audit is performed. Observe that in a competitive market, individual auditors take the audit fee as given, although all the auditors together determine the equilibrium audit fee.

I examine the partnership's problem in two scenarios: effort is contractible and non-contractible. The focus is on the latter scenario because in the real world, an auditor's effort choice cannot be verified and thus cannot be contracted on directly. The analysis of the former scenario is intended to provide a benchmark for comparison purposes.

When effort is contractible, partners jointly choose effort levels – including selling effort, auditing effort, and helping effort – to maximize the welfare of the partnership as a whole. Such effort levels are by definition Pareto efficient, and can be enforced through a penalty contract. In contrast, when effort is not contractible, each partner takes actions to maximize his own compensation – as determined by the firm's profit sharing rules – net of personal effort costs. Profit sharing rules considered in this study are linear in the audit fee revenues and legal liabilities associated with different auditors' clients.

The analysis shows the effects of the firm's compensation plan on individual partners' effort choices in performing various tasks, and the moral hazard problems with respect to different kinds of effort. In particular, a fixed audit fee contract implies that the revenues an auditor gets from an audit are fixed when he makes an effort choice for the audit. Thus, his effort decision for the audit is independent of the revenue-sharing rule, which specifies how partners share the audit fee revenues associated with the audit. On the other hand, how much effort he puts forth in an audit depends on the degree to which he is individually liable for the potential legal liabilities associated with the audit. Thus, the auditor's effort-input in an audit is a function of the liability-sharing rule, which specifies how partners share the legal liabilities associated with the audit.

It is shown that there does not exist a liability-sharing rule that perfectly aligns the individual's interest with the partnership's interest in the performance of an audit. That is,

the equilibrium effort profile for an audit (i.e., the mix of partners' equilibrium effort-inputs in an audit) differs from the Pareto efficient effort profile regardless of the choice of liability-sharing rules. This reflects moral hazard problems with respect to partners' effort choices – including auditing effort and helping effort – in the performance of an audit.

In soliciting clients, each partner chooses the amount of selling effort to maximize his personal payoff, anticipating the effort choices in the next stage (i.e., the auditing stage). The analysis shows that there may also exist a moral hazard problem with respect to auditors' selling effort. In particular, if a partner collects all the revenues from his audits, yet shares with his partner the legal liabilities associated with his audits, then he will be too aggressive in pursuing clients, which actually reduces the welfare of the firm as a whole. The reason lies in the discrepancy between the auditor's personal cost of an audit and the firm's cost (i.e., the cost to the partners as a whole). Specifically, when calculating the personal cost of an audit, the auditor only partially considers the expected legal liabilities associated with the audit – due to the liability sharing – and completely ignores his partner's cost of helping effort. This implies that the personal cost of an audit is less than the firm's cost. Therefore, if he is fully rewarded for the revenues from his engagements, the auditor's personal payoff from the audit will exceed the firm's payoff; as a result, he tends to exert too much selling effort from the firm's perspective. Further, I show that an auditor's personal payoff from an audit is positively related to his share in the revenues from his own engagements.

The analysis of the relations of the liability-sharing rule and the revenue-sharing rule to various effort decisions is crucial to our understanding of the firm's optimal choice of

compensation structure. In choosing profit sharing rules, the partners' objective is to exploit these relations to induce optimal partner behavior from the firm's point of view, and thereby maximize the welfare of the firm as a whole.

I find that the liability-sharing rule and the revenue-sharing rule play different roles in inducing optimal partner behavior. Recognizing the relation between the liability-sharing rule and auditors' effort-inputs in an audit, the firm uses the liability-sharing rule to induce appropriate amounts of teamwork in the performance of audits. As a result, the optimal liability-sharing rule requires each auditor to share some of the legal liabilities associated with his partner's audits. In the meantime, the revenue-sharing rule is chosen to induce optimal selling effort. It is shown that the optimal revenue-sharing rule also requires each auditor to share some of the revenues associated with his partner's audits. The reason is that without revenue sharing, an auditor's personal payoff would exceed the firm's payoff from an audit, and thus he would over-invest his selling effort. These results may explain why in practice "Eat what you kill" (see MaCann 2000), which bases each partner's compensation only on his engagement profits, is not a good compensation method.

Furthermore, the analysis shows that the moral hazard problem with respect to auditors' selling effort is overcome by the optimal revenue-sharing rule, but Pareto efficiency in the performance of audits cannot be restored under the optimal liability-sharing rule. Thus, compared with the benchmark case in which effort is contractible, any welfare loss due to the non-contractibility of information (about effort choices) results only from the inefficiency in the performance of audits.

Chapter 3 extends the analysis to an oligopolistic market setting and provides insights into the choice of compensation plans by the Big Five firms. The basic model setup is as follows. There are two audit firms in the economy, with two partners in each firm operating separately in offices located in two geographically different places. A partner is assumed not to solicit clients outside the place where his office is located. The production in an audit firm is viewed as a two-stage process. In the first stage (i.e., the bidding stage), in each location, auditors from different firms compete in bidding for clients. Unlike the competitive setting depicted in Chapter 2, since there are only two suppliers in each location, they have the market power to influence the audit price. In the second stage (i.e., the auditing stage), in each firm, auditors expend effort in performing audits and assisting each other in the performance of audits.

Two assumptions are crucial to the analysis. First, as in Chapter 2, I assume the efficient provision of an audit involves teamwork. Second, unlike in Chapter 2, I assume clients are different in that the efficient audits of different types of clients require different amounts of partner collaboration, namely different mix of partners' effort-inputs. This assumption is motivated by the real-world situation that, relative to the non-Big Five firms, the Big Five firms audit a much broader range of companies. The audits of different types of companies are likely to require different mix of partners' effort-inputs. For example, the audit of a local company is likely to involve less partner cooperation compared with the audit of an international company. To simplify the analysis, I assume there are two types of clients.

The analysis shows that, for each type of client, the auditors' decision problems in the two-stage production process are similar in spirit to the problems described in

Chapter 2, and thus the characterization of the relationships between profit sharing rules and auditors' various decisions is similar to that in Chapter 2.

I find that firms' equilibrium compensation strategies are different depending on whether client type is contractible. In the ideal case in which client type is contractible, firms can use client type specific sharing rules to induce appropriate partner behavior for different types of clients simultaneously. In fact, I show that firms have the same dominant strategy consisting of client type-specific sharing rules. The optimal liability-sharing rule induces the effort profile that maximizes the value of an audit (i.e., the joint surplus for shareholders and the audit firm) for every type of client, while the optimal revenue-sharing rule ensures that individual partners bid in the firm's interest for every type of client. The dominant strategy equilibrium is a perfect competition equilibrium in that, for each client, auditors from competing firms provide audits of the same quality, bid the same price (which equals the firms' costs), and earn zero economic profits.

However, the assumption that client type is contractible may not be a realistic description of the real world situation, since the client's characteristics that determine its type are in general non-contractible. For example, the risk of (financial statement) fraud, which may affect the audit technique,[8] depends on many factors that are too costly, if not impossible, to be verified to a court. Moreover, in reality we do not observe firms basing a partner's compensation on client type. Therefore, I believe that client type is not likely to be contractible, and thus cannot be used for partner compensation purposes.

Because client type is not contractible, audit firms cannot use type-specific compensation schemes to induce the optimal effort profile (i.e., the optimal mix of partners' effort inputs) for

[8] Audit technique describes the functional relationship between the audit quality and the mix of partners' effort-inputs in an audit.

both types of clients simultaneously. Yet, the seeming contracting disadvantage may actually work to both firms' advantage. I identify conditions under which there exists an equilibrium – which I refer to as a specializing equilibrium – where firms strategically choose different profit sharing plans to specialize in different types of clients. In equilibrium, each firm gains limited monopoly power over the clients in which it specializes, and earns positive economic profits. Moreover, both the audit quality and the audit price may differ between the competing firms for the same type of client. This suggests that, contrary to the general perception that the Big Five are a homogeneous group, they may differ in many aspects of the audit services they provide.

The idea of using compensation schemes to influence the individuals' behavior in an organization and thus the outcome of competition in an oligopoly is not new. For example, Fershtman and Judd (1987) show that, in an oligopolistic market, the owners of rival firms strategically choose incentive structures for their managers to affect the output decisions (or the pricing decisions) of the competing managers and thus the outcome of competition of firms.[9]

Furthermore, the idea of oligopolistic firms developing specializations in a market where services are differentiated is related to the spatial competition model in the economics literature (see Herter and Lederer 1985). The spatial competition model was first applied to the analysis of competition in an auditing oligopoly by Chan, Feltham, and Simunic (1999, CFS hereafter). In their model, CFS assume that clients differ in many dimensions that affect the costs of audit, such as client size, the complexity of the client's operations, the client's

[9] Other papers with similar ideas include Brander and Lewis (1986) and, in an international trade context, Brander and Brander (1983, 1985).

geographic locations, and the riskiness of client operations. They derive an equilibrium in which audit firms strategically choose different "locations" in the client characteristic space so that they each specialize in different types of clients. As a result, firms gain cost advantages over competitors with respect to the clients in which they specialize and earn positive economic rents.

There are several differences between my study and CFS' study. First, CFS view an audit firm as a single profit maximizing person, whereas I view an audit firm as a partnership consisting of individual auditors, and my analysis is based on the relation between the firm's behavior (i.e., its choice of compensation structure) and individual auditors' behavior. Second, they consider the investments in specializations as the strategic instruments used by competing firms, while I consider the compensation plans as the strategic instruments. Third, they assume there exist adjustment costs that prevent firms from being efficient for all types of clients, while in my study the non-contractibility of client type plays a similar role. Lastly, in their basic analysis of audit production and auditor choice, they focus on differences in audit costs, assuming audit quality is constant across client types, while I focus on differences in the shareholder surplus, and allow both the quality and the cost of an audit to vary with the client's characteristics and the audit firm's characteristics (i.e., compensation plans).

Chapter 4 of this thesis provides some empirical evidence consistent with the theory developed in Chapter 3. From the interviews with partners from Arthur Andersen and KPMG, I learned that these two firms use different profit sharing rules, consistent with observations made in prior studies. Based on the theory, I then conjecture that Arthur Andersen and KPMG have different clienteles (i.e., specialize in different types of clients), and provide services of different quality for the same type of client. The overall evidence supports the conjecture. In

particular, I find a (statistically) significant positive association between the company's total assets and the odds ratio between hiring Arthur Andersen versus KPMG, suggesting that Arthur Andersen may specialize in the large company sector, while KPMG may specialize in the relatively small company sector. In addition, tests based on accounting accruals and litigation rates provide some evidence that, relative to KPMG, Arthur Andersen provides higher quality services for the large size companies, and lower quality services for the small size companies.

The remaining chapters are organized as follows. Chapter 2 and Chapter 3 examine the compensation schemes of audit firms in a competitive audit market and in an oligopolistic audit market, respectively. Based on the theory developed in Chapter 3, Chapter 4 investigates differences between oligopolistic firms empirically. Chapter 5 concludes the thesis.

CHAPTER 2:

PROFIT SHARING IN A COMPETITIVE AUDIT FIRM

In this chapter, I consider a competitive audit market and study profit sharing rules in a competitive audit firm. In the firm, a partner's costly effort affects the welfare of the partnership, but is not verifiable. More specifically, contractible performance measures, such as individual partners' engagement profits, are not perfectly separable in partners' effort choices because the provision of an audit involves teamwork. In this situation, a partner's effort decision, which maximizes his own compensation net of his effort costs, may not maximize the partnership's collective interest. This is where the so-called "moral hazard problem" in a partnership arises. This chapter investigates moral hazard problems in a competitive audit firm, and shows how an audit firm (i.e., partners as a whole) uses profit sharing rules to align individual partners' interests with the firm's collective interest so as to maximize the welfare of the firm as a whole.

Section 2.1 presents the model and enumerates key assumptions. Section 2.2 examines the ideal case where effort is contractible. Section 2.3 analyzes the realistic case where effort is non-contractible, and characterizes optimal (linear) profit sharing rules. Section 2.4 concludes the chapter.

2.1 The model

2.1.1 The agency problem between shareholders and managers

Consider a one period economy that consists of identical two-partner audit firms and companies owned by shareholders and operated by managers. All agents in the economy are risk neutral. At the beginning of the period, shareholders of each company decide whether to continue or liquidate the company. A company is either a good or bad project, denoted by a 'g' or 'b' company, depending on its financial conditions. The prior probability that a company is a 'g' company is $\varphi \in (0,1)$. The interest rate is normalized to zero. A 'g' company is worth $V_g > 0$ if liquidated now, or returns $V > V_g$ at the end of the period if continued. A 'b' company is worth $V_b > 0$ if liquidated now, or returns zero if continued. Therefore, if shareholders knew the nature of the companies, they would liquidate 'b' and continue 'g' companies. However, only the company's manager privately observes the nature of the company. The focus of my analysis is on the audit firms' problems, and the agency problem between shareholders and managers is mainly exogenously specified.

Assumptions about managers are as follows. All the managers of 'g' companies prefer continuation to liquidation, and hence report 'g' to shareholders. A proportion of the managers of 'b' companies also prefer continuation to liquidation and report 'g'. The proportion is denoted by $\xi \in (0,1]$. Shareholders cannot pay a manager negative

compensation except through litigation. The end-of-period personal wealth of a dishonest manager is represented by $w \in [0, V_b)$.[1]

To distinguish between the manager's report and the nature of the company, let 'G' and 'B' denote the manager's 'g' report and 'b' report, respectively. Clearly, given a 'B' report, shareholders dissolve the company voluntarily. Given a 'G' report, shareholders choose between continuation and liquidation. If they approve continuation yet the company is actually a 'b' company, they suffer losses in the amount of V_b. The amount of losses they may recover through litigation against the manager is w. Assume it is optimal for shareholders to continue the company with a 'G' report. That is,

$$prob(g|G)V + prob(b|G)w > prob(g|G)V_g + prob(b|G)V_b, \tag{2.1}$$

where $prob(g|G) = \phi \equiv \dfrac{\varphi}{\varphi + (1-\varphi)\xi}$, and $prob(b|G) = 1 - \phi$.

2.1.2 Audit activity

Now consider the situation where shareholders may hire an auditor to verify the manager's 'G' report. Observe that when the manager reports 'B', shareholders dissolve

[1] The literature often assumes that w equals zero. I allow w to be positive because a manager may possess some personal wealth at the end of the period that can be used towards restitution payment. Here is a simple scenario as an example of management fraud. Suppose that, with some probability $\xi \in (0,1]$, the continuation of a company provides the manager with \$1 million worth perquisites or benefits from self-serving activities, such as related party transactions and insider trading. Shareholders cannot pay the manager negative compensation except through litigation. The manager's end-of-period wealth is \$0.5 million, which represents the maximum amount of penalty he can pay in the event of litigation. Litigation occurs when the manager provides a misstated financial report, and the shareholders suffer damages as a result of decisions made based on the manager's report. In this scenario, it is optimal for the manager of a 'b' company who has self-serving opportunities to commit fraud if his objective is to maximize his total economic payoff.

the company voluntarily, and there is no need for an audit. It follows that shareholders purchase an audit only if the manager reports 'G'.

Consider the performance of an audit in an audit partnership. An important assumption is that the efficient provision of an audit requires teamwork. In the real world, there are many ways cooperation among partners may improve the efficiency of an audit. For example, the audit of a company operating in multiple industries may require collaboration of partners with complementary industry expertise. In addition, decisions made in the performance of an audit are often affected by individual auditors' biases and random factors. Mutual reviews are useful in controlling these risks. In fact, the main reason cited by practitioners for the sole proprietorships to merge into a partnership is to exploit cooperation among auditors so as to provide services more efficiently to complex and risky clients. The recognition of the benefit of partner cooperation can be found in regulations that made cooperation among partners mandatory in some circumstances. For example, since 1977, the SEC in the U.S. has required that all audits of publicly held companies undergo second partner reviews prior to the issuance of audit opinions. Moreover, since 1999, the SEC Practice Section of the AICPA has set a new regulation for its member firms regarding second partner reviews for the SEC foreign registrants. Specifically, a firm is required to appoint its U.S. partners to review the fillings of foreign registrants audited by partners operating in offices outside the U.S.. Many firms already conducted such internal reviews before this regulation came into effect (The panel on audit effectiveness 2000, 151).

To capture teamwork in auditing, I assume that the audit quality, which is represented by the likelihood of detecting the material misstatement in the manager's

financial report, is a function of partners' joint effort-inputs in the audit, with the engagement partner's effort being the essential effort. Formally, for a client, let $e \in [0, \bar{e}]$ denote the level of auditing effort by the engagement auditor, and $c \in [0, \bar{c}]$ the level of helping effort by the other auditor. Effort is measured in terms of personal costs. The probability of detection given a misstated financial report, denoted by μ, is a function of partners' joint effort-inputs in the audit:

$$\mu : [0, \bar{e}] \times [0, \bar{c}] \rightarrow [0,1].$$

$\mu(e,c)$ is assumed to have the following properties.[2]

Assumption 2.1: $\mu(0,c) = 0$ for all c; $\mu(e,c) = 1$ if, and only if, $(e,c) = (\bar{e}, \bar{c})$.

Assumption 2.2: $\mu_e(e,c) > 0$ for all (e, c); $\mu_c(e,c) \geq 0$ for all (e, c), with strict inequality if $e > 0$.

Subscripts e and c represent derivatives. The first part of Assumption 2.1 means that the engagement auditor's effort is essential, in that the probability of detection is zero if the engagement auditor's effort is zero regardless of the level of his partner's helping effort. The second part of Assumption 2.1 means that a perfect audit is conducted (i.e., the probability of detection is one) if, and only if, both partners' effort levels attain the upper bounds. Assumption 2.2 means that the probability of detection is increasing in effort.

An engagement auditor may issue two kinds of opinions: qualified or unqualified. I assume that the auditor will not find any misstatement in the manager's report when there

[2] Similar assumptions can be found in Itoh (1991), who models mutual help between agents in a principal-agent setting.

is indeed none. This implies that the auditor always issues an unqualified opinion on the 'G' report from the manager of a 'g' company.[3] On the other hand, when a perfect audit is not economically feasible, there is some chance that the auditor fails to detect the misstatement. The auditor may face litigation consequences if he detects the misstatement but issues an unqualified opinion. Therefore, when detecting the misstatement, the auditor will insist that the manager correct it; otherwise, he will issue a qualified opinion and notify the shareholders.[4] The dishonest manager will correct the misstatement when it is detected, since he gains no benefit from refusing to do so. Thus, only an unqualified 'G' or an unqualified 'B' report is issued to shareholders.[5]

Audit failure refers to the situation in which the manager's 'G' report is misstated but the auditor fails to detect the misstatement. Audit success refers to either of the two situations: (a) the manager's 'G' report is true, and (b) the manager's 'G' report is misstated but the auditor detects the misstatement.

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[3] The real world situation is more complex because there may exist immaterial errors in the report prepared by a manager who reports truthfully. Nevertheless, the assumption of no type 1 error, i.e., an auditor will not conclude that the report is materially misstated when it is not materially misstated, prevails in the literature (see Dye 1993, Schwartz 1997). As specified in Section 350 of Statements on Auditing Standards (AICPA 1989, AU350.13), the risk of incorrect rejection during statistical sampling affects the efficiency of the audit, not the effectiveness of the audit. Specifically, if the auditor rejects a fairness assumption when in fact the financial statement is not materially misstated, "the application of additional audit procedures and consideration of other audit evidence would ordinarily lead the auditor to the correct conclusion."

[4] An engagement auditor can choose zero effort in the performance of the audit. Observe that the strategy of working and then "shredding evidence" is always (weakly) dominated by the strategy of not working and issuing an unqualified opinion. This implies that I can restrict the analysis to the situation where an auditor always provides an opinion consistent with the evidence obtained from the audit process (including no evidence).

[5] This is consistent with the fact that the SEC does not allow companies to file financial reports with qualified opinions.

2.1.3 Legal liabilities

I model the legal regime based on the U.S. legal regime, which consists of out-of-pocket damage measure, and negligence and proportionate liability rules.[6] The out-of-pocket damage measure implies that financial damages are measured as the losses suffered by shareholders as a result of their decisions made based on a misstated financial report; the damages in the current case are equal to V_b, namely the shareholders' investment in a bad project. The negligence liability rule implies that when an audit failure occurs, the audit firm is held liable if the jury finds that it fails to exert due care. Since due care is not definitively specified ex ante, whether or not the audit firm is negligent depends on the jury's ex post judgment. Assume that the higher the audit quality, the less likely the audit firm is found negligent. That is, the probability of being found negligent conditional on an audit failure, denoted by ψ, is a decreasing function of audit quality: $\psi \equiv \psi(\mu)$ and $\frac{d\psi}{d\mu} < 0$. Additionally, assume that, if the engagement auditor puts forth zero effort, it is certain that the audit firm is found negligent, namely $\psi(0) = 1$. The Private Securities Litigation Reform Act of 1995 in the U.S. requires the jury to allocate a plaintiff's losses among the defendants based on their relative responsibility. Accordingly, I assume that the liability allocated to the audit firm, denoted

[6] See Schwartz (1997) for a detailed discussion of the out-of-pocket damage measure and vague negligence rule in the U.S. legal regime.

by l, is a proportion of the total damages, i.e., $l = \nu W_b$, where $\nu \in (0, 1]$ is the percentage of fault assigned to the audit firm.[7]

2.1.4 The manager's problem

Consider the manager's problem in the presence of an audit. Assume that $w < (1-\nu)V_b$, i.e., a dishonest manager's end-of-period wealth is less than the restitution payment ordered by a court. This assumption is consistent with the fact that, more often than not, the fraudsters are impecunious compared with the shareholders' losses.

For simplicity, I assume that the reporting policy of a manager remains the same as in the no audit setting. This assumption may seem restrictive as one would expect that the action of hiring an auditor might change the manager's reporting policy. However, it is not unreasonable in some situations like the one considered here. In the current setting, this assumption may be justified for two reasons. First, a dishonest manager will not be penalized when the auditor detects the misstatement in his financial report, since the shareholders cannot pay the manager negative compensation except through litigation, but they have no basis to sue the manager for misreporting when they do not suffer damages. Second, the restitution payment made by a dishonest manager in a lawsuit does

[7] For simplicity, I assume ν is a known parameter. The factors considered in determining the percentage of responsibility among the defendants include "(i) the nature of the conduct of each covered person found to have caused or contributed to the loss incurred by the plaintiff or plaintiffs; and (ii) the nature and extent of the causal relationship between the conduct of each such person and the damages incurred by the plaintiff or plaintiffs."(The Private Securities Litigation Reform Act of 1995) The first factor is the nature of the conduct. The nature of the conduct refers to "negligence" or "fraud". The second factor seems to be closely related to the first factor. Accordingly, I assume that the allocation of the liability given that the audit firm is found negligent depends on the nature of the conducts of the audit firm and the manager, not on effort levels. In the context of this model, the nature of the auditor's conduct is negligence, and the nature of the manager's conduct is fraud. Therefore, ν is assumed to be a known parameter. Nevertheless, assuming that ν is a function of audit quality – note that audit quality is a function of partners' joint effort inputs – will not qualitatively change the analytical results.

not depend on whether or not the audit firm is found negligent because he has limited end-of-period wealth, i.e., $w < (1-v)V_b$. To see this, note that in the no audit setting, the penalty paid by the manager who provides fraudulent report is his end-of-period wealth w. In the audit setting, if the restitution payment made by the manager is also w regardless whether the audit firm is found negligent, then the manager who finds it optimal to lie in the no audit setting should stick to the same strategy in the audit setting. The "if" condition is satisfied because $w < (1-v)V_b$.

2.1.5 The shareholders' problem

Now consider the shareholders' problem. Let $\ddot{G}$ and $\ddot{B}$ denote unqualified 'G' and unqualified 'B' reports, respectively. If the shareholders receive a $\ddot{B}$ report, they will liquidate the company because there is no type 1 error (i.e., there is no incorrect rejection of the manager's truthful report). With a $\ddot{G}$ report, the shareholders' expected payoff from continuation is

$$prob(g|\ddot{G})V + prob(b|\ddot{G})(w + \psi l),$$

where $prob(g|\ddot{G}) = \dfrac{prob(g|G)}{prob(g|G) + prob(b|G)prob(\ddot{G}|b)} = \dfrac{\phi}{\phi + (1-\phi)(1-\mu)}$, and

$prob(b|\ddot{G}) = 1 - prob(g|\ddot{G}) = \dfrac{(1-\phi)(1-\mu)}{\phi + (1-\phi)(1-\mu)}$. Note that V is the expected amount collected by shareholders from the investment in the company given an unqualified 'G' report and a good outcome, while $(w + \psi l)$ is the expected amount collected by shareholders through litigation from the manager and the audit firm given an unqualified 'G' report and a bad outcome.

In contrast, with a $\ddot{G}$ report, the shareholders' expected payoff from liquidation is

$$prob(g|\ddot{G})V_g + prob(b|\ddot{G})V_b .$$

From (2.2) below we know that, given a $\ddot{G}$ report, the shareholders get a higher expected payoff from continuation than from liquidation. Thus, with a $\ddot{G}$ report, the shareholders will continue the company.

$$\begin{aligned}
&\phi V + (1-\phi)(1-\mu)(w+\psi l) \\
&= \phi V + (1-\phi)w - \mu(1-\phi)w + (1-\phi)(1-\mu)\psi l \\
&> \phi V_g + (1-\phi)V_b - \mu(1-\phi)w + (1-\phi)(1-\mu)\psi l \\
&> \phi V_g + (1-\phi)V_b - \mu(1-\phi)V_b + (1-\phi)(1-\mu)\psi l \\
&> \phi V_g + (1-\phi)(1-\mu)V_b .
\end{aligned} \tag{2.2}$$

The first inequality in (2.2) comes from the substitution from inequality (2.1). The second inequality holds because $w < V_b$.

Let f denote the audit fee. I assume a fixed audit fee contract, i.e., the audit fee is determined before the audit is performed. As will be shown later, the audit fee is determined endogenously in the equilibrium. The assumption of a fixed audit fee contract is consistent with many real world observations. An audit fee survey of 31 clients of the Big Five, conducted by the Committee on Corporate Reporting (CCR) in 1999, shows that a majority of the clients are able to negotiate fixed fees with their auditors before audits are performed.[8] In a study on the form of audit fee contracts, Palmrose (1989) finds that 51 percent of her sample companies (for 1980-1981 time period) use fixed audit fee contracts as opposed to cost-reimbursement contracts. She finds that auditors with fixed fee contracts tend to charge lower audit fees than those with cost-

[8] The survey information is obtained from the Financial Executives International website at http://www.fei.org/finrep/news.cfm.

reimbursement contracts. However, she notes that audit hours do not seem to be less for companies with fixed fee contracts. In addition, she shows that a greater number of fixed fee contracts appear in earlier years of auditor/client alignments, implying that fixed fee contracts may be a result of competition for clients.

Given the manager's 'G' report, the shareholders' ex ante payoff without purchasing an audit is $\phi V + (1-\phi)w$, while their payoff from purchasing an audit is

$$\begin{aligned} &prob(\ddot{G})[prob(g|\ddot{G})V + prob(b|\ddot{G})(w+\psi l)] + prob(\ddot{B})V_b - f \\ &= \phi V + (1-\phi)(1-\mu)(w+\psi l) + (1-\phi)\mu V_b - f. \end{aligned}$$

Comparing the shareholders' payoffs with and without an audit, we know that the shareholders' surplus (i.e., their incremental payoff) from purchasing an audit is

$$(1-\phi)\mu(V_b - w) + (1-\phi)(1-\mu)\psi l - f,$$

which equals the expected savings of the wasteful investment in a bad project, plus the expected recovery of damages from the audit firm through litigation, less the audit fee. An audit is valuable to shareholders if, and only if, the shareholder surplus is positive.

2.1.6 The audit firm's problem

So far, limited attention has been given to how auditors coordinate their productive activities in an audit partnership. I now focus on the audit firm's problem. I number the two partners in the firm auditor 1 and auditor 2. The production process in the firm can be seen as a two-stage process. In the first stage (also referred to as the soliciting stage), auditors expend effort in soliciting clients individually. In the second stage (also referred

to as the auditing stage), they cooperate in auditing clients obtained in the previous stage.[9]

In the soliciting stage, an auditor acts as a sales person, engaging in activities to sell his services, including learning about the companies and communicating with representatives of the shareholders. His action in this stage is characterized by the level of the selling effort, denoted by $a \in [0, \bar{a}]$. The auditor's selling effort is client-specific, and hence has little effect on the outcome of his partner's selling effort. Thus, I assume the outcomes of different auditors' selling effort are independent.

For auditor i, let n_i denote the number of clients he obtains. Assume that the expected number of clients he obtains is a function his selling effort a_i:

$$E(n_i | a_i) \equiv r = r(a_i), \; i \in \{1, 2\}.$$

Note that $r \geq 0$. Assume $r(a)$ has the following properties:

Assumption 2.3: $r(0)=0$ if, and only if, $a=0$; $r(a)$ is strictly increasing and concave in a.

Assumption 2.4: $r_a(0) \to +\infty$; $r_a(\bar{a}) \to 0$.

[9] For expositional convenience, I assume partners take sequential actions in soliciting clients and performing audits; however, the analytical results do not depend on this simplification. For example, an auditor can audit one client and solicit another client at the same time as long as effort is separable in different tasks. The assumption about sequential actions may indeed reflect the real world situation: Auditors seem to have different focuses of their work in different periods in a year. During the busy season (e.g., year-ends), they concentrate on performing audits, and concentrate on selling services during the off-season.

Assumption 2.3 means increasing benefit of effort and decreasing marginal benefit of effort. Assumption 2.4 is technical and is made to ensure an interior solution.

The following serves as an example in which the assumed relationship between the selling effort and the expected outcome of the selling effort holds. Let $\overline{N}_i$ denote the number of clients auditor i solicits, $\phi(n_i|a_i, \overline{N}_i)$ denote the probability of obtaining n_i clients given a_i and $\overline{N}_i$. Assume that $\phi(n_i = 0|a_i = 0) = 1$, and that $\phi(n_i = \overline{N}_i|a_i, \overline{N}_i) = 1$ if $r(a_i) \geq \overline{N}_i$. That is, the auditor obtains no clients if he exerts no effort at all, and obtains as many as the number of clients he solicited if $r(a_i) \geq \overline{N}_i$. Since he would not waste his effort, we have $r(a_i) \leq \overline{N}_i$. In addition, the number of clients obtained when $0 < r(a_i) < \overline{N}_i$ is assumed to have a binomial distribution:

$$\phi(n_i|a_i) = \binom{\overline{N}_i}{n_i}\left(\frac{r(a_i)}{\overline{N}_i}\right)^{n_i}\left(1 - \frac{r(a_i)}{\overline{N}_i}\right)^{\overline{N}_i - n_i}, \; n_i = 0, 1, \ldots, \overline{N}_i, \; i \in \{1, 2\}$$

where $\frac{r(a_i)}{\overline{N}_i} \in (0, 1)$, and represents the probability of success in obtaining a client. To summarize,

$$\phi(n_i|a_i, \overline{N}_i) = \begin{cases} 1 & \textit{if } r(a_i) = 0, \textit{ for } n_i = 0, \\ \binom{\overline{N}_i}{n_i}\left(\frac{r(a_i)}{\overline{N}_i}\right)^{n_i}\left(1 - \frac{r(a_i)}{\overline{N}_i}\right)^{\overline{N}_i - n_i} & \textit{if } 0 < r(a_i) < \overline{N}_i, \textit{ for } n_i = 0, 1, \ldots, \overline{N}_i, \\ 1 & \textit{if } r(a_i) = \overline{N}_i, \textit{ for } n_i = \overline{N}_i. \end{cases}$$

Clearly, in this example, the expected number of clients partner i obtains depends only on his aggregate effort a_i:

$$E(n_i|a_i) = r(a_i), \; i \in \{1, 2\}.$$

In the auditing stage, partners exert effort in performing audits and assisting each other in the performance of audits. Let $p(e, c)$ denote the probability that an audit firm incurs zero liability for an audit: $p(e,c) = 1-(1-\phi)(1-\mu(e,c))\psi(\mu(e,c))$. I make the following assumptions about $p(e, c)$.

Assumption 2.5: $p(e,c)$ is strictly concave over $((0,\bar{e}),\ (0,\bar{c}))$;

Assumption 2.6: $p_{ec} > 0$ for all $(e,c) > (0,0)$;

Assumption 2.7: $p_e(0,c) \to +\infty$, and $p_c(e,0) \to +\infty$ provided e > 0; $p_e(\bar{e},c)l < 1$ for all c, and $p_c(e,\bar{c})l < 1$ for all e.

Assumption 2.5 implies decreasing marginal benefit of effort. The main justification for this assumption is that some inputs in the production process are fixed (e.g., supporting staff and office facilities). Assumption 2.6 implies that the marginal benefit of an auditor's effort is increasing with his partner's effort. Assumption 2.7 implies that the marginal benefit of effort is infinite at zero level, and is very small at the upper bound. This technical assumption is made to ensure an interior solution.

It is useful to distinguish between "accounting profit" and "economic profit". The accounting profit of a partnership refers to the difference between the (audit fee) revenues and legal liabilities of the firm,[10] while the economic profit equals the accounting profit minus auditors' effort costs. The accounting profit is verifiable, whereas the economic

[10] Other operating expenses, such as staff wages, rents, and utilities, are assumed fixed; therefore, they are ignored in the analysis.

profit is verifiable only if effort is verifiable. Consistent with conventional use of profit as in "profit sharing", profit in this study refers to accounting profit unless otherwise noted.

I now analyze auditors' equilibrium effort choices, incentive problems, and the firm's profit sharing rules. For comparison purposes, I begin with the ideal case in which effort is contractible.

2.2 Benchmark: Effort contractible

When effort is contractible, partners jointly choose effort levels to maximize their collective welfare, and can enforce the effort choices by a threat of penalty. The effort levels jointly chosen are by definition Pareto efficient. Applying the general approach to a multiple stage problem, I solve for the efficient effort choices through backward induction.

In the auditing stage, since the random factors affecting the outcomes of different audits are independent, the decision problems for different audits are independent. For an arbitrarily chosen client, the partners' problem is to choose an effort profile (i.e., a mix of auditors' effort-inputs in an audit) to minimize the sum of the expected legal liabilities associated with the audit and effort costs, or equivalently, to maximize the expected *savings* of legal liabilities net of effort costs.[11] Note that with a fixed audit fee contract, the effort decisions are independent of the audit fee. Formally, the partners' decision problem is

[11] When an audit firm incurs legal liabilities, auditors also suffer reputation costs in terms of lost future clients. Addressing reputation effects is beyond the scope of this study. This study deals with a one period model and focuses on the legal liabilities as a motivational device for inducing partners to exert effort in performing audits.

$$\underset{e\in[0,\bar{e}],c\in[0,\bar{c}]}{Maximize}\ p(e,c)l-e-c\,. \tag{2.3}$$

Assumptions 2.5 to 2.7 ensure a unique and interior solution. The efficient effort profile, denoted by (e^o,c^o), is determined by the following conditions:

$$p_e(e,c)l-1=0\,, \tag{2.4}$$

$$p_c(e,c)l-1=0\,, \tag{2.5}$$

where $p_e(e,c)=\dfrac{\partial p(e,c)}{\partial e}$, $p_c(e,c)=\dfrac{\partial p(e,c)}{\partial c}$.

Now move back to the soliciting stage. Let κ^o denote the expected cost of an audit:

$$\kappa^o\equiv\kappa(e^o,c^o)=(1-p(e^o,c^o))l+e^o+c^o\,,$$

which consists of the expected legal liabilities related to the audit and both partners' effort costs incurred in the provision of the audit. Let π^o denote the expected payoff from an audit. Thus,

$$\pi^o\equiv\pi(e^o,c^o)=f-\kappa(e^o,c^o)\,.$$

The Pareto efficient levels of selling effort maximize the firm's welfare:

$$\underset{a_1\in[0,\,\bar{a}],\ a_2\in[0,\,\bar{a}]}{Maximize}\ \pi^o E(n_1+n_2|a_1,\,a_2)-a_1-a_2 \tag{2.6}$$

Given that the outcomes of auditors' selling effort are independent, the efficient effort choice, denoted by a^o, is the same for both partners. Assumptions 2.3 and 2.4 imply that a^o is unique and interior, and is determined by

$$(f-\kappa(e^o,c^o))r_a(a)-1=0\,, \tag{2.7}$$

where $r_a(a)=\dfrac{\partial r(a)}{\partial a}$.

In a competitive market, the equilibrium audit fee is determined by having the partnership earn the sum of the auditors' reservation wages. The auditor's reservation wage is assumed to be $\bar{u} > 0$. Let f^o denote the equilibrium audit fee, which is determined by

$$2[(f - \kappa(e^o, c^o))r(a^o) - a^o] = 2\bar{u}. \tag{2.8}$$

(2.7) and (2.8) combined imply that the equilibrium audit fee is $f^o = \kappa^o + \frac{\bar{u} + a^o}{r(a^o)}$, where a^o is determined by $\frac{r(a)}{r_a(a)} = \bar{u} + a$. Clearly, the equilibrium selling effort a^o is independent of κ^o or f^o.

From the analysis in Section 2.1.5, we know that the shareholders' surplus (i.e., the incremental payoff) from purchasing an audit is

$$(1-\phi)\mu(e^o, c^o)(V_b - w) + (1-\phi)(1-\mu(e^o, c^o))\psi(\mu(e^o, c^o))l - f^o.$$

Given that the auditor's expected payoff is a constant, the value of an audit can be measured by the shareholder's surplus from purchasing the audit.

Proposition 2.1: *The equilibrium audit fee is increasing in audit cost κ. Moreover, when the legal regime is strict and joint-and-several liability,*[12] *and when the manager is insolvent, i.e., when $\psi = v = 1$ and $w = 0$, the value of an audit is equal to $(1-\phi)V_b$ minus the equilibrium audit fee.*

[12] Strict liability means that the audit firm is liable for the shareholders' losses whenever there is an audit failure, regardless of the auditors' effort and care (*i.e.*, $\psi = 1$). Joint-and-several liability implies that the audit firm pays for all the losses if the manager is insolvent. Thus, $v = 1$ *when* $w = 0$.

Proof: (All proofs appear in Appendix 1.)

Proposition 2.1 characterizes the relation between the equilibrium audit price and the audit cost and, with the strict and joint-and-several liability regime and impecunious managers, the relation between the value of an audit and the audit price. The positive relation between the audit fee and audit cost is intuitive: the higher the audit cost, the more the shareholders have to pay for the service. The second part of Proposition 2.1 holds because if the audit firm pays for all the shareholders' losses whenever there is an audit failure, which is implied by the strict and joint-and-several liability regime with impecunious managers, then the shareholders' gross benefit from purchasing an audit is $(1-\phi)V_b$, as if they bought a full service guarantee from the audit firm. In this case, the shareholders' surplus, and thus the value of an audit, depends only on the audit fee, which is decreasing in the firm's audit cost. The results here will help us make welfare comparisons between the benchmark case and the case where effort is non-contractible.

2.3 Effort not contractible

I now consider the more realistic case in which effort is not verifiable, and thus the firm cannot base a partner's compensation on his effort choices. In performing a task, the partner's objective is to maximize his personal welfare, which equals his compensation less his effort costs. Since the firm's profit sharing rules affect the partner's compensation, they affect the partner's effort decisions, and ultimately the welfare of the partnership as a whole. A main objective of this section is to investigate how profit

sharing rules are used to align the individual's interest with the firm's interest to induce the optimal decisions from the firm's point of view.

2.3.1 Linear sharing rule

Profit sharing rules considered in this study are linear, i.e., each partner's compensation is a linear function of the revenues and legal liabilities associated with different auditors' engagements. I restrict myself to a linear contracting framework for two reasons. First, it is almost impossible to find the optimal compensation contract, as there are too many contingencies to incorporate in the contract. Thus, linear sharing rules are considered for tractability of the analysis. Second, linear sharing rules seem to have a basis in the real world. As Coase (1937) suggested, a firm may not be able to write a contract based on all verifiable events because of the prohibitively high transaction costs involved in enforcing such a contract. This may explain why, in practice, firms use simple compensation schemes. In fact, many compensation formulas used in audit firms can be translated to linear sharing rules as will be shown later in this section.

A firm's budget-balancing[13] linear sharing rule can be written as follows

[13] "Budget balancing" requires that the sum of individual partners' compensation equal the firm's profit.

$$y_i = \alpha_i R_i + (1-\alpha_j)R_j - \beta_i L_i - (1-\beta_j)L_j + \eta_{ij},$$ [14]

where

i, j : partners in the firm, $i \neq j,\ i, j \in \{1, 2\}$,

y_i : partner i's compensation,

$R_i \geq 0$: revenues related to the clients audited by partner i;

$L_i \geq 0$: legal liabilities related to the clients audited by partner i;

α_i: finite incentive weight assigned to revenues related to the clients audited by partner i;

β_i: finite incentive weight assigned to legal liabilities related to the clients audited by partner i;

η_{ij}: lump sum transfer between partners, $\eta_{12} = -\eta_{21}$.

The liability-sharing rule, represented by β, specifies how partners share each other's legal liabilities, and the revenue-sharing rule, represented by α, specifies how partners share each other's revenues. α and β may not be the same, meaning partners may share revenues and liabilities in different ways.

[14] If there are more than two partners, then the linear sharing rule is $y_i = \alpha_i R_i + \sum_{j \neq i} \alpha_{ij} R_j - \beta_i L_i - \sum_{j \neq i} \beta_{ij} L_j + \sum_{j \neq i} \eta_{ij}$, where α_{ij}, $j \neq i$, represents partner i's share of partner j's revenues, and β_{ij}, $j \neq i$, represents partner i's share of partner j's legal liabilities. Note that $\alpha_j + \sum_{i \neq j} \alpha_{ij} = 1$ and $\beta_j + \sum_{i \neq j} \beta_{ij} = 1$, $\forall j$.

In his article on partner compensation in audit firms, McCann (2000), a partner of an audit firm, characterizes the good and the bad compensation formulas. The bad formulas, which he views as shortsighted and flawed, include the following.

(a) "Eat what you kill". This formula bases a partner's compensation on the net profits he generated.

(b) "Ownership heavy". This formula pays a partner based on his capital invested in the firm.

(c) "Equal (no guts) strategy". This formula pays all partners equally.

(d) "Discretionary free-for-all (fight-it-out approach)". Under this formula, partners meet once a year to divide the net profit of the firm. As MacCann (2000, 53) commented, "This method gives an advantage to dominant, intimidating personalities. Obviously the partners with the most client-fee revenue, the most power and the loudest voice will walk away with the most money."

The good formulas include the following:

(a) "points system". Under this method, the firm divides the profit into two parts. The first part is allocated based on some predetermined criterion that is not related to a partner's performance, such as ownership. The second part is called the bonus pool, which is allocated based on performance as reflected by fee revenues and evaluations by the compensation committee.

(b) "Three-piece combination". This formula is similar to the "points system" except that the "Three-piece combination" method leaves more of the firm's profit open for profitability-based compensation. Specifically, under the "Three-piece combination" method, the first part of the profit is allocated based on ownership,

the second part is based on the profit contribution of each partner, and the last part is based on some discretionary factors.

It is easy to see that the "Equal strategy" and the "Ownership heavy" method can be expressed as linear sharing rules. Below are two more examples showing the connection between these real world formulas and linear sharing rules.

Example 2.1 ("Eat what you kill"): Consider a partnership with M partners. They base each partner's compensation only on his net engagement profits.

This contract is equivalent to a linear contract with $\alpha_i = 1, \beta_i = 1$, $\eta = 0$, $i \in \{1, 2, ..., M\}$.

Example 2.2 ("Three-piece combination'): Consider a partnership with M partners. Each partner's share of the ownership is x_i, $i \in \{1, 2, ..., M\}$. Their profit sharing rule goes as follows: u_1 percent of the profit is allocated based on ownership; u_2 percent of the profit is allocated based on each partner's net engagement profit; and the rest is allocated based on seniority. The relative seniority of each partner is denoted by λ_i. All numbers are expressed as percentages. Thus

$$\sum_{i \in \{1,...,M\}} x_i = \sum_{i \in \{1,...,M\}} \lambda_i = 1.$$

Under this contract, each partner's compensation is

$$y_i = [x_i u_1 + \lambda_i (1 - u_1 - u_2) + u_2](R_i - L_i) + [x_i u_1 + \lambda_i (1 - u_1 - u_2)] \sum_{j \neq i} (R_j - L_j).$$

Therefore, this contract is equivalent to a linear sharing rule with

$$\alpha_i = \beta_i = x_i u_1 + \lambda_i (1 - u_1 - u_2) + u_2, \ \eta = 0, \ i \in \{1, 2, ..., M\}.$$

2.3.2 Auditors' game and strategic decisions

In the partnership, the auditors' game is a non-cooperative game in that they each maximize their own economic interests in making decisions. The timeline of the game is described as follows.

Stage 0: Partners choose profit sharing rules.

Stage 1: Each auditor chooses an effort level in soliciting clients.

Stage 2: Each auditor chooses effort levels in performing audits and helping his partner in the performance of audits.

Finally, outcomes are revealed, and partners are compensated according to the sharing rules specified in Stage 0.

From a game theoretical point of view, this game consists of two proper subgames: the whole game itself and the game starting at Stage 1. A proper subgame is a part of the game that can be treated as a game in its own right.[15] Technically, a proper subgame requires that the subgame start with an information set that is a singleton, which means that the player who moves at that point can distinguish the other party's actions in the previous stage. The game starting at Stage 1 forms a proper subgame, since the profit sharing rules selected in Stage 0 become public knowledge when partners take actions in subsequent stages. However, the game starting at Stage 2 does not form a proper subgame. The reason is that each auditor does not know his partner's effort choice made in Stage 1 when he makes his own effort choices in Stage 2, except that he knows that his

[15] For a rigorous definition of the proper subgame, please refer to Fudenberg and Tirole (1991, 94).

partner has put forth a positive amount of selling effort if he observes his partner has a positive number of engagements. Therefore, the auditor's effort choices in Stage 2 could be contingent on his belief about his partner's effort choice in Stage 1.

In solving the game, I look for a subgame perfect Nash equilibrium (see Fudenberg and Tirole 1991, 95). That is, the equilibrium strategy profile is not only a Nash equilibrium for the whole game, but the restriction of the strategy profile to the subgame starting at Stage 1 is also a Nash equilibrium for every choice of profit sharing rules.

Stage 2's problem: effort choices in the performance of audits

In Stage 2, auditors cooperate in auditing clients they obtained in the previous stage. Because audit fees are fixed prior to the provision of services, an auditor's decision problem in this stage is not affected by his belief about his partner's selling effort in Stage 1. In choosing the effort-input in an audit, an auditor's objective is to maximize his share of the expected *savings* of the legal liabilities associated with the audit net of his personal effort costs, treating sharing rules and his belief about his partner's effort-input in that audit as given. Let symbols with hats denote beliefs. To illustrate, consider partners' decision problems for one of auditor 1's clients:

$$\underset{e\in[0,\bar{e}]}{Maximize}\ \beta_1 p(e,\hat{c})l - e, \tag{2.9}$$

$$\underset{c\in[0,\bar{c}]}{Maximize}\ (1-\beta_1)p(\hat{e},c)l - c\ . \tag{2.10}$$

(2.9) describes auditor 1's decision problem, and (2.10) the decision problem of auditor 2, who is the helping partner with regard to this client.

I will restrict β_1 to nonnegative values. The reason is as follows. If $\beta_1 \leq 0$, then both auditors put forth zero effort in the audit. Hence, they can always replace $\beta_1 < 0$ with $\beta_1 = 0$ to induce the same effort profile.

If $\beta_1 \in (0,1)$, from Assumptions 2.5 to 2.7 I obtain auditors' single-valued reaction curves $e(\hat{c})$ and $c(\hat{e})$ defined by (2.11) and (2.12) respectively[16]:

$$\beta_1 p_e(e,\hat{c})l - 1 = 0, \tag{2.11}$$

$$(1-\beta_1)p_c(\hat{e},c)l - 1 \leq 0, \text{ with equality if } \hat{e} > 0. \tag{2.12}$$

Clearly, the amount of effort an auditor puts forth in an audit is contingent on his belief about his partner's effort-input in that audit. Moreover, $\frac{de}{d\hat{c}} = -\frac{p_{ec}}{p_{ee}} > 0$ and $\frac{dc}{d\hat{e}} = -\frac{p_{ce}}{p_{cc}} > 0$ (provided effort levels are positive). This implies the reaction curves are increasing, and thus the auditors' effort-inputs in an audit are strategic complements. The equilibrium effort profile for the audit is determined by the intersection of the reaction curves.

Let the first subscript stand for the partner, and the second subscript the client. For example, c_{jk}, $k \in \{1,...,n_i\}$, represents the helping effort expended by auditor j for one of auditor i's clients. The equilibrium effort profiles in the performance of audits are characterized in Proposition 2.2.

[16] An auditor's reaction curve specifies how he responds to the other auditor's action.

Proposition 2.2: *Given a compensation contract characterized by* $\{\beta_1, \beta_2\}$, *the equilibrium is such that, for auditor i's clients,* $i \in \{1,2\}$, *an auditor chooses the same unique level of effort – auditing effort or helping effort – for each audit, i.e.,* $e_{ik}^* = e_i^*$, $c_{jk}^* = c_j^*$, $k \in \{1,...,n_i\}$, $j \neq i$, $i, j \in \{1,2\}$. *If* $\beta_i = 0$, *then* $e_i^* = c_j^* = 0$. *If* $\beta_i \geq 1$, *then* $e_i^* \in (0,\bar{e}]$, $c_j^* = 0$. *If* $\beta_i \in (0,1)$, *then* $e_i^* \in (0,\bar{e})$, $c_j^* \in (0,\bar{c})$, *and* (e_i^*, c_j^*) *are determined by the following conditions:*

$$\beta_i \, p_e(e,c)l - 1 = 0, \tag{2.13}$$

$$(1-\beta_i)p_c(e,c)l - 1 = 0, \tag{2.14}$$

where $p_e(e,c) = \dfrac{\partial p(e,c)}{\partial e}$, $p_c(e,c) = \dfrac{\partial p(e,c)}{\partial c}$.

Proposition 2.2 illustrates that the equilibrium effort profile for an audit (i.e., the equilibrium mix of auditors' effort-inputs in an audit) is a function of the firm's liability-sharing rule. In other words, the amount of effort an auditor puts forth in an audit is determined by the extent to which he is individually responsible for the legal liabilities associated with the audit. He will be reluctant to invest any effort in doing tasks when incentives are absent. For example, if $\beta \geq 1$, then $1-\beta \leq 0$, and the equilibrium helping effort is zero; that is, an auditor has no incentive to exert effort to help his partner if he bears no liability for his partner's clients.

Observe that the revenue-sharing rule has no effect on partners' effort choices in this stage. This is because, given fixed audit fee contracts, the revenues an auditor receives are fixed when he makes effort decisions in the performance of audits.

Moral hazard problems with respect to the effort choices can be shown by comparing the equilibrium effort profile with the Pareto efficient effort profile derived in Section 2.2. It is easily seen that $(e^*(\beta), c^*(\beta)) \neq (e^o, c^o)$ for any β, where $e^*(\cdot)$ *and* $c^*(\cdot)$ are effort choice functions defined in Proposition 2.2. This tells us it is impossible to perfectly align individual auditors' interests with the partnership's interests in the performance of an audit. In particular, when $\beta \in (0,1)$, both partners tend to shirk. This is caused by the fact that an auditor fully bears the pain of his effort, yet shares the benefit of his effort with the other auditor. The shirking problem with respect to helping effort is most severe when $\beta \geq 1$, in which case the equilibrium helping effort is zero. Interestingly, the moral hazard problem with respect to the engagement auditor's effort works in the opposite direction when $\beta > 1$. In this case, the engagement auditor tends to exert more effort than is desired from the firm's perspective. The reason is that the marginal benefit of effort is over-weighed by the auditor due to the penalty imposed on him. In fact, imposing penalties on an auditor over and above the legal liabilities associated with his audits hurts the firm as a whole. This point will be formally shown later in Lemma 2.2.

Stage 1's problem: effort choices in soliciting clients

When deciding how much effort to expend in selling his services, an auditor estimates the expected personal payoff from an engagement (before deducting the cost of selling effort), represented by $\breve{\pi}$. Given the firm's profit sharing rules, $\breve{\pi}$ equals the auditor's share of the firm's profit from the audit minus his cost of auditing effort:

$$\breve{\pi}_i \equiv \breve{\pi}(\alpha_i, \beta_i) = \alpha_i f - \beta_i l(1 - p(e^*(\beta_i), c^*(\beta_i))) - e^*(\beta_i), \; i \in \{1,2\}.$$

In contrast, the partnership's expected payoff from the audit (before deducting the cost of selling effort) is

$$\pi_i \equiv \pi(\beta_i) = f - l(1 - p(e^*(\beta_i), c^*(\beta_i))) - e^*(\beta_i) - c^*(\beta_i),\ i \in \{1,2\}.$$

The personal payoff $\breve{\pi}$ may differ from the firm's payoff π because (a) the auditor only cares about his share of the firm's profits, and thus discounts the revenues and expected legal liabilities associated with the audit by α_i and β_i, respectively, and (b) he completely ignores his partner's cost of helping effort. The incentive problems caused by the discrepancy in the payoffs will become clear soon.

There is assumed to be no synergy in auditors' selling effort. Hence, auditors' decision problems in soliciting clients are independent. In choosing the level of selling effort, each auditor's objective is to maximize his own welfare:

$$\underset{a_i \in [0,\bar{a}]}{\text{Maximize}}\ \breve{\pi}(\alpha_i, \beta_i) E(n|a_i) - a_i,\ i \in \{1,2\}. \tag{2.15}$$

The equilibrium levels of selling effort are characterized in Proposition 2.3.

Proposition 2.3: *Given a compensation contract* $\{\alpha_1, \beta_1, \alpha_2, \beta_2\}$, *if* $\breve{\pi}(\alpha_i, \beta_i) > 0$, *partner* i *'s equilibrium choice of selling effort is interior and unique, i.e.,* $a_i^* \in (0, \bar{a})$, *and is determined by*

$$\breve{\pi}(\alpha_i, \beta_i) r_a(a) - 1 = 0,\ i \in \{1, 2\}. \tag{2.16}$$

There may exist a moral hazard problem with respect to auditors' selling effort. Observe that the optimal level of selling effort for auditor i from the firm's perspective is determined by

$$\pi(\beta_i)r_a(a) - 1 = 0. \tag{2.17}$$

When $\breve{\pi}$ differs from π, the auditor's selling strategy does not maximize the firm's welfare. Specifically, the auditor's effort choice exceeds the firm's desired level if $\breve{\pi}(\alpha_i, \beta_i) > \pi(\beta_i)$, meaning that he is too aggressive in pursuing clients if an engagement is worth more to him than to the firm. Conversely, his effort choice falls short of the firm's desired level if $\breve{\pi}(\alpha_i, \beta_i) < \pi(\beta_i)$, meaning that he shirks if an engagement is worth less to him than to the partnership as a whole.

Stage 0's problem: profit sharing rules

In the contracting stage, both partners prefer the profit sharing rules that maximize their joint welfare. The argument goes as follows. Suppose $(\boldsymbol{\alpha}, \boldsymbol{\beta})$ maximizes the partners' joint welfare. Consider any sharing rule $(\boldsymbol{\alpha}', \boldsymbol{\beta}')$ that does not maximize the joint welfare but is preferred by partner 1. Partner 2 can always make a lump sum payment to partner 1 so that partner 1 is indifferent between $(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\eta})$ and $(\boldsymbol{\alpha}', \boldsymbol{\beta}')$, while partner 2 is strictly better off with $(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\eta})$. I ignore the determination of the mutual transfer between partners because it does not affect auditors' effort decisions. Nevertheless, given symmetry, it is natural that $\eta_{12} = \eta_{21} = 0$. Formally, in choosing profit sharing rules, the partnership's problem is

$$\underset{\boldsymbol{\alpha}, \boldsymbol{\beta}}{Maximize} \sum_{i \in \{1,2\}} [\pi(\beta_i) r(a^*(\breve{\pi}(\alpha_i, \beta_i))) - a^*(\breve{\pi}(\alpha_i, \beta_i))] \tag{2.18}$$

$$subject\ to\ \ \breve{\pi}(\alpha_i, \beta_i) > 0, \tag{2.19}$$

$$\beta_i \in [0, \overline{\beta}\ ], \qquad i \in \{1,2\}, \tag{2.20}$$

where $\overline{\beta}$ is such that for any $\beta_i \geq \overline{\beta}$, the equilibrium effort levels are constant: $e_i^* = \overline{e}$ *and* $c_j^* = 0$.

Since partners are symmetric, the optimal sharing rules must be the same for them, i.e., $(\alpha_1^*, \beta_1^*) = (\alpha_2^*, \beta_2^*)$. Hence, I drop the subscripts that stand for partners. Constraint (2.19) requires that the sharing rules be such that the personal payoff from an audit is positive, because there would be zero supply of audit services otherwise. Moreover, the choice of β is limited to the set in (2.20), because any β not in the set can be replaced by a value in the set that induces the same effort profile for an audit.

Lemma 2.1: *For a given liability-sharing rule* $\beta \in [0, \overline{\beta}]$, *the firm's welfare is maximized at* α^* *over* $\alpha \in \{\alpha | \breve{\pi}(\alpha_i, \beta_i) > 0\}$, *where* α^* *is determined by* $\breve{\pi}(\alpha^*, \beta) = \pi(\beta)$. *That is, the conditional optimal revenue-sharing rule is*

$$\alpha^*(\beta) = \frac{f - (1-\beta)(1 - p(e^*(\beta), c^*(\beta)))l - c^*(\beta)}{f}.$$

Lemma 2.1 characterizes conditional optimal revenue-sharing rules. It shows that, for a given β (and thus a fixed production plan in the auditing stage), there always exists a revenue-sharing rule that equates the personal payoff from an audit with the firm's payoff to ensure that the individual's selling strategy also maximizes the firm's welfare.

Substituting the conditional optimal revenue-sharing rule $\alpha^*(\beta)$ into the firm's original maximization problem (2.18), I obtain

$$\underset{\beta \in [0, \overline{\beta}]}{Maximize}\ \pi(\beta) r(a^*(\pi(\beta))) - a^*(\pi(\beta)) \tag{2.21}$$

The liability-sharing rule β that solves (2.21), combined with $\alpha^*(\beta)$, solves the original maximization problem. Now, the task of solving for optimal profit sharing rules reduces to that of solving for optimal liability-sharing rules. Lemma 2.2 below eliminates all the β's greater than one from our consideration.

Lemma 2.2: *The firm's welfare strictly decreases in* β *over* $\beta \in (1, \overline{\beta}]$.

We learn from Lemma 2.2 that, even though incurring legal liabilities is bad, it is not optimal for the firm to impose too high a penalty on the engagement partner. The reason is as follows. For any $\beta > 1$, we know from Proposition 2.2 that the equilibrium helping effort is zero, and that the engagement partner's effort e^* is determined by

$$\beta p_e(e^*, 0)l - 1 = 0. \tag{2.22}$$

Observe that, at e^*, the (net) marginal benefit of effort to the auditor is zero, while it is negative to the firm because $p_e(e^*, 0)l - 1 < 0$. This implies the auditor puts forth more effort than the firm's desired level. Since the auditor's effort choice increases as β increases, the firm's welfare is strictly decreasing in $\beta \in (1, \overline{\beta}]$.

Before solving for the optimal liability-sharing rule, I need to make one more assumption that pertains to the production of audits. One major feature of audit production that I want to incorporate in the model is teamwork, i.e., the efficient provision of an audit requires some amount of cooperation between partners. Assumption 2.8 below identifies a set of conditions under which it is optimal for a firm to induce partner cooperation in the performance of audits.

Assumption 2.8: $(p_e l - 1)e_\beta + (p_c l - 1)c_\beta \Big|_{\beta \to 0^+} > 0$ and

$$(p_e l - 1)e_\beta + (p_c l - 1)c_\beta \Big|_{\beta \to 1^-} < 0 .$$

Note that $\frac{\partial \kappa(\beta)}{\partial \beta} = -[(p_e l - 1)e_\beta + (p_c l - 1)c_\beta]$. Thus, Assumption 2.8 means that as β approaches zero (i.e., when the engagement partner takes little responsibility for the legal liabilities associated with his audits), the cost of an audit decreases with a small *increase* in β. On the other hand, as β approaches one (i.e., when the engagement partner is individually responsible for almost all the legal liabilities associated with his audits), the cost of an audit decreases with a small *decrease* in β. With these conditions satisfied, Proposition 2.4 below characterizes the firm's optimal (linear) sharing rules.

Proposition 2.4: *Assume that $e^*(\beta)$ and $c^*(\beta)$ are left continuous at $\beta = 0$ and right continuous at $\beta = 1$, and that conditions in Assumption 2.8 hold.*[17] *There exist optimal (linear) profit sharing rules, denoted by (α^*, β^*), that maximize the firm's welfare. The optimal liability-sharing rule $\beta^* \in (0,1)$, and satisfies the following condition:*

$$(p_e l - 1)e_\beta + (p_c l - 1)c_\beta = 0 \tag{2.23}$$

The optimal revenue-sharing rule is

[17] There are many examples in which these assumptions hold. Here is an example. Suppose $\mu(e,c) = 0.6\sqrt{e} + 0.4\sqrt{ec}$, $e \in [0, 1]$, $c \in [0, 1]$, $\phi = 0.7$, $\psi = \nu = 1$, $w = 0$, $V_b = 6$. Under these assumptions, the conditions in Proposition 2.4 are satisfied, and the optimal liability-sharing rule is unique: $\beta^* = 0.9402$. In addition, the equilibrium effort profile is $(e^*, c^*) = (0.2438, 0.00029)$.

$$\alpha^* = \frac{f - (1-\beta^*)(1 - p(e^*(\beta^*), c^*(\beta^*)))l - c^*(\beta^*)}{f}.$$

Condition (2.23) in Proposition 2.4 characterizes the optimal liability-sharing rule β^*. To see where this condition comes from, recall that, for a given β, the firm's and the individual's objective functions in choosing the level of selling effort coincide under the conditional optimal revenue-sharing rule. Based on the Envelope theorem, we know that the firm's welfare is increasing in the firm's payoff from an audit $\pi(\beta)$. Thus, the firm's welfare attains its maximum when $\pi(\beta)$ is maximized, or equivalently when $\kappa(\beta)$ (i.e., the firm's audit cost) is minimized. $\kappa(\beta)$ attains its minimum at β^* only if condition (2.23) (i.e., the first-order condition) is satisfied.

Two major conclusions are drawn from Proposition 2.4. First, in order to induce teamwork in the performance of audits, the optimal liability-sharing rule is such that an auditor should share some of the legal liabilities associated with his partner's clients, i.e., $\beta^* < 1$. In setting the optimal liability-sharing rule, the firm trades-off between the benefit of inducing more of the engagement partner's effort and the cost of discouraging cooperation between partners. Technically, condition (2.23) implies that, at the optimal β^*, the marginal change of auditing effort and that of helping effort in response to a change in β have opposite signs. Intuitively, on the one hand, the more individually responsible an auditor is held for the legal liabilities associated with his clients, the more effort he exerts in performing his audits. On the other hand, the more individually responsible an auditor is held for the legal liabilities associated with his clients, the less

consultation or help he receives from his partner. The optimal β^* brings a balance between the tradeoff.

Second, observe that $\beta^* \in (0,1)$ implies $\alpha^* \in (0,1)$. This suggests it is also optimal for an auditor to share some of the fee revenues associated with his partner's clients. This result may seem puzzling at first glance. Why, one may wonder, should partners share each other's fee revenues when there is no synergy in their selling effort? The key lies in the firm's attempt to overcome the moral hazard problem with respect to auditors' selling effort. Recall that, in calculating the personal cost of an audit, a partner only partially takes into account the potential legal liabilities related to the audit due to liability sharing, and completely ignores his partner's cost of helping effort. Therefore, the partner's personal payoff exceeds the firm's payoff from the audit if he is fully compensated for each dollar of revenues he brought in the firm; that is, $\breve{\pi}(\alpha,\beta^*) > \pi(\beta^*)$ if $\alpha = 1$. As a result, without revenue sharing, the partner would put forth too much effort in pursuing clients from the firm's perspective. The purpose of revenue sharing is to induce the appropriate amount of selling effort.

2.3.3 Equilibrium audit fee and welfare effects

The equilibrium audit fee f^* is determined by having a firm earn expected economic profit equal to the sum of the auditors' reservation wages. That is, f^* is determined by

$$2[(f - \kappa(\beta^*))r(a^*(f,\kappa(\beta^*))) - a^*(f,\kappa(\beta^*))] = 2\bar{u}. \tag{2.24}$$

(2.17) and (2.24) imply that the equilibrium audit fee $f^* = \kappa^* + \frac{\bar{u} + a^*}{r(a^*)}$, where

$\kappa^* \equiv \kappa(\beta^*)$, and a^* is determined by $\frac{r(a)}{r_a(a)} = \bar{u} + a$.

Observe that under the optimal revenue-sharing rule, the individuals' interests perfectly align with the firm's interests when they solicit clients. Therefore, any welfare loss (i.e., the decrease in the value of audits) compared with the benchmark case is caused by moral hazard problems with respect only to the effort choices in the auditing stage.

Proposition 2.1 also holds here, although it is derived in the context where effort is contractible. According to Proposition 2.1 the equilibrium audit fee in the current case is higher than in the benchmark case because $\kappa(e^*(\beta^*),\ c^*(\beta^*)) > \kappa(e^o, c^o)$. Further, when the legal regime is strict and join-and-several liability, and when the manager is insolvent, the welfare loss for an audit due to the non-contractibility of information (about effort) can be measured by the difference between the equilibrium audit fees in the two cases: $(f^* - f^o)$. These insights are summarized in Corollary 2.1.

Corollary 2.1: *Under the optimal sharing rules, any welfare loss, compared with the benchmark case, is caused by moral hazard problems with respect only to the effort choices in the performance of audits. In addition, when the legal regime is strict and join-and-several liability, and when the manager is insolvent, i.e., when* $\psi = v = 1$ *and* $w = 0$, *the welfare loss for an audit due to the non-contractibility of information (about effort) can be measured by the difference between the equilibrium audit fees in the two cases:* $(f^* - f^o)$.

2.4 Concluding remarks

In this chapter, I view an audit firm as a partnership in which auditors make decentralized decisions in performing various tasks, and investigate how the firm (i.e., partners as a whole) optimally choose profit sharing rules. Specifically, I model the production in an audit firm as a two-stage process. In the first stage (i.e., the soliciting stage), partners expend effort in soliciting clients individually. In the second stage (i.e., the auditing stage), partners expend effort in performing audits and assisting each other in the performance of audits. I assume that effort choices are not contractible, and that the efficient provision of an audit requires teamwork.

I find that the optimal (linear) sharing rules are such that an auditor should share some of the legal liabilities and some of the audit fee revenues associated with his partners' engagements. The purpose of liability sharing is to induce teamwork in the performance of audits, while the purpose of revenue sharing is to induce appropriate amount of selling effort. These results are intuitive and help us understand the profit sharing rules in the real world. For instance, they explain why "Eat what you kill", which compensates a partner based only on his net engagement profits, is not a good compensation strategy for an audit firm where cooperation is beneficial to the firm's welfare. Furthermore, by comparing the case in which effort is non-contractible with the hypothetical case in which effort is contractible, I show how the non-contractibility of information (about effort choices) may cause social welfare loss.

In this chapter, I assume that the audit market is competitive, and that clients are identical in the sense that the efficient provision of audits requires the same mix of partners' effort-inputs, i.e., the efficient production plan for an audit is the same for all

clients. The assumed market structure matches the market for the non-Big Five audit firms. The reason is as follows. The non-Big Five firms (which are mainly local and regional firms) do not have the capability to audit large publicly held clients. Their clients consist mainly of privately held companies and small publicly held companies. Relative to the Big Five's clients, there is not much variation in the clients audited by the non-Big Five firms. Even if there are variations in the clients, given limited capacity, a firm usually focuses only on one type of clients. Yet, for each type of clients, there are still many competing audit firms. In this case, the competitive market refers to the market for the audits of a specific type of clients. The assumption about the market structure is changed in the next chapter, which examines the Big Five audit firms.

CHAPTER 3:

PROFIT SHARING IN AN AUDITING OLIGOPOLY

In Chapter 2, I analyzed incentive issues and profit sharing rules in an audit firm in a competitive market. In that setting, each firm acts passively and takes the audit price as given. This chapter, in contrast, considers an oligopolistic market setting where there are only a few audit firms, and thus each firm has the power to influence the audit price.

In the real world, audit firms have been roughly divided into two groups according to firm size or brand name: the Big Five and non-Big Five. The Big Five each have offices all over the world, and collectively dominate the market for audits of publicly held companies. For example, in the U.S. about eighty percent of publicly held companies are audited by the Big Five firms. From the technological point of view, the formation of each of the Big Five through either internal expansion (AA) or mergers (KPMG, PWC, DTT, EY) is a natural response to the globalization of the economy. In the past two decades, more and more companies have become international by setting up operations in multiple countries, which creates the need for integration of audit firms. The merger of national audit firms to form an international audit firm encourages auditors who specialize in national practices to cooperate on a global level so as to provide cross-

jurisdiction services to complex clients more efficiently than they would before the merger.

The wave of mergers of audit firms, during the 1980's and 1990's, has reduced the then Big Eight to the Big Five. With a few firms controlling a majority of audit services for public companies, one would expect imperfect competition among the Big Five and positive rents (i.e., economic profits) for each firm, at least in the short run before new entries occur. The question is not whether there is imperfect competition, but rather how firms compete in the market and how they earn positive rents. This is one of the main questions addressed in this chapter.

As in Chapter 2, an audit firm is viewed as a partnership instead of a single profit-maximizing person. Within the firm, each partner acts in his self-interests when making decentralized decisions. The firm's compensation plan affects individual partners' decisions through its effects on their economic interests. Therefore, partners may use compensation schemes as strategic instruments to compete with rival firms, by inducing optimal partner behavior from the firm's point of view, anticipating the compensation strategies of rival firms. This chapter examines the role of profit sharing plans in the strategic competition of firms.

Section 3.1 introduces the model, which is built on the model developed in Chapter 2. Sections 3.2 and 3.3 derive equilibrium profit sharing rules under the assumptions that client type is contractible and not contractible, respectively. Section 3.4 concludes the chapter.

3.1 The model

Consider a one period economy with two geographically different places and two audit firms. Each firm has two partners operating separately in the two locations. This assumption captures a real-life situation wherein an audit firm establishes offices in different states (countries) with partners operating separately in different offices. A partner in one state (country) is assumed not to solicit clients from another state (country). I number the two places 1 and 2, and denote the two firms A and B. Thus, auditor A1, for instance, refers to the partner of firm A who operates in place 1. With no loss of generality, I assume each auditor's reservation wage is zero.

In each location, there are risk neutral auditors (from different firms), shareholders, and managers. The agency problem between shareholders and managers is the same as in Chapter 2. The two locations are symmetric and have identical legal regimes.

A distinctive assumption in this setting is that clients (i.e., companies) are different in that the efficient audits of different types of clients require different effort profiles (i.e., different mix of partners' effort-inputs in an audit).[1] A client is described by a bundle of characteristics that affect the production of the audit: (a) the risk of financial statements being misstated, which is represented by $(1-\phi)$ in the model, (b) damages suffered by shareholders in the event of audit failure, which is represented by V_b in the model, and (c) the characteristics that affect the audit technique $\mu(\cdot)$, which describes the functional relationship between the effort profile and the audit quality. The fraud risks and the

[1] The effects of product differentiation on oligopolistic competition was first analyzed by Hotelling (1929).

industrial and geographic dispersion of a client's operations may affect the audit technique.

For expositional convenience, I focus on the differences in (a) and (c) above, and assume there are only two types of clients: simple and complex, denoted by S and C, respectively. The efficient audit of a C type client requires different amounts of partner cooperation from the efficient audit of an S type client. In the real world, C type clients may be companies operating in multiple industries and/or multiple locations or companies with high risks of financial statement fraud, whereas S type clients may be companies operating in a single industry and/or a single location or companies with low fraud risks.

The assumption about client differentiation is motivated by the real-world observation that the Big Five firms audit a broad range of companies. Companies at one end of the spectrum (e.g., small local companies) can also be audited by small partnerships, while those at the other end of the spectrum (e.g., large complex companies) can only be audited by the Big Five. The audits of different types of clients are very likely to require different amounts of partner cooperation.

To capture the difference in audit technique between different types of client, I assume that given an effort profile (e,c), the audit quality μ^t, varies with client type, where the superscript t indicates client type, $t \in \{S,C\}$. μ^t is assumed to have the same properties as described by Assumptions 2.1 and 2.2. We know from the analysis in Section 2.1 that the probability of an audit firm incurring zero legal liability for a client is

$$p^t(e,c) = 1-(1-\phi^t)(1-\mu^t(e,c))\psi(\mu^t(e,c)),$$

with the same properties as described by Assumptions 2.5 to 2.7. The shareholders' surplus from purchasing an audit is

$$(1-\phi^t)(1-\mu^t)\psi(\mu^t)l+(1-\phi^t)\mu^t(V_b-w)-f\,. \tag{3.1}$$

Now consider the audit firms' problems. Since clients are different in that the efficient audits of different types of clients require different effort profiles, a firm may want to use client type specific sharing rules to induce optimal partner behavior for every type of clients. In reality, however, it is unlikely that client type is contractible. That is, it is too costly, if not impossible, for an independent party like a court to verify each client's type. A client's type is determined by a bundle of characteristics, among which the risk of (financial statement) fraud, for instance, is not easily verified to a court. Even if some information that is highly associated with client type is verifiable, such as the number of subsidiaries a client has in different locations, or the number of industry sectors in which it operates, this information may not perfectly classify a client. For example, consider a company with subsidiaries in multiple locations. If the affiliated companies engage in many intra-firm transactions, a great degree of cross jurisdiction partner consultation may be needed to address difficult auditing issues arising from transfer pricing, tax planning, and related party transactions. However, if their operations are relatively independent, the audit may not entail much partner collaboration.

Therefore, it is reasonable to believe that client type is not contractible, and thus cannot be used for partner compensation purposes. Hence, the emphasis of my analysis is not on the case in which client type is contractible, but on the more realistic case in which client type is non-contractible. Nevertheless, to see the connections and differences

between these two cases, I analyze both cases. As we see later, the analysis of the latter case can be built on the analysis of the former.

3.2 Client type contractible

As in Chapter 2, the profit sharing rule is assumed to be linear, i.e., each partner's compensation is a linear function of the revenues and legal liabilities associated with different offices and, if client type is contractible, with different types of clients. Since partners are symmetric, the firm's budget-balancing linear sharing rule can be written as follows:[2]

$$y_i = \sum_{t\in\{S,C\}} \alpha^t R_i^t + \sum_{t\in\{S,C\}} (1-\alpha^t) R_j^t - \sum_{t\in\{S,C\}} \beta^t L_i^t - \sum_{t\in\{S,C\}} (1-\beta^t) L_j^t + \eta_{ij},$$

where

i, j : partners in the firm, $i \neq j,\ i, j \in \{1, 2\}$,

y_i : partner i's compensation,

$R_i^t \geq 0$: revenues related to the t type clients audited by partner i,

$L_i^t \geq 0$: legal liabilities related to the t type clients audited by partner i,

α^t : finite incentive weight assigned to revenues related to the t type clients audited by partner i,

β^t : finite incentive weight assigned to legal liabilities related to the t type clients audited by partner i,

η_{ij} : lump sum transfer between partners, $\eta_{12} = -\eta_{21}$.

[2] Note that α and β do not vary across auditors because, given symmetry, the optimal sharing rules for different auditors must be the same, as I have shown in Chapter 2.

The production in an audit firm is viewed as a two-stage process. In the first stage, each auditor submits bids to shareholders in the area where his office is located, competing against the auditor from the rival firm. Again, the audit fee is assumed to be determined before the audit is performed (i.e., a fixed audit fee contract). In the second stage, auditors expend effort in performing audits and helping each other in the performance of audits.

I assume that the shareholder surplus has the first order effect on the outcome of bidding for a client, compared with the soliciting effort, and ignore the effect of soliciting effort in the analysis. In other words, the analysis focuses on the shareholder surplus – which is a function of both the audit quality and the audit fee – as the determining factor in auditor choice.[3]

The timeline of the auditors' game is described as follows.

Stage 0: In each firm, partners select a profit sharing rule.

Stage 1: In each location, auditors from different firms submit bids to shareholders in the area under the names of their firms. For each client, the auditor who provides shareholders with the higher positive surplus wins the bid.[4]

[3] In this thesis, I assume that the shareholder surplus (which is jointly determined by the audit quality and the audit price) has the first order effect on the shareholders' auditor choice, compared with the auditor's selling effort. In Chapter 2 (a competitive market), auditors act passively, and the shareholder surplus provided by competing auditors is the same. In that situation, the number of engagements an auditor obtains depends on his selling effort. In contrast, in Chapter 4 (the oligopolistic setting) where auditors have the power to influence the shareholder surplus, the auditor who provides the higher shareholder surplus wins the bid. Introducing the effect of selling effort only affects the bidding outcome when auditors provide the same shareholder surplus, and thus will not qualitatively change the analytical results – note that in the specializing equilibrium to be developed later, the competing auditors provide different shareholder surplus. Thus, for simplicity of analysis, I ignore the effect of soliciting effort in Chapter 3.

[4] The bidding outcome in the case of a tie will be specified later in Assumption 3.1.

Stage 2: In each firm, partners choose effort levels in performing audits and helping each other.

Finally, outcomes are revealed, and partners are compensated according to the sharing rule specified in Stage 0.

In the jargon of game theory, this game is a "multi-stage game with observed actions" in that (a) actions taken in the previous stage become public knowledge in the next stage,[5] and (b) players move simultaneously in each stage. It follows that each of the games starting from stages 2, 1, and 0 constitutes a proper subgame. I solve the game for a subgame perfect equilibrium. In addition, I consider only pure strategies.[6]

Stage 2's problem: effort choices in the performance of audits

The game starting at Stage 2 is a proper subgame consisting of two independent, simultaneous games. Each game is played by partners within the firm. Given symmetry, I focus on auditors' problems in firm A. For an arbitrarily chosen client, each auditor's problem is to choose the level of auditing effort or helping effort to maximize his share of

[5] In particular, the assumption that partners know the compensation schemes of competing firms is a reasonable description of the situation in the real world. Burrows and Black interviewed partners from the Melbourne offices of then Big Six firms in 1995. They report: " despite the dearth of published information on the topic, each partner knew in general how rival firms shared profits." (Burrows and Black 1998, 522). Additionally, it is assumed that the price of an audit is observed before an audit is performed. However, the analytical results are the same without this assumption, since effort choices for each client in Stage 2 do not depend on prices set in Stage 1.

[6] The restriction to pure strategies will have no effect on the analysis of the subgame at Stage 2 because, as I will show, the effort choice equilibrium is unique. However, there generally exist mixed strategy equilibria for the bidding subgame at Stage 1. Since audit fees are public information, discriminatory pricing – which is implied by mixed strategies – hurts auditor/client relations. In that sense, randomizing prices may not be practical. Moreover, it is reasonable to assume that the profit sharing rules specified in a partnership agreement are fixed rather than random.

the expected *savings* of legal liabilities net of his effort costs, treating sharing rules and his belief about his partner's effort choice as given. Formally, the engagement auditor's decision problem for the client is

$$\underset{e\in[0,\bar{e}]}{Maximize}\ \beta^t p^t(e,\hat{c})l - e. \tag{3.2}$$

The other auditor's decision problem is

$$\underset{c\in[0,\bar{c}]}{Maximize}\ (1-\beta^t)p^t(\hat{e},c)l - c. \tag{3.3}$$

β^t is restricted to nonnegative values by the same argument made in Chapter 2. Let the first subscript stand for the firm, the second subscript the partner, and the third subscript the client. For example, c_{A1k}, $k \in \{1,...,n_A^S\}$, denotes the helping effort expended by auditor A1 for one of auditor A2's clients of type S. The equilibrium effort choices are characterized in Proposition 3.1.

Proposition 3.1: *In firm $i \in \{A,B\}$, given a compensation contract characterized by $\{\beta_i^S, \beta_i^C\}$, the equilibrium is such that an auditor chooses the same unique level of effort – auditing effort or helping effort – for the audit of every client of the same type, i.e., $e_{i1k}^{t*} = e_{i2k}^{t*} = e_i^{t*}$, $c_{i1k}^{t*} = c_{i2k}^{t*} = c_i^{t*}$, $t \in \{S,C\}$, $k \in \{1,...,n_i^t\}$. If $\beta_i^t = 0$, then $e_i^{t*} = c_i^{t*} = 0$. If $\beta_i^t \geq 1$, then $e_i^{t*} \in (0,\bar{e}]$, $c_i^{t*} = 0$. If $\beta_i^t \in (0,1)$, then $e_i^{t*} \in (0,\bar{e})$, $c_i^{t*} \in (0,\bar{c})$, and (e_i^{t*}, c_i^{t*}) are determined by the following conditions:*

$$\beta_i^t p_e^t(e,c)l - 1 = 0, \tag{3.4}$$

$$(1-\beta_i^t)p_c^t(e,c)l - 1 = 0, \tag{3.5}$$

$$where\ \ p_e^t(e,c) = \frac{\partial p^t(e,c)}{\partial e},\ p_c^t(e,c) = \frac{\partial p^t(e,c)}{\partial c}.$$

Proposition 3.1 shows that the equilibrium effort profile for a client (i.e., the equilibrium mix of auditors' effort-inputs in an audit) is a function of the firm's *type specific* liability-sharing rule. In addition, with fixed audit fee contracts, effort choices are independent of the firm's revenue-sharing rule.

Stage 1's problem: pricing strategies

The subgame starting at Stage 1 consists of two simultaneous games played separately in two locations. In each location, auditors from different firms compete in bidding for clients. As the games in two locations are symmetric, it will suffice to analyze the local competition between auditors A1 and B1. My approach to the pricing game (also known as Bertrand game) follows the approach of Hurter and Lederer (1985, 1986).

For a client of type $t \in \{S,C\}$, let f_{i1}^t, $i \in \{A,B\}$, represent the bid made by auditor $i1$, κ_i^t represent auditor $i1$'s personal cost of the audit, and K_i^t represent the firm's cost. We have

$$\kappa_i^t \equiv \kappa^t(\beta_i^t) = \beta_i^t[1 - p^t(e^{t*}(\beta_i^t), c^{t*}(\beta_i^t))]l + e^{t*}(\beta_i^t),$$

$$\mathrm{K}_i^t \equiv \mathrm{K}^t(\beta_i^t) = [1 - p^t(e^{t*}(\beta_i^t), c^{t*}(\beta_i^t))]l + e^{t*}(\beta_i^t) + c^{t*}(\beta_i^t).$$

Thus, auditor $i1$ gains a personal payoff of $\breve{\pi} = (\alpha_i^t f_{i1}^t - \kappa_i^t)$ if he wins the bid, whereas the firm's payoff from the audit is $\pi = (f_{i1}^t - \mathrm{K}_i^t)$. The payoff from an audit may differ

between the engagement auditor and the firm as a whole. The intuition for this has been explained in Chapter 2.

α_i^t is restricted to positive values, since it will be shown later that a firm can always choose a positive α_i^t in the contracting stage.

I now introduce some new notation I will use in this analysis. First, let $\underline{P}_i^t$ stand for auditor $i1$'s break-even price for an engagement, i.e., the price at which he earns zero payoff from the engagement. Clearly, $\underline{P}_i^t = \frac{\kappa_i^t}{\alpha_i^t}$. Second, let υ_i^t denote the gross benefit auditor $i1$ provides to the shareholders; we know from (3.1) that

$$\upsilon_i^t = (1-\phi^t)(1-\mu^t)\psi^t l + (1-\phi^t)\mu^t(V_b - w).$$

Third, let σ_i^t represent the maximum shareholder surplus auditor $i1$ can provide: $\sigma_i^t = \upsilon_i^t - \underline{P}_i^t$. Last, denote the auditor whose σ^t is higher the high surplus auditor.

When rival auditors A1 and B1 have the same $\sigma^t \geq 0$, the competition is vigorous. Each auditor has the incentive to undercut his competitor until the entire surplus goes to shareholders. As a result, the equilibrium is for auditors to bid their break-even prices. On the other hand, when they have different σ^t's, the high surplus auditor wins the bid. To see this, suppose $0 \leq \sigma_A^t < \sigma_B^t$, and consider the strategy profile $(f_{A1}^t, f_{B1}^t) = (\underline{P}_A^t, \upsilon_B^t - \sigma_A^t - \varepsilon)$, where ε is an arbitrarily small positive number. Note that $\sigma_A^t < \sigma_B^t$ implies $\upsilon_B^t - \sigma_A^t - \varepsilon > \underline{P}_B^t$. The strategy profile is that auditor A1, who is the low surplus auditor, bids his break-even price, while auditor B1 bids the price that gives the shareholders a slightly higher surplus than does auditor A1, wins the bid, and gains a

positive payoff. There is a technical problem with this strategy profile being an equilibrium. Auditor B1's payoff from the audit does not attain a maximum: he wants to choose a positive ε as small as possible, but there does not exist a smallest positive number. This problem is often referred to as the "openness problem" (Tirole 1988). One way to deal with the problem is to define the equilibrium as the limit. The other way, which I will adopt in this study, is to define the buyer' preference in the case of a tie as in Assumption 3.1.

Assumption 3.1: If $\min(\sigma_i^t, \sigma_j^t) \geq 0$, $i \neq j, i, j \in \{A, B\}$, when indifferent between auditors, shareholders choose the high surplus auditor, and choose auditors randomly with equal chance if auditors have the same σ^t.

The first part of Assumption 3.1 says that when shareholders are indifferent between two bids, the high surplus auditor wins the bid. This assumption is justified on the grounds that when the low surplus auditor breaks even, the high surplus auditor can always adjust his price to give the shareholders a slightly higher surplus than his competitor can possibly afford. Under this assumption, $(f_{A1}^t, f_{B1}^t) = (\underline{P}_A^t, \upsilon_B^t - \sigma_A^t)$ constitutes an equilibrium in the above example. In the second part of the assumption, the odds of choosing one auditor versus the other when they have the same σ^t are arbitrary and have no effect on the analytical results.

When auditors have different σ^t's, there exist other equilibria. To see this, consider the preceding example (i.e., $0 \leq \sigma_A^t < \sigma_B^t$), and any strategy profile

$(f_{A1}^t, f_{B1}^t) = (f', \upsilon_B^t - \upsilon_A^t + f')$, where $\upsilon_A^t - \sigma_B^t < f' < \underline{P}_A^t$. That is, auditor A1, who is the low surplus auditor, bids below his own break-even price but higher than $(\upsilon_A^t - \sigma_B^t)$ based on the belief that B1 will match his offer and win the bid. If B1 believes A1's threat and correctly anticipates the level of A1's bid, B1's best response is to match the shareholder surplus offered by A1 and win the bid. Such a strategy by A1 has no benefit to himself, but lowers B1's payoff. The problem with this kind of equilibrium is that bids are not irreversible. Grossman (1981) argues in a similar setting that buyers do not believe that a seller will actually commit to a price below his break-even price, because the seller has the ex post incentive to renegotiate the price (or renege on the contract). Similar to Grossman (1981) and Lederer and Hurter (1985), I impose the following feasibility restriction on auditors' pricing strategies.[7]

Assumption 3.2: An auditor will not bid below his break-even price, i.e., $f_{ik}^t \geq \underline{P}_i^t$, $i \in \{A, B\}$, $k \in \{1, 2\}$.

Notice that shareholders choose not to purchase an audit if they get a negative surplus. Thus, if $\sigma_i^t < 0$ *and* $\sigma_j^t < 0$, then both auditors have zero demand; if $\sigma_i^t < 0$ *and* $\sigma_j^t \geq 0$, then auditor $i1$ has zero demand, and auditor $j1$ becomes a

[7] Lederer and Hurter (1985) eliminates the strategy of threat by imposing the feasibility restriction. However, Lederer and Hurter (1986) eliminates the strategy of threat by restricting players to using only undominated strategies. Lemma 1 of their paper claims that a player's pricing strategy is undominated if, and only if, his price is equal to or greater than his marginal cost. This Lemma seems incorrect, since the price equal to the player's marginal cost is dominated by any price greater than his marginal cost. In fact, there does not exist undominated pure strategy equilibrium for the bidding game.

monopolist and sets the monopoly price equal to υ_j^t. The equilibrium pricing strategies are stated in Proposition 3.2.

Proposition 3.2: *Given compensation contracts characterized by* $\alpha_A^t, \beta_A^t, \alpha_B^t, \beta_B^t$, $t \in \{S, C\}$, *in each location, for a client of type* $t \in \{S, C\}$, *if* $\sigma_i^t < 0$ *and* $\sigma_j^t < 0$, $i, j \in \{A, B\}$, *then both auditors have zero demand. If* $\sigma_i^t < 0$ *and* $\sigma_j^t \geq 0$, *then the auditor of firm i has zero demand, and the auditor of firm j wins the bid with the monopoly price equal to* υ_j^t. *If* $\min(\sigma_i^t, \sigma_j^t) \geq 0$, *then there exists a unique (pure strategy) Nash equilibrium. Specifically, if* $\sigma_A^t = \sigma_B^t \geq 0$, *then both auditors bid their break-even prices, and win the bid with equal chance. If* $0 \leq \sigma_i^t < \sigma_j^t$, *then the auditor of firm i bids his break-even price, while the auditor of firm j wins the bid with the price equal to* $(\upsilon_j^t - \sigma_i^t)$.

Individual auditors' equilibrium pricing strategies may not maximize the firm's welfare. An auditor has the incentive to bid below the firm's cost if his break-even price is lower than the firm's cost. For instance, when $0 \leq \sigma_B^t < \sigma_A^t$, auditor A1 wins the bid and gains a positive payoff from the engagement because $f_{A1}^{t*} = \upsilon_A^t - \sigma_B^t > \underline{P}_A^t$. However, firm A as a whole suffers a loss if $\underline{P}_A^t < f_{A1}^{t*} < \mathrm{K}_A^t$. On the other hand, if his break-even price exceeds the firm's cost, an auditor has the incentive to forgo the chance to win a bid that would add value to the partnership. Consider the preceding example, and suppose

$\underline{P}_B^t > \mathrm{K}_B^t$. Firm B as a whole would gain from winning the bid if auditor B1 would bid slightly below his break-even price.

Stage 0's problem: profit sharing rules

As was explained in Chapter 2, within a firm both partners prefer profit sharing rules that maximize their joint welfare. Therefore, I use the firm's strategy to refer to its partners' strategy. The game in Stage 1 can be viewed as a simultaneous game between two firms: each firm sets sharing rules to maximize its welfare against the compensation strategy of the rival firm.

Let n^t be the total number of t type clients in both places. It follows from Proposition 3.2 that, for clients of type $t \in \{S, C\}$, the expected welfare of firm A, denoted by Π_A^t, is

$$\Pi_A^t(\alpha_A^t, \beta_A^t, \hat{\alpha}_B^t, \hat{\beta}_B^t) = \begin{cases} 0, & \text{if } \sigma_A^t \le 0 \text{ or } 0 < \sigma_A^t < \sigma_B^t; \\ (\underline{P}_A^t - \mathrm{K}_A^t)\dfrac{n^t}{2}, & \text{if } \sigma_A^t = \sigma_B^t > 0; \\ (\upsilon_A^t - \sigma_B^t - \mathrm{K}_A^t)n^t, & \text{if } \sigma_A^t > \sigma_B^t \ge 0; \\ (\upsilon_A^t - \mathrm{K}_A^t)n^t, & \text{if } \sigma_A^t > 0 \text{ and } \sigma_B^t < 0. \end{cases}$$

The expected welfare of firm B, denoted by Π_B^t, can be written down similarly.

The search for optimal revenue-sharing rules can be limited to positive values, i.e., $\alpha^t > 0$. The reason is as follows. A firm chooses $\alpha^t \le 0$ only if it wants to discourage its

partners from bidding for clients. However, the firm can always use a positive β^t and a sufficiently small positive α^t such that $\upsilon^t(\beta^t) - \frac{\kappa^t(\beta^t)}{\alpha^t} < 0$ to achieve that objective.

We have seen that the moral hazard problem with respect to pricing strategies is caused by the incongruence between an individual partner's break-even price and the firm's cost of an audit. I now show that a firm can induce the optimal pricing strategy by exploiting the relation between the revenue-sharing rule and the break-even price. Recall that $\underline{P}^t(\alpha_i^t, \beta_i^t) = \frac{\kappa^t(\beta_i^t)}{\alpha_i^t}$. Hence, for a given β^t (and thus a fixed production plan), by adjusting α^t such that an individual partner's break-even price coincides with the firm's cost, the firm ensures that the partner's pricing strategy also maximizes the firm's welfare. Clearly, for a given β^t, the revenue-sharing rule that induces the optimal pricing strategy from the firm's perspective is $\alpha^t(\beta^t) = \frac{\kappa^t(\beta^t)}{\mathrm{K}^t(\beta^t)}$. Consistent with Chapter 2, I call such a revenue-sharing rule the conditional optimal revenue-sharing rule.

Before characterizing the equilibrium sharing rules, I need to define the value maximizing liability-sharing rule $\beta^{t\circ}$ for a client of type $t \in \{S, C\}$. The value of an audit is measured as the sum of two things: the shareholders' surplus from purchasing the audit and the firm's surplus from producing the audit.

Definition 3.1: For a client of type $t \in \{S, C\}$, define $\beta^{t\circ}$ as the liability-sharing rule that maximizes the value of the audit. That is, $\beta^{t\circ}$ solves the following maximization problem:

$$\underset{\beta^t \in [0,\overline{\beta}^t]}{Maximize}\ [\upsilon^t(\beta^t) - f] + [f - \mathrm{K}^t(\beta^t)]$$
$$= (1-\phi^t)\mu(e^{t*}(\beta^t), c^{t*}(\beta^t))(V_b - w) - e^{t*}(\beta^t) - c^{t*}(\beta^t) \tag{3.6}$$

where $\overline{\beta}^t$ is the liability-sharing rule such that $e^{t*}(\beta) = \overline{e}$ and $c^{t*}(\beta) = 0$ for any $\beta \geq \overline{\beta}^t$.

(3.6) demonstrates that the value of an audit equals the benefit from improved investment decisions (in terms of the reduction of the wasteful investment in a bad project), less the auditors' effort costs in providing the audit. Although legal liabilities do not constitute a component of the value because they are just transfers between shareholders and auditors, they affect the value of an audit through affecting auditors' effort choices.

Assume enough regularity such that $\beta^{t\circ}$ is unique and $\beta^{t\circ} \in (0,1)$. $\beta^{t\circ} > 0$ implies that the maximized value of an audit is positive, which provides the rationale for the existence of an audit market. $\beta^{t\circ} < 1$ implies that some degree of partner cooperation is necessary for the efficient provision of an audit. Finally, assume that the difference between the two types of clients is nontrivial such that $\beta^{S\circ} \neq \beta^{C\circ}$. The equilibrium sharing rules are characterized in Proposition 3.3.

Proposition 3.3: *Firms have the same dominant strategy: for clients of type* $t \in \{S, C\}$, *the sharing rules are* $(\alpha^{t*}, \beta^{t*}) = (\alpha^{t\circ}, \beta^{t\circ})$, *where* $\alpha^{t\circ} \equiv \frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}$. *In the dominant strategy equilibrium, firms share clients of each type and earn zero economic profit.*

The equilibrium has the two firms set the same compensation strategy that is composed of client type specific sharing rules. The equilibrium liability-sharing rule maximizes the value of an audit for every type of client; the equilibrium revenue-sharing rule equates an individual auditor's break-even price with the firm's cost for every type of client. As was explained before, such a revenue-sharing rule induces the optimal pricing strategy for every type of client. To understand why a firm optimally chooses the value maximizing liability-sharing rule, note that the firm's payoff from an audit equals the value of the audit minus the maximum shareholder surplus offered by the competing auditor. Therefore, the liability-sharing rule that maximizes the firm's payoff is the one that maximizes the value of the audit.

Observe that $\beta^{t\circ} \in (0,1)$ implies $\alpha^{t\circ} \in (0,1)$. That is, given that it is optimal to induce teamwork in the performance of audits, it is also optimal for partners to share office revenues. The reason is that an auditor has the incentive to bid below the firm's cost if he gets the entire revenue from his engagements (i.e., if $\alpha^t = 1$). This can be seen by noticing that the auditor's break-even price equals his personal cost when $\alpha^t = 1$, and that his personal cost is less than the firm's cost given $\beta^{t\circ} \in (0,1)$. Sharing revenues counteracts individual partners' inappropriate aggressiveness in bidding for clients.

The compensation schemes characterized in Proposition 3.3 constitute a dominant strategy for each firm. That is, the compensation strategy is optimal for each firm regardless of what the rival firm's compensation strategy is. Therefore, the dominant strategy equilibrium offers the most reasonable prediction of how the game will be played.

Although there are only two audit firms in the economy, the equilibrium is a perfect competition equilibrium: for each client, auditors from different firms bid the same price (which equals the firm's audit cost), win the bid with equal chance, provide services of the same quality, and earn zero economic profit. Shareholders benefit the most from the perfect competition in that they collect the entire value of audits. The perfect competition result is often called "Bertrand paradox" (Tirole 1988) because it is hard to believe that perfect competition is maintained when there are only two suppliers in the market.

3.3 Client type not contractible

The crucial assumption underlying the perfect competition equilibrium is that client type is contractible. As was argued in Section 3.1, this assumption is not likely to be satisfied in the real world. This section considers the more realistic case in which client type is not contractible. Specifically, I assume that the type of a client is observable to parties who are actively involved in the audit (including representatives of the shareholders, the engagement partner, and the partner who provides assistance in the performance of the audit), but cannot be verified and used for partner compensation purposes. I examine how the equilibrium and the nature of the competition differ from the previous case (in which client type is contractible).

In the current case, sharing rules cannot depend on client type, hence $\alpha^S = \alpha^C$ and $\beta^S = \beta^C$. The linear sharing rule of a partnership becomes

$$y_i = \alpha(R_i^S + R_i^C) + (1-\alpha)(R_j^S + R_j^C) - \beta(L_i^S + L_i^C) - (1-\beta)(L_j^S + L_j^C) + \eta_{ij}, \; i \neq j, \; i, j=1,2.$$

The structure of the game is the same as described in the previous case. As before, I solve for a subgame perfect equilibrium.

Analysis and results

The effort choice subgame starting at Stage 2 is the same as in the previous case; hence, the equilibrium effort strategies are the same functions as $e^{t^*}(\cdot)$ and $c^{t^*}(\cdot)$ defined in Proposition 3.1. In addition, the engagement auditor's personal cost and the firm's cost of an audit remain the same functions as before: $\kappa_i^t = \kappa^t(\beta_i)$ and $\mathrm{K}_i^t = \mathrm{K}^t(\beta_i)$, $i \in \{A, B\}$.

The bidding subgame starting at Stage 1 is also the same as in the previous case. The same reasoning yields the same equilibrium pricing strategies characterized in Proposition 3.2.

Now consider the game in the contracting stage when each firm strategically sets profit sharing rules. The critical difference between this case and the previous case is that, in the previous case, a firm can choose client type specific sharing rules to induce optimal auditor behavior for every type of client; in contrast, in the current case, a firm cannot find a pair of sharing rules (i.e., a combination of the revenue-sharing rule and the liability-sharing rule) that induces the same optimal behavior for both types of clients simultaneously. More specifically, unless $\frac{\kappa^S(\beta)}{\mathrm{K}^S(\beta)} = \frac{\kappa^C(\beta)}{\mathrm{K}^C(\beta)}$ for some β, there does not

exist a revenue-sharing rule that ensures that individual auditors bid in the firm's interests for all clients. Even if there exists a β such that $\frac{\kappa^S(\beta)}{\mathrm{K}^S(\beta)} = \frac{\kappa^C(\beta)}{\mathrm{K}^C(\beta)}$, it is impossible for this β to maximize the value of audits for all clients because $\beta^{S\circ} \neq \beta^{C\circ}$. However, careful examination of interactions between firms reveals that, although each firm cannot be efficient for all clients, firms may differentiate themselves by specializing in different types of clients, and gain limited monopoly power over the clients in which they specialize.

Definition 3.2: A specializing equilibrium is characterized by the firms' liability-sharing rules $(\beta_i, \beta_j) = (\beta^{S\circ}, \beta^{C\circ})$, $i \neq j$, $i, j \in \{A, B\}$. That is, in the equilibrium, firms specialize in different types of clients by choosing different value maximizing liability-sharing rules. The type of clients in which a firm specializes constitutes the firm's niche market or its auditors' niche market.

Proposition 3.4: *If* $\frac{\mathrm{K}^S(\beta^{S\circ}) + \upsilon^S(\beta^{C\circ}) - \upsilon^S(\beta^{S\circ})}{\kappa^S(\beta^{C\circ})} < \frac{\mathrm{K}^C(\beta^{C\circ})}{\kappa^C(\beta^{C\circ})}$ *and* $\frac{\mathrm{K}^C(\beta^{C\circ}) + \upsilon^C(\beta^{S\circ}) - \upsilon^C(\beta^{C\circ})}{\kappa^C(\beta^{S\circ})} < \frac{\mathrm{K}^S(\beta^{S\circ})}{\kappa^S(\beta^{S\circ})}$, *then there exists a specializing equilibrium:* $\beta_A^* = \beta^{S\circ}$, $\beta_B^* = \beta^{C\circ}$, $\alpha_A^* = \alpha^{S\circ}$, $\alpha_B^* = \alpha^{C\circ}$. *In the equilibrium, each firm audits only clients from its niche market, and earns positive economic profit:*

$$\Pi_A = n^S(\min\{\upsilon_A^S, \frac{\kappa_B^S}{\kappa_B^C}\mathrm{K}_B^C + \upsilon_A^S - \upsilon_B^S\} - \mathrm{K}_A^S),$$

$$\Pi_B = n^C(\min\{\upsilon_B^C, \frac{\kappa_A^C}{\kappa_A^S}\mathrm{K}_A^S + \upsilon_B^C - \upsilon_A^C\} - \mathrm{K}_B^C).$$

In the equilibrium characterized in Proposition 3.4, firm A (firm B) chooses the liability-sharing rule that maximizes the value of audits for S type (C type) clients. As a result, auditors from firm A (firm B) become specialists for S type clients (C type clients). Notice that an auditor being a specialist for a type of client does not mean that he has specialized skills at performing the audit, but rather means that – because of his firm's compensation schemes – he and his partner are induced to provide a more efficient audit for that type of client than would auditors from the rival firm.

Under the conditions stated in Proposition 3.4, the maximum shareholder surplus provided by a specialist auditor exceeds that of a non-specialist auditor in equilibrium. This implies that an auditor will not attract demand from the competing auditor's niche market, taking into consideration the rival firm's compensation strategy. As a result, an auditor audits only clients from his niche market, and earns positive economic profits from these clients.

Unlike the case in which client type is contractible, here both the audit quality and audit fees may differ between the two firms for the same type of client. The audit quality, represented by the detection probability $\mu^t(e^*(\beta), c^*(\beta))$, differs between firms because they use different liability-sharing rules, which induce different effort profiles for the audit of the same type of client. Moreover, a specialist auditor may charge a higher price

than a non-specialist auditor, since shareholders consider both the benefit of an audit and the audit fee when choosing an auditor. For example, when $\sigma_B^S \geq 0$, i.e., when the maximum shareholder surplus provided by a non-specialist auditor (i.e., firm B's auditors) is nonnegative, a specialist auditor (i.e., firm A's auditors) charges a higher price for a S type client than does a non-specialist auditor if $\upsilon_A^S - \upsilon_B^S > 0$, with the price premium equal to $(\upsilon_A^S - \upsilon_B^S)$ – the difference in the gross benefits provided by competing auditors.

Shareholders' welfare is also different between the two cases. In the previous case, the value of an audit all goes to shareholders, while here a specialist auditor shares the audit's value with shareholders if the maximum shareholder surplus provided by his competitor is positive, and enjoys the entire value otherwise.

Interestingly, the specializing equilibrium is also an equilibrium in the case in which client type is contractible. However, in that case the specializing equilibrium is dominated by the perfect competition equilibrium characterized in Proposition 3.3. In other words, each firm finds it a dominant strategy to use type specific sharing rules rather than use a uniform sharing rule for all types of clients. In contrast, Corollary 3.1 shows that the specializing equilibrium is undominated in the current case.

Corollary 3.1: *The specializing equilibrium characterized in Proposition 3.4 is undominated.*

The key for the oligopolistic firms to preserve positive economic profits from specialization is that each firm cannot unilaterally deviate from its equilibrium position

by changing its liability-sharing rule without incurring strictly positive costs (in terms of the lost economic profits from its niche market).

Extension

The preceding results generalize naturally to the case where there are m audit firms and the same number of different types of clients, where $m > 2$. For ease of notation, let the *ith* firm specialize in the *ith* type of client, $i \in \{1,...,m\}$. Let subscripts stand for firms, and superscripts client types. Thus, σ^i_{i+1}, for instance, represents the maximum shareholder surplus for the *ith type* of client provided by an auditor of the *i+1th* firm that specializes in the *i+1th* type of client. The sufficient conditions for the specializing equilibrium in which firms choose specializing sharing rules $(\beta^*_i, \alpha^*_i) = (\beta^{i\circ}, \frac{\kappa(\beta^{i\circ})}{\mathrm{K}(\beta^{i\circ})})$, $i \in \{1,...,m\}$, are that, at (β^*_i, α^*_i), $\sigma^i_i > \max\{\sigma^i_1,...,\sigma^i_{i-1},\sigma^i_{i+1},...,\sigma^i_m\}$ for all *i*. As before, the sufficient conditions imply that, in the equilibrium, the value of an audit provided by a specialist auditor is greater than the maximum shareholder surplus provided by other auditors. In the equilibrium, each firm audits only clients from its niche market and earns a positive economic profit equal to $n^i[\min\{\upsilon^i_i, \upsilon^i_i - \max\{\boldsymbol{\sigma}^i_j\}\} - \mathrm{K}^i_i],\ j \neq i$, where n^i denotes the total number of the *ith* type clients in both locations.

Welfare effects

The perfect competition equilibrium in the case where client type is contractible ensures that all the audits with positive value will be provided. However, this may not be true for the specializing equilibrium when client type is non-contractible. A simple

example will illustrate this point. In the basic model with two audit firms and two types of clients, the welfare of the economy is maintained at the same level in the two cases, because each type of client is audited by the firm that is efficient in providing the audit. However, suppose there exists a third type of client, the audit of which generates positive value. As is shown by Example 3.1 below, this type of client will not be served if the value of an audit is sufficiently small compared with that of the other two types.

Example 3.1: Suppose there are two types of clients and two audit firms. Let subscripts denote firms and superscripts denote client types. Client type is not contractible. The value maximizing liability-sharing rules for the two types of clients are $\beta^{1o} = 0.6$, $\beta^{2o} = 0.7$. Suppose the conditions in Proposition 3.4 are satisfied so that in equilibrium firms specialize in different types of clients: $\beta_1 = \beta^{1o}$, $\beta_2 = \beta^{2o}$. Let $\vartheta^t(\beta)$ denote the value of an audit: $\vartheta^t(\beta) = \upsilon^t(\beta) - \mathrm{K}^t(\beta)$, $t \in \{1,2\}$. The maximized value of an audit associated with the two types of clients are $\vartheta^1(\beta^{1o}) = \$40$ and $\vartheta^2(\beta^{2o}) = \$30$, while the economic profits earned from an audit are \$25 and \$27 for firm 1 and firm 2, respectively. Now consider what happens if there appears a third type of clients. The value maximizing liability-sharing rule and the maximized value of an audit for a third type client are $\beta^{3o} = 0.9$ and $\vartheta^3(\beta^{3o}) = \$2$, respectively. The number of clients is assumed the same across types. Assume that $\vartheta^1(\beta_1)$ and $\vartheta^2(\beta_2)$ are decreasing as β's increase from the current levels (i.e., β^{1o} *and* β^{2o}). Assume that $\vartheta^3(\beta)$ is decreasing as β decreases from 0.9, and that it decreases to zero at $\beta = 0.8$. Then the two firms will not serve the third type of clients if, for example, $\vartheta^1(0.8) < \$10$ and $\vartheta^2(0.8) < \$10$,

because the potential benefits of serving the third type of clients are less than the costs measured by lost rents from niche markets.

This example shows that when client type is not contractible and there are more client types than there are audit firms, it is possible that some audits with positive value will not be provided; as a result, the welfare of the economy could be lower compared with the case in which client type is contractible, although audit firms are better off with the limited monopoly power.

3.4 Concluding remarks

This chapter shows the relations between a firm's profit sharing rules and individual partners' decisions in performing various tasks in an auditing oligopoly. As in Chapter 2, with fixed audit fee contracts, the amount of effort a partner invests in an audit is influenced by the firm's liability-sharing rule, and not by the firm's revenue-sharing rule. Furthermore, the revenue-sharing rule affects an individual partner's pricing strategy through its effects on his personal payoff from engagements.

It is assumed that clients are different in that the efficient audits of different types of clients require different amounts of partner collaboration. Equilibrium sharing rules are derived separately in two cases: client type is contractible and not contractible. When client type is contractible, there exists a dominant strategy equilibrium where each firm uses the same client type specific sharing rules to induce optimal partner behavior for every type of client. The equilibrium is a perfect competition equilibrium in that, for each client, partners from competing firms bid the same price (which equals the firm's cost), and earn zero economic profit. In contrast, when client type is not contractible – which is

believed to be a more reasonable description of the situation in the real world – firms may strategically differentiate themselves by choosing different sharing rules to specialize in different types of clients. In doing so, firms avoid cutthroat competition, and earn positive economic profits from clients in which they specialize. The imperfect competition due to the non-contractibility of client type benefit both firms, but may have adverse welfare effects because when there are more client types than there are audit firms, it is possible that some audits with positive value will not be provided.

The theory developed in this chapter helps explain the observed differences in the compensation plans of the Big Five firms. In addition, the theory implies that, contrary to the common view that the "Big" firms are a homogeneous group, they may have different clienteles, and may offer audit services of different quality and charge different audit fees for the same type of client. The objective of the next chapter is to empirically examine these differences within the Big Five group.

CHAPTER 4:

EMPIRICAL EVIDENCE

4.1 Empirical implications for the choice of audit firms and audit quality

Existing research on the choice of audit firms (i.e., client/auditor alignment) has focused mostly on choices between the Big Five and non-Big Five firms, with the Big Five firms assumed to provide services of higher quality. (see Simunic and Stein 1987, Francis and Wilson 1988) There are basically two arguments for the quality differentiation between the Big Five and non-Big Five. DeAngelo (1981) assumes there exist switching costs for clients and learning curves for auditors, which give incumbent auditors cost advantages over competitors and thus allow the incumbent to earn "quasi-rents" from their clients. She then argues that a large audit firm has the incentive to provide higher quality services than a small audit firm, because a large firm has more clients and hence loses more "quasi-rents" in the event of audit failure. Along the same line of thought, another argument reasons that a large firm has larger wealth exposed to legal liabilities (i.e., "deeper pocket") than a small firm, and hence large firm auditors work harder than small firm auditors (see Dye 1993, 1995).

These arguments essentially view an audit firm as a single auditor. If we look at an audit firm as a partnership, then a large firm losing more clients (or larger wealth) relative

to a small firm in the event of litigation does not necessarily imply that an individual partner suffers greater losses compared with a partner from the small firm. A counter argument could be that as the firm size gets larger, free-riding problems are likely to get worse (because more people will share the consequences of a single auditor's action), and thus a Big Five partner may work less hard than a non-Big Five partner.

Furthermore, focusing on either audit quality or audit fees, as most studies in the literature do, does not allow us to say much about the choice of audit firms, which is determined by the shareholder surplus (i.e., consumer surplus) from the purchase of audits.[1] It is not necessarily true that the shareholder surplus increases with audit quality, because the former also depends on the audit fee, and both the audit fee and audit quality are simultaneously determined by the characteristics of both the audit firm and the company. Therefore, in studying the choice of audit firms, it is more appropriate to examine the shareholder surplus; neither audit fee nor audit quality alone is adequate for understanding the issue.

To understand the shareholders' choice among the Big Five audit firms, which together dominate the market for audits of publicly held companies, we must also consider the nature of the competition of these firms. What strategies do the Big Five use to compete in the market? How do these strategies affect individual auditors' behavior, and thereby affect the shareholder surplus and the choice of audit firms?

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[1] Note that in this study, the shareholders of a company hire an audit firm to verify the manager's financial report and then decide whether or not to keep investing in the company. Hence, the shareholders are the consumers, and the shareholders or the representatives of the shareholders (e.g., the audit committee) decide which audit firm to hire. Yet, in accordance with the convention in the literature, I use clients to refer to the companies. In addition, note the difference in the role of audits between this study and the signaling literature. In the signaling literature (see Datar, Feltham, and Hughes 1991), the focus is on the conflicts of interest between the current shareholders – often referred to as an entrepreneur – and the future shareholders in an Initial Public Offering context. In that setting, the entrepreneur is identified with the manager, who has private information about the profitability of the company. Hence, in that setting, it is the entrepreneur who chooses an audit firm, and uses an audit as a signaling device.

In addressing these questions, empirical work has focused on possible industry specialization. It is conjectured that the Big Five develop specializations in different industries, and thus charge higher audit fees for clients in which they specialize. For example, using Australian data, Craswell, Francis, and Taylor (1995) find that the (then) Big Six that are defined as industry specialists charge higher audit fees than the Big Six non-specialists. However, the results are sensitive to the definition of industry specialist. They define an industry specialist as the firm that audits at least 10% of the companies or collects at least 10% of total audit fees in the industry in *any* year during the sample period 1982-1987. But the audit fee premium ceases to be (statistically) significant if the 10% threshold is raised to 20%. Moreover, a Big Five firm as a whole specializing in an industry seems to contradict the motivation behind the formation of the firm. It is generally believed that the merger of small firms to form a large firm is intended to foster specialization at the individual level and cooperation at the firm level so as to provide complementary industry expertise and comprehensive services to complex clients, whose operations are often spread across several industries.

In Chapter 3, I take a different view of the differences among companies. Rather than classifying clients based on their industries, I characterize a client by a collection of characteristics that affect the audit production and the shareholder surplus, including the risk of (financial statement) fraud, the potential damages suffered by shareholders in the event of audit failure, and the client characteristics that affect the audit technique. In particular, the audit technique describes the functional relationship between the effort profile (i.e., the mix of auditors' effort-inputs in an audit) and the audit quality (represented by the probability of detecting material misstatements in a financial report).

For example, the industrial dispersion of a client's operations may affect the audit technique. That is, to achieve a given level of audit quality, the audit of a company operating in several industries may require different amounts of partner cooperation from the audit of a company operating in a single industry. An individual partner could be an industry specialist, but he may need cooperation from partners with complementary industry expertise when auditing a client that operates in several industries.

My analysis views an audit firm as a partnership, and is based on the incentives in the firm and the relation between the firm's compensation structure and individual partners' behavior. It is assumed that the efficient audits of different types of clients require different effort profiles (i.e., different amounts of partner cooperation). However, as was argued in Chapter 3, it is unlikely that client type is contractible for partner compensation purposes; therefore, an audit firm cannot use client type specific compensation plans to induce efficient effort profiles for all types of clients simultaneously. Yet I illustrate, through a stylized model, the idea that audit firms in an oligopoly may strategically choose different compensation plans to specialize in different types of clients, and thereby develop different niche markets and earn positive economic profits. Unlike industry specialization, in my analysis, an auditor being a specialist for a type of client does not mean that he has specialized skills at performing the audit, but rather means that the firm's compensation plan induces a more efficient effort profile for the type of client in which the firm specializes, compared with the rival firm.

Two important implications of the theory are (a) audit firms in an oligopoly may use different profit sharing rules and thus have different clienteles, and (b) for the same type of client, auditors from different firms may provide services of different quality because

firms use different liability-sharing rules, which induce different effort profiles for the audit of the same type of client. The purpose of this chapter is to seek empirical evidence that supports or refutes the theory.

4.2 Empirical evidence

4.2.1 Differences in compensation plans among oligopolistic audit firms

In December 2000, we interviewed two partners from Arthur Andersen and KPMG, two of the Big Five audit firms, to obtain information about partner compensation in their firms.[2] I find that the compensation plans of the two firms differ considerably. In KPMG, legal liabilities are primarily allocated to national partnerships where they are incurred, whereas in Arthur Andersen legal liabilities are almost equally shared among firmwide partners.[3] Furthermore, in KPMG, the profit of a national partnership – which equals the national firm's revenues minus operating expenses including allocated legal liabilities – is shared among partners within the country, with office profitability being the most important factor in determining individual partners' compensation. In contrast, in Arthur Andersen the firm's profit is shared among partners worldwide, and office profitability is not an important factor in determining individual partners' compensation.

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[2] Professor Dan Simunic, the supervisor of my Ph.D. thesis, and I conducted the interview together. The partners we interviewed are Mr. Malcolm Clay from KPMG and Mr. Olin Anton from Arthur Andersen. They were in the Vancouver offices of these firms.

[3] Specifically, in KPMG, a national firm is self-insured for litigation claims up to a certain amount; bigger claims are insured by the international firm. But even the insured part will be ultimately attributed back to the national partnership where it is incurred. In contrast, Arthur Andersen has its own captive insurance company. Insurance premiums paid by national firms are based not on performance, but on the legal environments in different countries. Liabilities above the insured level are equally shared among firmwide partners. During the interview, we learned that Arthur Andersen has two kinds of partners: "national partners" and "global partners". Strictly speaking, "national partners" (also called "salaried partners") are not true partners because they receive salaries and bonuses, and do not share in the firm's profits and losses. Thus, in this study the partners refer only to the true global partners.

The differences in compensation plans among the (then) Big Eight audit firms are documented in Trompeter's Ph.D. dissertation (1988). Based on his survey and interviews in the 1980's, Trompeter divides the Big Eight firms into officewide firms and worldwide firms according to the importance of local office profitability in the determination of individual partners' compensation. Table 1[4] is an excerpt from Appendix 7 of Trompeter's thesis (1988, 184-187). Partners' responses are made on a 7-point scale where higher numbers indicate stronger agreement with the statement.

Table 1 shows that office revenue/liability is a more important factor in the determination of individual partners' compensation in "officewide firms" than it is in "worldwide firms". This is consistent with my observation of the difference in compensation plans of KPMG and Arthur Andersen. The empirical investigation in this study is based on the comparison between Arthur Andersen and KPMG, using the U.S. data.

4.2.2 Choice of audit firms

Anecdotal evidence

The theory suggests that oligopolistic audit firms using different compensation schemes have different clienteles. From information gathered from the U.S. Senate 1975 survey and "Who Audits America" (1978-1994), I note that the clients of Arthur Andersen and KPMG differ in size.

[4] All the tables are collected in Appendix 2.

Based on the U.S. Senate survey (1975, 30-31, 421) of the (then) Big Eight firms, Table 2 presents client distribution for Arthur Andersen (AA) and KPMG[5] in 1975 regarding two groups of companies: corporations listed on either New York Stock Exchange (NYSE) or American Stock Exchange (ASE), and public corporations not listed on these exchanges plus private corporations. Table 2 indicates that both firms serve public corporations as well as private corporations, and that, relative to Arthur Andersen, a greater proportion of KPMG's clients are corporations not listed on major stock exchanges.

Table 3 and Table 4 are based on "Who Audits America" 1986 edition and 1994 edition, respectively. Note that the book "Who Audits America", and hence the sample, includes only publicly held companies. Table 3 shows the number of clients audited by each firm as of 1986 in each category based on the size of the company's sales. Without considering client characteristics, the 2,237 publicly held companies are about equally split between hiring Arthur Andersen and hiring KPMG. However, Table 3 shows that the larger the client in terms of sales, the more likely it hires Arthur Andersen, and that the smaller the client, the more likely it hires KPMG. In particular, for clients with sales between 1 million to 100 million dollars, a greater proportion of the sample clients choose KPMG over Arthur Andersen, while for clients with sales over 100 million dollars, a greater proportion of the sample clients choose Arthur Andersen over KPMG. Similar observation holds for Table 4.

Due to data availability, the empirical tests in this study examine publicly traded companies, or, more precisely, companies on the Compustat data files with non-missing

[5] KPMG refers to Peat, Marwick, Mitchell & Co., the legacy firm of KPMG. Peat, Marwick, Mitchell & Co. and Klynveld Main Goerdeler (KMG) merged into KPMG in 1987.

values for regression variables. However, a relatively high proportion of KPMG's clients are private companies and small public companies, as is shown in Tables 2-4. Private companies are not included in the Compustat database; in addition, small public companies are more likely to have missing values for regression variables than large public companies in the Compustat database. As a result, KPMG's clients are likely to be under-represented in the sample, which may reduce the power of the tests.

Logistic regression model

When the shareholders of a company decide to choose among the Big Five firms[6], it has five discrete alternatives. If the shareholder surplus from an audit differs depending on which audit firm provides the service, as the theory suggests, then the shareholders should align with the audit firm that provides them with the highest surplus.

Let the subscript i denote the audit firm, and superscript t denote the client type. Recall from Chapter 3 that the maximum shareholder surplus provided by an auditor equals the gross benefit the shareholders obtain from the audit minus the auditor's break-even price for the engagement:

$$\sigma_i^t = \upsilon_i^t - \underline{P}_i^t \tag{4.1}$$

where

[6] This study does not address the choice between the Big Five and non-Big Five firms. The shareholders' preference for the Big Five over non-Big Five firms could be due to various reasons. First, since the pay is higher in the Big Five relative to the non-Big Five firms, the Big Five are more likely to attract more competent people. Second, a Big Five firm has better insurance arrangement and diversification, and thus is less likely to go bankrupt than a non-Big Five firm. Third, a Big Five firm has more partners with different specialties, and thus may provide audits to complex clients more efficiently compared with a non-Big Five firm.

$\upsilon_i^t = (1-\phi^t)(1-\mu^t(e^{t*},c^{t*}))\psi(\mu^t(e^{t*},c^{t*}))vV_b^t + (1-\phi^t)\mu^t(e^{t*},c^{t*})(V_b^t - w)$,[7]

$\underline{P}_i^t = \dfrac{\kappa_i^t}{\alpha_i}$,

$\kappa_i^t \equiv \kappa^t(\beta_i) = \beta_i^t[1-p^t(e^{t*}, c^{t*})]l^t + e^{t*} = \beta_i\,(1-\phi^t)(1-\mu^t)\psi(\mu^t(e^{t*},c^{t*}))vV_b^t + e^{t*}$;

(e_i^{t*}, c_i^{t*}) are determined by the following conditions according to Proposition 3.1:

$$\beta_i\, p_e^t(e,c)vV_b^t - 1 = 0, \tag{4.2}$$

$$(1-\beta_i)p_c^t(e,c)vV_b^t - 1 = 0, \tag{4.3}$$

where $p^t(e,c) = 1-(1-\phi^t)(1-\mu^t(e,c))\psi(\mu^t(e,c))$.

Note the following two remarks about the (maximum) shareholder surplus from an audit. First, the client's characteristics, which affect the audit production and the shareholder surplus, include the risk of (financial statement) fraud (1-ϕ^t), the damages suffered by shareholders in the event of audit failure V_b^t, and those characteristics that affect the audit technique $\mu^t(\cdot)$. Second, the client's characteristics do not change across audit firms. However, the shareholder surplus may differ across audit firms because the same set of client characteristics may have different effects on audit production in different firms due to the differences in the compensation structures of these firms.

I assume that the shareholder surplus σ_i^t is a linear function of the client's characteristics (or a linear function of the transformations of the client's characteristics).[8]

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[7] In this chapter, I also consider the variation of V_b (i.e., the potential damages from an audit failure) across client types, while V_b is assumed constant across types in Chapter 3.

[8] I do not know the functional form of the audit technique, and thus I do not know the exact relationship between client characteristics and the shareholder surplus. The linearity assumption is to facilitate empirical analysis. Nevertheless, an important task of empirical analysis is to approximate the relationship by examining data.

Based on the second remark about the shareholder surplus, I note that the client's characteristics do not vary across audit firms, and that the coefficients on these characteristics may be audit firm specific. That is,

$$\sigma_i^t = \mathbf{z}^{t\prime}\varsigma_i \tag{4.4}$$

where $\mathbf{z}^t$ is a vector of a client's characteristics (or transformations of the characteristics), and ς_i is a vector of unknown parameters, which may differ across audit firms.

The unobservable shareholder surplus σ_i^t explains the discrete choice of audit firms. That is, for a client of type t, the auditor whose σ_i^t (i.e., the maximum shareholder surplus) is the highest wins the engagement. This warrants the use of a multinomial choice model. Notice that a multinomial choice model has the property that the odds between any two choices do not depend on the other choices.[9] Thus, I can analyze the odds between hiring Arthur Andersen versus KPMG by estimating a binomial logistic model as follows:

$$\ln[\frac{prob(Auditor = AA)}{prob(Auditor = KPMG)}] = \mathbf{z}^{t\prime}(\varsigma_{Andersen} - \varsigma_{KPMG}),$$

Let $\varsigma \equiv \varsigma_{Andersen} - \varsigma_{KPMG}$. My objective is to estimate ς, which describes the effects of the client characteristics on the odds ratio between hiring Arthur Andersen versus KPMG.

Selection of independent variables

The selection of independent variable is based on the theory developed in Chapter 3. In particular, the variables are chosen to capture the client characteristics that determine

[9] For reference, please see Davison and MacKinnon (1993).

the shareholder surplus σ_i^t. As is shown by (4.1) – (4.3), these characteristics include the risk of (financial statement) fraud, the financial damages from an audit failure, and those characteristics that affect the audit technique. I now discuss the effect of each of the characteristics on the shareholders surplus and the measurement of these characteristics.

a. The risk of (financial statement) fraud

The risk of (financial statement) fraud, represented by $(1-\phi^t)$ in the model, refers to the likelihood that the manager's financial report contains material misstatements. The risk of fraud affects the shareholder surplus in many ways. First, it directly affects the shareholders' (gross) benefit from an audit υ_i^t and the engagement partner's break-even price $\underline{P}_i^t$, as is shown by (4.1). Second, examining (4.2) and (4.3), we know that the risk of fraud affects the equilibrium effort profile (e_i^{t*}, c_i^{t*}), which will in turn affect the shareholder surplus. Third, the risk of fraud may affect the audit technique $\mu^t(\cdot)$. The reason is as follows. To achieve a given level of audit quality, the audit of a high-risk client may require different amounts of partner collaboration compared with the audit of a low-risk client. During the interview with the partners from Arthur Andersen and KPMG, they informed us that the audit risk is a main factor that contributes to intensive internal reviews of working papers among partners. We know from (4.2) and (4.3) that the audit technique affects the effort profile (e_i^{t*}, c_i^{t*}), which will in turn affect the shareholder surplus.

There are many motives for fraudulent financial reporting. Based on real world observations and prior studies, I consider two related motives: financial distress and raising funds through the sale of stocks. Financial distress is viewed as a possible motive

for fraud because the more likely the company will go bankrupt, the greater incentives the manager has to commit financial statement fraud for fear of losing his job, job-related benefits, and personal wealth invested in the company's stocks. Loebbecke, Eining, and Willingham (1989) show that 19% of the fraud companies in their sample have solvency problems.

Related to financial distress, raising funds through the sale of stocks is one of the most cited reasons for financial statement fraud. Kellogg and Kellogg (1991) state that one of the main reasons for financial statement fraud is to encourage investors to buy a company's stocks as shareholders, or to lend money to the company as creditors. Encouraging investment in the company's stocks is also listed in National Association of Certified Fraud Examiners (1993) as one of the main reasons for financial statement fraud. Examining motivations for financial statement fraud discussed in the Accounting and Auditing Enforcement Releases, Dechow, Sloan, and Sweeney (1996, 10) show that the most frequently cited motivation is to raise funds through the issuance of stocks.

Since audits are usually performed throughout the (fiscal) year (including the review of quarterly statements), shareholders choose an audit firm at the end of the previous year based on information available at that time. Therefore, client characteristics at the end of the year $t-1$ (or equivalently at the beginning of the year t) are used to explain the choice of audit firm for the year t.

Based on Dechow, Sloan, and Sweeney (1996), I use Free Cash Flow to measure the level of financial distress, and use the actual issuance of stocks to capture the manager's incentives to raise external funds at favorable terms.[10] Free Cash Flow (FCF hereafter)

[10] There are two differences between the variables used in this study and those used in Dechow, Sloan, and Sweeney (1996). First, rather than using Free Cash Flow, they construct an indicator variable, which equals

indicates how well the firm's capital investment can be financed internally by operating cash flow, or by current assets if the desired level of capital expenditure exceeds operating cash flow. Dechow, Sloan, and Sweeney (1996) use FCF to measure the firm's ex ante demand for external financing, while I use it to measure financial distress because financially distressed companies are likely to have insufficient funds to meet their capital investment requirements. There is no inconsistency if we view financial distress as one of the reasons for external financing.

FCF for the year $t-1$ measures financial distress experienced by the manager at the end of the year $t-1$; therefore, FCF relates to the manager's incentives to manipulate financial statements during the year t, and to the shareholders' perception of the manager's incentives when they choose an audit firm at the end of the year $t-1$. The average capital investment for the years $t-2$ and $t-3$ is used to measure the desired level of capital investment for the year $t-1$. Let the subscript t stand for time. FCF_{t-1} is calculated as the difference between the operating cash flow and the desired level of capital investment for the year $t-1$ divided by current assets at the beginning of the year $t-1$. That is:

$$Free\ cash\ flow_{t-1} = \frac{Operating\ cash\ flow_{t-1} - Average\ capital\ \exp enditure_{t-3\ to\ t-2}}{Current\ assets_{t-2}}$$

where:

$$Operating\ cash\ flow_{t-1} = NI_{t-1} + DEP_{t-1} + E_{t-1} + G_{t-1} + T_{t-1} + (CL_{t-1} - CL_{t-2}) - (CA_{t-1} - CA_{t-2}) + (C_{t-1} - C_{t-2}) - (SD_{t-1} - SD_{t-2}),$$

1 if Free Cash Flow is less than -0.5, meaning that the difference between the expected level of capital expenditure and operating cash flow can be financed solely by current assets for less than two years. I use Free Cash Flow in this study. Second, they collect information on security issuance from Securities Data Corp., while I obtain the information from Compustat item #108, which represents funds received from issuance of common and preferred stocks.

where NI is earnings before extraordinary items, DEP is depreciation and amortization expenses, E is equity in earnings of unconsolidated subsidiaries (i.e., the amount of dividends received from unconsolidated subsidiaries), G is other funds from operations (e.g., amortization of goodwill on unconsolidated subsidiaries), T is deferred tax expense, CL is current liabilities, CA is current assets, C is cash equivalents, SD is debt in current liabilities (see Lee, Ingram, and Howard 1999).

Altman's Z-score (Altman 1968) and Ohlson's bankruptcy prediction models (Ohlson 1980) are often used in empirical accounting research to measure financial distress. Hammer (1983) shows that these models do not have significant differences in predicting bankruptcy. These models are based on variables that measure the company's profitability and liquidity. However, the variables that measure the company's profitability, such as retained earnings and market value of equity, are likely to be affected by the manager's earnings manipulation. For example, Dechow, Sloan, and Sweeny (1996, 17) report that, compared with a control sample, the median for the market value of equity is significantly higher for the sample of companies subject to the SEC enforcement actions.[11] In addition, Summers and Sweeney (1998) find a significant positive relation between fraud and the return to assets (i.e., the ratio of earnings before extraordinary items to assets) in the year prior to the occurrence of fraud compared with no-fraud companies, and find no significant relation between fraud and the Z-score.

[11] The test sample consists of companies that violated the financial reporting requirements of the Securities Exchange Act of 1934, and thus were subject to enforcement actions by the SEC during 1982-1992.

Using FCF as a measure of financial distress minimizes the effects of the manager's earnings manipulation on the measure.[12]

The second motive for financial statement fraud examined in this study is raising external funds through the sale of stocks. I use the actual existence of stock issuance in the year t to capture the manager's incentive to overstate earnings during the year t, and assume that the issuance of stocks in the year t is anticipated by the shareholders when they choose audit firms at the end of the year $t-1$. "Issuance_t" is an indicator variable; it equals 1 if the company issues stocks in the year t, and 0 otherwise.

Corporate governance serves as a deterrent to fraud. Client exchange listings are used to measure different levels of corporate governance. As Jiambalvo (1996) suggests, different exchanges have different requirements on corporate governance. In particular, audit committee[13] policies are different among stock exchanges. The New York Stock Exchange (NYSE hereafter) requires that audit committee consist only of independent members. The American Stock Exchange (ASE hereafter) and NASDAQ did not impose the audit committee independence requirement until the year 2000. Moreover, companies listed on NASDAQ are often less mature with inexperienced personnel and less internal control relative to companies listed on NYSE and ASE. Companies that are traded on other stock exchanges do not need to meet as stringent requirements of corporate governance as companies traded on major stock exchanges. Thus, stock exchanges are used as a crude measure of corporate governance. Stock exchange, denoted by Exchg, is

[12] In a sensitivity test, I re-run the logistic regression replacing FCF with Altman's Z-score as an alternative measure of financial distress. The results remain qualitatively the same.

[13] The role of audit committee includes the oversight of the manager's financial reporting process, the review of the internal control system, and communication with internal and external auditors.

set to numbers from 1 to 5. Exchg is equal to 1 if the company is listed on NYSE, 2 if ASE, 3 if NASDAQ, 4 if regional stock exchanges, and 5 if others. Hence, smaller numbers indicate better corporate governance.

b. Damages in the event of audit failure

The financial damages suffered by shareholders in the event of audit failure are represented by V_b^t in the model (i.e., the shareholders' investment in a bad company). The potential damages affect the shareholder surplus in two ways. First, they have direct effects on the shareholders' (gross) benefit from an audit υ_i^t, and on the engagement partner's break-even price $\underline{P}_i^t$, as is shown by (4.1). Second, we know from (4.2) and (4.3) that the potential damages influence the equilibrium effort profile (e_i^{t*}, c_i^{t*}), which in turn affects the shareholder surplus. Market Value of Equity is used as a proxy for the potential damages as it represents the shareholders' investment in a company that could be lost due to fraud and audit failure.[14]

As was explained earlier, the information at the end of the year $t-1$ (or equivalently, at the beginning of the year t) is used to explain the choice of audit firm for the year t. Thus, market value of equity at the end of the year $t-1$ is used as a proxy for the damages from an audit failure related to the audit for the year t.

[14] In Chapter 3, I consider a setting where the shareholders decide whether to continue or liquidate their company, and measure the potential damages from an audit failure by the liquidation value of the company. In a sensitivity test, I re-run the logistic regression replacing the market value of equity with the liquidation value of equity (i.e., a Compustat item that measures the shareholders' interest in a company in the event of liquidation of company assets) as a measure of the financial damages. The empirical results remain qualitatively the same.

c. Audit technique

Audit technique, represented by $\mu^t(\cdot)$ in the model, describes the functional relationship between the effort profile (i.e., the mix of auditors' effort-inputs in an audit) and audit quality. As is shown by (4.1) – (4.3), audit technique affects effort profile (e_i^{t*}, c_i^{t*}) and the shareholder surplus σ_i^t. Client characteristics that affect the audit technique may include the following: (a) Total assets. To achieve a given level of audit quality, the more assets the client has, the more effort the engagement partner puts forth in verifying the existence and the value of various assets. If the client operates in multiple industries and/or locations, greater assets also imply more cooperation among partners. (b) The risk of financial statement fraud. To achieve a given level of audit quality, the greater the risk of fraud, the more effort is needed from both the engagement partner and the reviewing partner(s). (c) Industrial dispersion. To achieve a given level of audit quality, the more industry segments over which a client's operations are spread, the more cooperation the engagement partner may need from partners with complementary industry specialties. (d) Geographic dispersion. To achieve a given level of audit quality, the more geographically different locations in which a client operates, the more cooperation the engagement partner may need from partners of other jurisdictions.

The information at the end of the year $t-1$ (or equivalently, at the beginning of the year t) is used to explain the choice of audit firm for the year t. Therefore, I include in the model the total assets, the number of different industry sectors, and the number of different geographic regions at the end of year $t-1$ to capture the effects of audit technique on the choice of audit firm for the year t.

Based on the above analysis, a binomial logistic model is estimated to analyze the effects of client characteristics on the odds ratio between hiring Arthur Andersen versus KPMG. Total Assets and Market Value of Equity have been transformed using natural log's in an effort to minimize the effects of heteroskedasticity and the influence of extreme values on parameter estimates. The model is:

$$\ln[\frac{prob(Auditor_t = Andersen)}{prob(Auditor_t = KPMG)}] = \varsigma_0 + \varsigma_1 Lat_{k,t-1} + \varsigma_2 Fcf_{k,t-1} + \varsigma_3 Issuance_{kt} + \varsigma_4 Lmv_{k,t-1} + \varsigma_5 Exchg_{k,t-1} + \varsigma_6 Indnum_{k,t-1} + \varsigma_7 Geonum_{k,t-1} + \varepsilon_{kt}$$

where:

Subscripts k and t refer to the client and the time, respectively;

$Lat_{k,t-1}$: natural log of total assets;

$Fcf_{k,t-1}$: free cash flow;

$Issuance_{kt}$: indicator variable, which equals 1 if there is an actual issuance of equity in the year t, and 0 otherwise;

$Lmv_{k,t-1}$: natural log of market value of equity;

$Exchg_{k,t-1}$: stock exchange, which equals 1 if NYSE, 2 if ASE, 3 if NASDAQ, 4 if Regional Stock Exchange, 5 if others.

$Indnum_{k,t-1}$: the number of business segments collected by Standard & Poor's for the company. A business segment is an industry segment or product line. The number varies from 1 to 10.

$Geonum_{k,t-1}$: the number of geographic segments collected by Standard & Poor's for the company. A geographic segment is a region, territory, or area where a company has operations and reports financial outcomes. The number varies from 1 to 5.

The sample

The sample consists of actively traded U.S. companies on the Compustat data files between 1996 and 2000 that appoint either Arthur Andersen or KPMG as audit firms. The year 1996 is chosen as a cutoff because the numbers of geographic and industry segments are not available before 1996. The year 2000 is chosen as a cutoff because the Enron debacle, which caused the collapse of Arthur Andersen, occurred in 2001. Financial institutions (i.e., companies with SIC codes from 6000 to 6999) are deleted due to the special nature of the industry. Observations with missing values for independent variables are excluded. The final sample consists of 4839 company-year observations, among which 2702 company-years are audited by Arthur Andersen, and 2137 by KPMG.

Descriptive statistics

Table 5 presents descriptive statistics for independent variables for the two samples of clients of Arthur Andersen and KPMG. The t-statistic and z-statistic measure the (statistical) significance of the mean and median difference between samples, respectively. For the continuous variable Lat, both the t and z statistics are positive and (statistically) significant, suggesting that Arthur Andersen's clients are more likely to have large assets than KPMG's clients. In addition, the z-statistic is positive and significant for the discrete variable Indnum, and is negative and significant for the discrete variable Exchg. This implies that Arthur Andersen's clients are more likely to operate in multiple industries and more likely to be traded on exchanges denoted by smaller numbers (i.e., NYSE and ASE), compared with KPMG's clients.

Neither the mean nor the median for the variable Lmv is significantly different between the two samples. This implies that the financial damages from an audit failure do not differ between the clients of the two firms.

For the variables used to proxy for the risk of fraud (i.e., Fcf and Issuance) and for geographic dispersion (i.e., Geonum), the two samples of clients are not significantly different in central tendencies (i.e., mean or frequency or median). Notice that all the companies in the sample have at least two geographic locations (i.e., $Geonum \geq 2$), which means they all have foreign operations. Publicly traded local companies are not included in the sample probably due to missing values for regression variables. As was discussed earlier, KPMG's clients are likely to be under-represented in the sample because a relatively higher proportion of KPMG's clients are small companies compared with Arthur Andersen (see Tables 2-4).

Logistic regression results

Table 6 presents the correlation matrix for independent variables. The correlations between variables are not very high except for the correlation between Lat and Lmv (which is 0.83). However, as will be shown by the logistic regression results, coefficient estimates for both variables are highly significant, suggesting that multicollinearity does not pose a problem.

Lat is highly correlated with Lmv. In addition, Lat is quite highly correlated with Exchg, Indnum, and Geonum. This confirms the intuition that companies with large total assets have larger market capitalization, tend to be listed on major stock exchanges, and

are more industrially and geographically dispersed than companies with small total assets.

Table 7 presents logistic regression results. The overall model is statistically significant at the 0.001 level according to the Likelihood Ratio statistic. The coefficient on Lat is positive and highly significant. This suggests that companies with large assets are more likely to choose Arthur Andersen over KPMG than companies with small assets, other things equal. After controlling for total assets, the coefficients on Indnum and Exchg are not significant, the central tendencies for which are significantly different between the clients of the two firms in the univariate analysis. It is likely that their effects on the odds ratio have been captured by total assets. The coefficient on Lmv is negative and significant. The interpretation for this will be discussed later.

Since coefficients on variables other than Lat and Lmv are statistically insignificant, I reduce the full model to a partial model that includes only Lat and Lmv as independent variables. I refer to the original full model and the partial model as Model 1 and Model 2, respectively. The regression results for Model 2 are shown in Table 8. Model 2 is statistically significant at the 0.001 level according to the Likelihood Ratio statistic. The Likelihood Ratio test that compares the two models shows that Model 1 is not an improvement over Model 2; the Chi-squared value equals 6 with 5 degrees of freedom, not significant ($p=0.30$). Hence, Model 2 is chosen over Model 1.

In order to interpret the negative coefficient on Lmv, I run regressions including only Lat or only Lmv, one at a time. The results are shown in Table 8. When only Lat is included in the model (referred to as Model 3), the coefficient on Lat is positive and highly significant, and the model is significant at the 0.001 level. In contrast, when only

Lmv is included in the model (referred to as Model 4), the coefficient on Lmv is not significant, neither is the model. This suggests that the variable Lmv has an impact on the odds ratio only through adjusting the effect of Lat on the odds ratio. Observe that Lat incorporates two factors: audit complexity (which affects the audit technique), and the potential damages from an audit failure, as is reflected by its high correlation with the damage measure Lmv. But the damages per se do not have an influence on the odds between hiring one firm versus the other firm; therefore, the variable Lmv is used to adjust for the damage factor incorporated in Lat. In other words, including Lmv in the model provides a better estimate of the effect of audit technique on the odds ratio by "subtracting" the damage factor incorporated in the variable Lat.

Table 9 shows that Model 2 predicts 91% of Arthur Andersen's clients correctly, while it predicts only 10% of KPMG's clients correctly (based on a threshold value of 50%), with the overall percentage of correct prediction equal to 55.1%. To interpret this result, we need to take two considerations in mind. [15] First, as was mentioned before, KPMG's clients are likely to be under-represented in the sample, and thus we have fewer observations for KPMG than for Arthur Andersen. This sampling problem reduces the predictive power of the model. Second, Maximum Likelihood Estimation means that the coefficients are chosen to maximize the joint likelihood of the dependent variables, not the predictive power of the model. For example, for Model 2, the overall percentage of correct prediction is 55.1%, whereas the percentage increases to 56.3% for Model 3. However, the coefficient estimate on Lat is biased in Model 3. The Likelihood Ratio test comparing Model 2 and Model 3 shows that Model 3 suffers from omitted variable

[15] These considerations are inspired by Greene's discussion of the issues related to different Goodness of Fit Measures for binomial choice models (Greene 1990, 682-683).

problem (Chi-squared value = 22, d.f.=1, $p<0.001$). Therefore, if the focus is on obtaining good estimates of the effects of client characteristics on the odds ratio, Model 2 should be chosen; if the focus is on getting a model with good predictive power, Model 3 should be chosen, but the parameter estimate is biased.

The main result from the logistic regression analysis is that total assets have a significant positive effect on the odds between hiring Arthur Andersen versus KPMG. Moreover, to correctly estimate the effects of total assets on the odds ratio, the damage factor incorporated in total assets should be "subtracted" by including a damage measure (e.g., market value of equity) in the model.

The results are consistent with the theory that client characteristics that affect audit production and shareholder surplus have impacts on the shareholders' choice between oligopolistic firms with different compensation structures. Furthermore, the descriptive information about the compensation plans used in Arthur Andersen and KPMG helps us interpret the results. Intuition suggests that the efficient audits of large companies require more of partner cooperation, and that the efficient audits of small companies require less of partner cooperation. Arthur Andersen's liability-sharing rule is likely to induce more cooperation among firmwide partners, compared with KPMG, while KPMG's liability-sharing rule seems more tailored to the audit technology for relatively small companies. Hence, it is likely that Arthur Andersen specializes in the large company sector, while KPMG specializes in the relatively small company sector. Consistent with the intuition, empirical results show that companies with large total assets are more likely to choose Arthur Andersen over KPMG.

4.2.3 Audit quality

The theory states that, in a specializing equilibrium, shareholders purchase audits from the specialist auditors, who provide the highest shareholder surplus. In the real world, however, there may exist other factors not captured in the model that affect the actual auditor/client alignments; hence, we do not expect that all clients align with the specialist firms. Given that firms use different liability-sharing rules, which induce different effort profiles for the audit of the same type of client, the quality of audits provided by different firms may differ for the same type of client. I do not predict the sign of the difference, because the specializing liability-sharing rule for a type of client maximizes the value of the audit but not necessarily the quality of the audit. To understand this, recall from Chapter 3 that the value of an audit is equal to the benefit of the audit (which is an increasing function of audit quality) net of auditors' effort costs. Therefore, it is possible that a specialist audit firm provides an audit of higher value through a combination of relatively lower quality service and considerably lower effort costs, compared with non-specialist audit firms. The objective of this section is to test whether audit quality differs between Arthur Andersen and KPMG for the same type of client.

Audit quality is not observable. Prior research has relied on various variables, such as audit fees, earnings response coefficients, accounting accruals, and litigation rates, to infer audit quality (see Simunic 1980, Teoh and Wong 1993, Becker et al. 1998, and Palmrose 1988).

In this chapter, I examine accounting accruals and provide some descriptive information about litigation rates. Compared with other measures, litigation rates may be

the best measure of audit quality, but information about lawsuits involving different types of clients is hard to collect. Compared with audit fees and earnings response coefficients, accounting accruals are more directly linked to the product of an audit – earnings. A detailed discussion of using accruals as a measure of audit quality is provided in the next section.

4.2.3.1 Difference in accounting accruals for the same type of clients

Accrual-based accounting requires managers to estimate revenues and expenses as they are incurred. This gives managers opportunities to inflate earnings by manipulating accruals. For example, Dechow, Sloan, and Sweeney (1996) show that, among a sample of companies that violated financial reporting standards, 40.2% of them inflate earnings by overstating revenues, 15.5% by both overstating revenues and understating expenses, and 13% by delaying recognizing losses or understating loss reserves.

The effect of accruals on earnings for a given accounting period will be reversed in the future periods. Initially, a manager who has the incentive to inflate earnings will use accounting procedures within Generally Accepted Accounting Principles (GAAP). If he wants to cover up the reversing effect of accruals on earnings or continue to inflate earnings in the future periods, he will be more aggressive in using accounting procedures both within and outside GAAP, and even make up fictitious transactions when he has little room to manipulate accruals. The effect of fictitious transactions on earnings will not be reversed in the future. In this study, I use five-year cross sectional data to examine the relation between accruals and the choice of audit firms. Thus, the short-term earnings management (e.g., one year manipulation) is likely to have a very small effect on test

results because the effects of accruals on earnings sum to zero in a longer time window, and because a company generally stays with one audit firm for many years.

Lee, Ingram, and Howard (1999) show that large positive accruals (adjusted for company size) could be an indicator for aggressive accounting or even fraud. They compare accruals[16] scaled by assets for 56 fraud companies during 1978 –1991 with a control sample of no-fraud companies. They find the statistic (i.e., accruals scaled by assets) for fraud companies is considerably larger than for non-fraud companies. In particular, 64% of the fraud companies have a statistic greater than the upper 10% of the distribution of no-fraud firms, suggesting that large accruals per dollar of assets could be a "red flag" for fraud.

High quality audits are more likely to detect misstatements of earnings – which affect accruals but not cash flows – than low quality audits, and thus the accrual levels are expected to differ between audits of different quality. This leads to my hypothesis that, for the same type of client, the accruals differ between Arthur Andersen and KPMG after controlling for client characteristics that affect accruals.

The difficulty is how to identify client types empirically. The results in Section 4.2.2 indicate that Arthur Andersen's niche market is likely to be companies with large assets, while KPMG's niche market is likely to be companies with relatively small assets. Accordingly, I divide the sample into four groups based on total assets, and investigate whether accruals are affected by the choice of audit firms within each size group after controlling for client characteristics that affect accruals.

Accruals are calculated as earnings (NI) minus operating cash flow (OCF):

[16] They add depreciation expenses to accruals.

$$Accruals_t = NI_t - OCF_t,$$

where OCF_t is calculated as in Section 4.2.2. Several client characteristics affect accruals. First, the absolute value of accruals increases with client size. This is the reason why researchers often scale accruals by total assets in empirical studies. However, in scaling accruals by total assets, they basically assume a linear relationship between the two variables. Examining the relationship between accruals and assets by plotting one against the other, I find that the linear assumption describes the relationship poorly, and that the log transformations of the variables fit the linear relationship much better. Second, managers' incentives influence accruals. Based on the discussion in Section 4.2.2, the prior year free cash flow (Fcf_{t-1}) and the existence of stock issuance in the year t ($Issuance_t$) are used to control for differences in managers' incentives to manipulate accruals in the year t due to financial distress and the sale of stocks. Finally, the stock exchange at the beginning of year t is used to control for differences in corporate governance.

Accruals are positive when earnings exceed operating cash flow, and negative otherwise.[17] When accruals are negative, it is more likely that managers are engaged in income *decreasing* accrual management than when accruals are positive. Anecdotal evidence and prior studies suggest that lawsuits against auditors involve overstatement of earnings, not understatement of earnings (see St. Pierre and Anderson 1984). Hence, auditors may not be as concerned about income decreasing accruals as about income increasing accruals. Thus, I estimate the following regression model, allowing

[17] The probability of accruals being zero is generically zero.

coefficients on independent variables to be different depending on the sign of the accruals:

$$
\begin{aligned}
Laccr_{kt} = {} & \gamma_0 + \gamma_1 Lat_{k,t-1} + \gamma_2 Issuance_{kt} + \gamma_3 Fcf_{k,t-1} + \gamma_4 Aud_{kt} + \gamma_5 Exchg_{t-1} \\
& + \gamma_6 Neg_{kt} + \gamma_7 (Neg_{kt} \times Lat_{k,t-1}) + \gamma_8 (Neg_{kt} \times Issuance_{kt}) \\
& + \gamma_9 (Neg_{kt} \times Fcf_{kt-1}) + \gamma_{10} (Neg_{kt} \times Aud_{kt}) + \gamma_{11} (Neg_{kt} \times Exchg_{kt-1}) + \varepsilon_{kt}
\end{aligned}
$$

where

$Laccr_{kt}$: natural log of the absolute value of accruals for the year t;

$Lat_{k,t-1}$: natural log of total assets at the beginning of the year t;

$Issuance_{kt}$: indicator variable, which equals 1 if there is an actual issuance of equity in year t, and 0 otherwise;

$Fcf_{k,t-1}$: free cash flow for the year t-1.

Aud_{kt}: indicator variable, which equals 1 if the audit firm in the year t is Arthur Andersen, and 0 if the audit firm is KPMG;

Neg_{kt}: indicator variable, which equals 1 if the accruals for the year t are negative, and 0 otherwise.

Descriptive statistics

Table 10 divides the sample into four groups according to the total assets in a descending order. It shows that over 57% of the top 75% of the sample companies choose Arthur Andersen, while the bottom 25% of the sample companies split equally between Arthur Andersen and KPMG.

Observations with missing values for accruals are deleted. Descriptive statistics for each size group are presented in Table 11.

Except for the first group, for the variables that proxy for the risk of financial reporting fraud (i.e., Fcf and Issuance), there is no (statistically) significant difference in the central tendency (i.e., mean or median or frequency) between the clients of the two firms. For the first group, a greater proportion of KPMG's clients sold stocks than Arthur Andersen's clients, and the difference is significant. Also note that there is no significant difference in the proportion of clients having negative accruals between the clients of the two firms for any group. In each group, fewer than 30% of companies have positive accruals. Furthermore, for the first two groups, the difference in the median Exchg is negative and significant. This means Arthur Andersen's large size clients are more likely to be traded on exchanges denoted by small numbers (i.e., NYSE and ASE), compared with KPMG's large size clients.

For the first two groups, the difference in the mean (median) Laccr (i.e., log of the absolute value of accruals) is not significant between the clients of the two firms. But the difference in the mean Lat is positive and significant. This implies that Arthur Andersen's clients are on average larger than KPMG's clients, yet have on average the same absolute value of accruals.[18] For the third group, the difference in the mean (median) Laccr is negative and significant, while the difference in the mean (median) Lat is not significant. This implies that Arthur Andersen's clients are on average the same size as KPMG's clients, yet have on average smaller absolute value of accruals than KPMG's clients.

For the last group (i.e., the smallest size group), the difference in the mean (median) Laccr is not significant, and only the difference in the median Lat is positive and significant. This implies that Arthur Andersen's clients have on average the same

[18] More precisely, I fail to reject the null hypothesis that there is no difference in the mean (median) absolute value of accruals between the clients of the two firms.

absolute value of accruals as KPMG's clients, and that the median Lat is larger for Arthur Andersen's clients than for KPMG's clients.

Regression results

Regression results are presented in Table 12. I discuss the results for positive and negative accruals separately. Note that auditors are more concerned about overstatement of earnings than understatement, and that income-increasing earnings management is more likely to generate positive accruals as opposed to negative accruals.

When accruals are positive, coefficients on Lat are significant and positive for all size groups, suggesting a positive association between total assets and positive accruals. Most importantly, the coefficient on Aud is negative and significant for Group 3, and is positive and significant for Group 4. This implies that the relatively large companies (i.e., Group 3) audited by Arthur Andersen tend to have *smaller* positive accruals compared with the relatively large companies audited by KPMG, other things equal. Conversely, the relatively small companies (i.e., Group 4) audited by Arthur Andersen tend to have *larger* positive accruals compared with the relatively small companies audited by KPMG, other things equal.

The coefficient on "Issuance" is positive and significant for the first two groups, consistent with my conjecture that managers raising funds through the sale of stocks have incentives to inflate earnings. The coefficient on Fcf is negative and significant for the first group, consistent with my conjecture that managers facing financial distress have incentives to inflate earnings. The coefficient on Exchg is not significant for any group.

When accruals are negative, the coefficient on the interaction term ($Neg \times Aud$) is not significant for any size group. This implies that, relative to KPMG, for Group 3, Arthur Andersen has a negative effect on the absolute value of accruals, while for Group 4 Arthur Andersen has a positive effect on the absolute value of accruals. Combined with the results on positive accruals, these results suggest that for the relatively large companies (i.e., Group 3), relative to KPMG, Arthur Andersen not only reduces more of the income-increasing accruals when accruals are positive, but also reduces more of the absolute value of income-decreasing accruals when accruals are negative, although auditors are not likely to be sued for understatement of earnings. Similar observation holds for KPMG with regard to the smallest size group (i.e., Group 4).

The coefficient on $Neg \times Lat$ is significant only for Group 4, and is smaller in absolute value than the coefficient on Lat. This suggests a positive association between the total assets and the absolute value of accruals.

The effects of stock issuance on negative accruals are mixed. Stock issuance makes negative accruals more negative for Group 1 and Group 4, but makes negative accruals less negative for Group 2. In addition, for Group 1, the coefficient on $Neg \times Fcf$ is significant and positive but smaller than the absolute value of the coefficient on Fcf, suggesting that financial distress makes negative accruals more negative. The coefficients on $Neg \times Exchg$ are positive and significant for Group 1 and Group 4. This suggests that for clients with negative accruals, exchanges denoted by small numbers (i.e., NYSE and ASE) make negative accruals less negative. These relations seem to indicate that negative accruals are less likely to be discretionary, and are more likely to truthfully reflect the financial condition of a company, compared with positive accruals.

The overall results indicate that for the third group and the fourth group of clients, Arthur Andersen and KPMG have significantly different impacts on accounting accruals, and thus provide some evidence supporting the hypothesis that Arthur Andersen and KPMG offer services of different quality within the same size group.

One concern is that the differences in audit quality may be driven by the differences in the risk factors of the companies that aligned with different firms. However, the descriptive statistics in Table 11 show that the risk factors and exchange listings do not differ between the clients of the two firms for Group 3 and Group 4.

4.2.3.2 Difference in lawsuit rates for the same type of clients

Litigation rates for audit firms are direct measures of audit quality. Do the litigation rates differ between Arthur Andersen and KPMG for the same type of clients? This section addresses this question.

As in the pervious section, I classify client types based on size. Specifically, I compare litigation rates of Arthur Andersen and KPMG for each of the following two groups of companies: (a) publicly held companies, and (b) publicly held companies not listed on NYSE or ASE plus private corporations. Companies in the former group are on average larger than the companies in the latter group.

Palmrose (1988) compares litigation rates among the Big Eight firms for the period 1960-1985 for public companies. She reports that litigation rates for KPMG and Arthur Andersen are 3.6% and 3.4%, respectively. I replicate her study using a new litigation database developed by her (Palmrose 1999).[19]

[19] The litigation database includes various disputes against the Big Five firms (or their legacy firms) involving services rendered in the U.S. between 1960 and 1995. It consists of civil litigation against

Table 13 compares the number of lawsuits against KPMG with that against Arthur Andersen involving public companies for services rendered during 1960-1985. Palmrose (1988, 62) reports that, based on "Public Accounting Report" and "Who Audits America", during 1960-1985 the numbers of public clients audited by KPMG and AA are 1,456 and 1,665 respectively. Based on these numbers, I calculate litigation rates for the two firms for this period. I find that KPMG has a higher litigation rate than does Arthur Andersen: 7.1% versus 4.6%. Using a Chi-squared test, I reject the null hypothesis of no difference in the litigation rates of the two firms at the significance level of 0.006 (χ^2=9.03, d.f.=1, two tailed test). Moreover, the evidence suggests that Arthur Andersen provides services of higher quality than KPMG for public companies as a group.

Table 14 compares the numbers of lawsuits against the two firms involving public companies not listed on NYSE or ASE plus private corporations for services rendered during 1960-1985. I use the number of such companies each firm audited in 1975 as the average client base to calculate litigation rates for the period 1960-1985 (see Table 2). This approximation may not present a big problem, as the average client turnover was low for the Big Eight firms during that time period. I find that Arthur Andersen has a higher litigation rate with these clients than does KPMG: 0.85% versus 0.36%. Using the Chi-squared test, I reject the null hypothesis of no difference in the litigation rates of the two firms at the significance level of 0.001 (χ^2=24.3, d.f.=1, two tailed test). Moreover, the evidence suggests that KPMG provides services of higher quality than Arthur Andersen for these small companies as a group.

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auditors, disputes resolved with settlement outside court, and cases with enforcement actions against audit firms and/or individual auditors by the SEC or other kinds of regulators.

The results in this section are consistent with the results in Section 4.2.3.1. Namely, audit quality differs between Arthur Andersen and KPMG for companies of similar size. In addition, Arthur Andersen is likely to provide services of higher quality than KPMG for the large company sector, whereas KPMG is likely to provide services of higher quality than Arthur Andersen for the small company sector. However, the results in this section are only descriptive because the number of clients for each group is based on estimates, and the differences in the client characteristics affecting litigation rates are not controlled for.

4.3 Concluding remarks

The results from Section 4.2.2 show a significant positive association of the total assets with the odds between choosing Arthur Andersen versus KPMG, suggesting that Arthur Andersen is likely to specialize in the large company sector, whereas KPMG is likely to specialize in the small company sector. The evidence is consistent with the theory that oligopolistic audit firms, which use different compensation plans, have different clienteles. The descriptive information I have obtained about the compensation schemes of the two firms helps explain the differences in the clienteles.

The evidence from Section 4.2.3 is consistent with the theory that oligopolistic audit firms, which use different compensation plans, differ in audit quality for the same type of client. In particular, the choice of audit firms has effects on earnings management – as reflected by accounting accruals – and litigation rates for companies of similar size.

Although the results are consistent with the theory, these tests are not sufficiently powerful for us to accept the theory. There may be differences between audit firms other

than profit sharing rules that contribute to the observed difference in the clienteles and audit quality. But until we can identify these differences and form hypotheses, it is not possible to compare theories.

CHAPTER 5:

CONCLUDING REMARKS

In this chapter, I summarize the main results of this thesis, and discuss the limitations and contributions of this study and opportunities for future research.

This study examines the incentives and compensation schemes in audit partnerships. Economists have long been interested in moral hazard and contractual problems in organizations. While a substantial body of research has focused on agency problems in corporations, very little research has been done in exploring the incentive problems and contractual relationships in professional partnerships such as audit firms, law firms, and consulting firms.[1] In the accounting literature, typically, an audit firm is treated as a single profit-maximizing auditor, and we have little knowledge of the firm's reward and control systems and their effects on individual partners' behavior. One of the reasons for the lack of research on this topic is the scarcity of public information on audit firms. Although auditors perform an important function in the capital market, and large audit firms have thousands of partners, partnerships are private firms and, under current disclosure regulations, are not required to disclose information about their compensation and control systems. This impedes observations and thus academic research.

[1] See Glison and Mnookin (1985) for a discussion of profit sharing in law firms.

This study draws from conversations with practitioners, from anecdotal evidence, and from observations documented in prior studies (Trompeter 1988, Burrows and Black 1998, Zimmer and Holmes 1998). The model in this study captures many real world features of audit firms. First, audit fees are not contingent on audit outcomes (i.e., audit opinions and the success or failure of an audit), and are often fixed before audits are performed. On the other hand, legal liabilities in the event of audit failure and negligence are imposed on audit firms through a legal system. Second, partners in an audit firm make decentralized decisions in performing multiple tasks, such as soliciting clients and cooperating with each other in the performance of audits. Auditors' effort-inputs in various tasks are not contractible and have different effects on the welfare of the firm. Finally, partners do not share in the firm's profits and losses equally; rather, they base individual partners' compensation on measurable performance as reflected by the revenues and legal liabilities associated with individual partners' engagements.

The analysis is undertaken under different market structures: a competitive market and an oligopolistic market, which are intended to capture the different markets for the non-Big Five audit firms and the Big Five audit firms, respectively. The analysis of the firm's optimal choice of profit sharing plans is based on the relation of the compensation schemes to individual partners' behavior. Non-cooperative game theory is used to analyze the strategic interaction of partners within a partnership, as well as the strategic interaction of firms when the market is an oligopoly.

In each market setting, I characterize moral hazard problems with respect to partners' various decisions made in performing tasks, and show how a firm (i.e., partners as a whole) uses profit sharing rules to induce optimal decisions from the firm's perspective.

I find that partners may share legal liabilities and fee revenues in different ways, and for different purposes. The liability-sharing rule is used to foster cooperation and induce the optimal mix of partners' effort-inputs in an audit, while the revenue-sharing rule is used to induce the optimal selling strategy from the firm's point of view.

The analysis shows that the optimal liability-sharing rule requires an auditor to share some of the legal liabilities associated with his partners' engagements. Specifically, an auditor has little incentive to expend effort to help his partner in the performance of audits if he bears no liability for his partner's clients. Since the efficient provision of an audit requires teamwork, it is optimal for partners to share their legal liabilities. Further, given that teamwork is required in the performance of audits, it is also optimal for an auditor to share some of his partner's engagement revenues, not from the fairness point of view but from the efficiency point of view, because without sharing revenues, a partner's personal payoff from an engagement would exceed the firm's payoff (i.e., the payoff to the partnership as a whole), resulting in inappropriate selling strategies. For example, in the oligopolistic market setting, an auditor would bid below the firm's cost (i.e., the cost of an audit to the partnership as a whole) by offering clients too large price discounts. Revenue sharing functions like a tax imposed on each auditor to overcome his inappropriate aggressiveness in selling his services.

To capture the fact that, relative to the non-Big Five firms, the Big Five are capable of auditing a much broader range of clients, in the oligopolistic market setting I assume that clients are different in that the efficient provision of audit services for different types of clients entails different effort profiles (i.e., different mix of partners' effort-inputs). I find there may exist a specializing equilibrium where firms specialize in different types

of clients by strategically choosing different compensation plans to induce efficient effort profiles for the clients in which they specialize. A key assumption underlying the specializing equilibrium is that client type is not verifiable and thus cannot be used for partner compensation purposes. As a result, a firm cannot choose type-specific sharing rules to induce efficient effort profiles for all clients simultaneously.

In equilibrium, audit firms have different niche markets, charge prices higher than the firms' costs, and earn positive economic profits. The theory offers an explanation for the observed differences in the compensation plans of the Big Five firms, and predicts that there may exist differences in clienteles, audit quality, and audit fees within the Big Five group due to the differences in their compensation plans. Evidence from Chapter 4 supports the prediction that oligopolistic firms, which use different compensation schemes, have different clienteles and provide services of different quality for the same type of client.

To empirically test the causal relationship between the differences in compensation plans and the differences in the clienteles and audit quality, we need to control for other differences in the internal structures of audit firms that may contribute to the differences in the clienteles and audit quality. This study hopes to generate more research that may provide us with competing hypotheses.

The results from this study indicate that the non-contractibility of information has implications for social welfare. Specifically, in Chapter 2 where the market for audits is competitive and clients are identical,[2] I show that because effort is not contractible, the Pareto efficient production plan (i.e., the Pareto efficient mix of partners' effort-inputs in

[2] Clients are identical in that the efficient provision of audit services requires the same effort profile.

an audit) cannot be implemented. This is illustrated by the fact that there does not exist a liability-sharing rule that perfectly aligns individual partners' objectives with the firm's objective in the performance of an audit. I then show that any welfare loss compared with the ideal case in which effort is contractible results from the inefficiency in the performance of audits.

In Chapter 3 where the market is an oligopoly and clients are different, I show that when client type is not contractible – which is believed to be a realistic description of the situation in the real world – the equilibrium may be an imperfect competition equilibrium. Observe that perfect competition implies that all the audits with positive value will be provided. In contrast, imperfect competition may result in some audits with positive value not being provided because when there are more client types than there are audit firms, firms may find it optimal not to audit clients that generate relatively small economic profits.

This study has limitations. First, it focuses on the firm's compensation schemes, which are only part of the incentive and control systems in a partnership. For example, during the interviews with the partners, I learned that a firm has peer review systems. During a peer review, a partner's working papers are randomly selected and reviewed by inspecting partners from outside the office. One extension of the study is to look into how firms design the monitoring systems like peer reviews to induce optimal partner behavior. Second, in the model, I only consider economic incentives, while things like peer pressure, firm culture, and norms, which may play important roles in mitigating moral

hazard problems, are ignored.[3] Third, in the model, all the partners are assumed to be equally competent. Another extension of the study is to examine the firm's choice of compensation schemes when there are problems associated with both hidden action and hidden type. Fourth, this study is based on a single period model. It would be interesting to know how partners' contractual relationships change in a repeated game.

Nevertheless, this study has laid a foundation for future research on audit firms. It contributes to the accounting literature in several ways and provides a number of research opportunities. First, in the literature, limited attention has been given to the effects of the audit firm's reward and control systems on individual partners' behavior. This study is among the first few steps taken towards understanding the relations between compensation schemes of audit firms and individual partners' decisions in performing various tasks. Second, in the literature, the study of the audit firm's behavior has not been related to the incentive problems within an audit partnership. In this study, I examine the firm's behavior by linking the incentive problems within a firm with the strategic interaction of firms in the market. This approach may be applied to future studies on audit firms' behavior, and to studies examining the effects of regulations, auditing standards, and legal regimes on audit firms' behavior. Third, the literature generally treats audit firms in a dichotomous way: Big Five versus non-Big Five. This study shows that the Big Five may not be a homogeneous group, and suggests how and why individual firms may differ. More empirical tests are needed to test the implications of the theory developed in this study, and these studies will help us gain a greater understanding of the functioning of audit firms in the economy.

[3] See Kandel and Lazear (1992) for a study of the role of peer pressure in mitigating moral hazard problems in partnerships.

APPENDIX 1: PROOFS

Proof of Proposition 2.1

Substituting the selling effort choice function $a(f, \kappa)$ defined by (2.7) into (2.8), and totally differentiating (2.8) gives

$$[r + (f - \kappa)r_a a_f - a_f]df + [(-r) + (f - \kappa)r_a a_\kappa - a_\kappa]d\kappa = 0 \tag{A.1}$$

(A.1) and (2.7) implies that $r(a^o)(df - d\kappa) = 0$. But $r(a^o) > 0$. Thus, $\frac{df}{d\kappa} = 1 > 0$.

Alternatively, notice that in the equilibrium

$$f^o = \kappa^o + \frac{\bar{u} + a^o}{r(a^o)}, \tag{A.2}$$

where a^o is determined by $\frac{r(a)}{r_a(a)} = \bar{u} + a$, and is independent of κ^o and f^o. Thus, totally differentiating (A.2) gives $\frac{df}{d\kappa} = 1 > 0$.

When $\psi = v = 1$ and $w = 0$, the value of an audit (i.e., the shareholder surplus) becomes $(1 - \phi)V_b - f^o$. Q.E.D.

Proof of Proposition 2.2

Consider one of auditor i's clients, $i \in \{1,2\}$. The auditors' s single-valued reaction curves $e(\hat{c})$ and $c(\hat{e})$ are determined by (2.11) and (2.12) in the text. The proof of the equilibrium in the situation where $\beta_i \in (0,1)$ takes two steps.

Step 1: Existence of an equilibrium

Denote by $\hat{c}$ the level of effort by the helping auditor given that the engagement auditor's effort level attains the upper bound. That is, $\hat{c} = c(\bar{e})$, which is less than $\bar{c}$ given Assumption 2.7. Note that $e(\hat{c})$ *and* $c^{-1}(c)$ are continuous and strictly increasing on $[0, \hat{c}]$, where $c^{-1}(\cdot)$ is the inverse function of $c(\cdot)$.

Consider the function h defined by $h(c) = e(c) - c^{-1}(c)$. $h(0) > 0$ because $e(0) > 0$ and $c^{-1}(0) = 0$. On the other hand, $h(\hat{c}) < 0$ because $e(\hat{c}) < \bar{e}$ and $c^{-1}(\hat{c}) = \bar{e}$. Since h is continuous on $[0, \hat{c}]$, according to the intermediate value theorem there exists $c' \in (0, \hat{c})$ such that $h(c') = 0$, which implies $e(c') = c^{-1}(c')$. Thus, the reaction curves intersect in $(0, \hat{c})$. This proves the existence of an equilibrium.

Step 2: Uniqueness of the equilibrium

A sufficient condition for the solution to be unique (i.e., for the reaction curves to intersect only once) is that the reaction curve of the engagement auditor is flatter than that of the helping auditor. This condition is satisfied given Assumption 2.5. To see this, observe that Assumption 2.5 implies $p_{ee}p_{cc} - p_{ec}p_{ec} > 0$, which, combined with Assumption 2.6, implies that $\left|\frac{p_{ec}}{p_{ee}}\right| < \left|\frac{p_{cc}}{p_{ec}}\right|$.

The proof of equilibrium strategies in other situations (i.e., $\beta_i = 0$ and $\beta_i \geq 1$) is straightforward, and is hence omitted. Q.E.D.

Proof of Proposition 2.3

If $\breve{\pi}(\alpha_i, \beta_i) > 0$, Assumptions 2.3 and 2.4 imply that the optimal effort choice is interior and unique, i.e., $a_i^* \in (0, \overline{a})$, which is determined by

$$\breve{\pi}(\alpha_i, \beta_i) r_a(a) - 1 = 0. \quad \text{Q.E.D.}$$

Proof of Lemma 2.1

For a given $\beta \in [0, \overline{\beta}]$, effort choices in the auditing stage are fixed. If $\breve{\pi}(\alpha, \beta) = \pi(\beta)$, then the firm's objective function is the same as the engagement partner's objective function in the soliciting stage; therefore, the partner's optimal selling effort also maximizes the firm's welfare. This implies the optimal revenue sharing-rule given β is $\alpha^*(\beta) = \dfrac{f - (1-\beta)(1 - p(e^*(\beta), c^*(\beta)))l - c^*(\beta)}{f}$. Q.E.D.

Proof of Lemma 2.2

Substituting the conditional optimal revenue-sharing rule into the firm's welfare function (2.18), we have

$$2[\pi(\beta) r(a^*(\pi(\beta))) - a^*(\pi(\beta))].$$

The marginal change in the welfare in response to an increase in β is

$$2[\pi_\beta r + (\pi r_a - 1) a_\pi \pi_\beta] = 2\pi_\beta r.$$

For any $\beta \in (1, \overline{\beta}]$, from Proposition 2.2 we know that $c^* = 0$, and that e^* is determined by $\beta p_e l - 1 = 0$. Clearly, $\frac{de}{d\beta} > 0$. But $\pi_\beta = (p_e l - 1)e_\beta < 0$, because $p_e l - 1 < 0$. Thus, $2\pi_\beta r$<0. This implies that the firm's welfare is strictly decreasing in $\beta \in (1, \overline{\beta}]$. Q.E.D.

Proof of Proposition 2.4

Lemma 2.1 and Lemma 2.2 imply that the firm's objective function is

$$\underset{\beta}{Maximize}\ \pi(\beta)r(a^*(\pi(\beta))) - a^*(\pi(\beta)) \tag{A.3}$$

$$\text{Subject to } -\beta \le 0 \tag{A.4}$$

$$\beta - 1 \le 0. \tag{A.5}$$

Since $e^*(\beta)$ and $c^*(\beta)$ are left continuous at $\beta = 0$ and right continuous at $\beta = 1$, the objective function is continuous on [0, 1], and thus the solution exists. The Lagrangian for this problem is

$$L = \pi(\beta)r(a^*(\pi(\beta))) - a^*(\pi(\beta)) - \lambda_1(-\beta) - \lambda_2(\beta - 1),$$

where the Kuhn-Tucker multipliers λ_1 and λ_2 are nonnegative.

The Kuhn-Tucker first order conditions are

$$\pi_\beta r + [\pi r_a - 1]a_\pi \pi_\beta + \lambda_1 - \lambda_2 = 0 \tag{A.6}$$

$$-\beta \le 0 \tag{A.7}$$

$$\beta - 1 \le 0 \tag{A.8}$$

There are three possibilities regarding whether one or none of the constraints are binding: (1) $\lambda_1 = 0, \lambda_2 > 0$, (2) $\lambda_1 > 0, \lambda_2 = 0$, and (3) $\lambda_1 = 0, \lambda_2 = 0$. I analyze each of the possibilities separately.

1) $\lambda_1 = 0, \lambda_2 > 0$

This implies $\beta = 1$ and $\frac{\partial \pi}{\partial \beta} r\Big|_{\beta \to 1^-} = \lambda_2 > 0$.

But $\frac{\partial \pi}{\partial \beta}\Big|_{\beta \to 1^-} = (p_e l - 1)e_\beta + (p_c l - 1)c_\beta\Big|_{\beta \to 1^-} < 0$ by Assumption 2.8. Contradiction.

2) $\lambda_1 > 0, \lambda_2 = 0$

This implies $\beta = 0$ and $\frac{\partial \pi}{\partial \beta} r\Big|_{\beta \to 0^+} = -\lambda_1 < 0$.

But $\frac{\partial \pi}{\partial \beta}\Big|_{\beta \to 0^+} = (p_e l - 1)e_\beta + (p_c l - 1)c_\beta\Big|_{\beta \to 0^+} > 0$ by Assumption 2.8. Contradiction.

Thus, it must be true that none of the constraints are binding (i.e., $\lambda_1 = 0, \lambda_2 = 0$), and that the optimal β satisfies

$$(p_e l - 1)e_\beta + (p_c l - 1)c_\beta = 0. \tag{A.9}$$

According to Lemma 2.1, the optimal revenue-sharing rule is

$$\alpha^* = \frac{f - (1-\beta^*)(1 - p(e^*(\beta^*), c^*(\beta^*)))l - c^*(\beta^*)}{f}. \quad \text{Q.E.D.}$$

Proof of Proposition 3.1

The proof is similar to the proof of Proposition 2.2, and is hence omitted.

Proof of Proposition 3.2

Consider the local competition in place 1 for a client of type $t \in \{S, C\}$. Notice that shareholders choose not to purchase an audit if they get a negative surplus. Thus, if $\sigma_i^t < 0$ *and* $\sigma_j^t < 0$, $i \neq j, i, j \in \{A, B\}$, then both auditors have zero demand; if

$\sigma_i^t < 0$ *and* $\sigma_j^t \geq 0$, then auditor i1 has zero demand, and auditor j1 becomes the monopolist and sets the monopoly price equal to υ_j^t.

If $\sigma_A^t = \sigma_B^t \geq 0$, the competition between the auditors is the fiercest. It is easy to verify that the only equilibrium is for both auditors to bid their break-even prices. Since shareholders are indifferent between auditors, it follows from Assumption 3.1 that the auditors win the bid with equal chance.

If $0 \leq \sigma_i^t < \sigma_j^t$, the strategy profile $(f_{i1}^{t*}, f_{j1}^{t*}) = (\underline{P}_i^t,\ \upsilon_j^t - \sigma_i^t)$ is an equilibrium. The argument goes as follows. Since the shareholders are indifferent between the two bids, it follows from Assumption 3.1 that auditor j1 wins the bid. Given auditor j1's equilibrium strategy, auditor i1 would still have zero demand if he increased the bid above his break-even price, and would suffer a loss if he decreased the bid below his break-even price. Similarly, given auditor i1's equilibrium strategy, auditor j1 would lose the profitable bid if he increased his bid above ($\upsilon_j^t - \sigma_i^t$), and would leave money on the table if he decreased his bid below ($\upsilon_j^t - \sigma_i^t$). In addition, the equilibrium is the unique pure strategy equilibrium given that an auditor cannot bid below his break-even price. To check this, consider the situation when auditor i1 bids above his break-even price: $f_{i1}^{t\prime} > \underline{P}_i^t$. This cannot be an equilibrium strategy. Auditor j1's best response is to bid a price at $\upsilon_j^t - (\upsilon_i^t - f_{i1}^{t\prime})$. However, auditor i1 could then increase his profits by choosing a price between his break-even price and $f_{i1}^{t\prime}$.

Since the games in two locations are symmetric, the equilibrium for any client in place 2 is the same. Q.E.D.

Proof of Proposition 3.3

Consider firm A's problem. The proof takes three steps. The first step is to show that, for clients of type $t \in \{S, C\}$, $(\alpha(\beta), \beta) = (\frac{\kappa^t(\beta)}{\mathrm{K}^t(\beta)}, \beta)$ dominates strategy (α', β), for all $\alpha' \neq \alpha(\beta)$ and $\beta \in \{\beta | \upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0\}$. The second step is to show that $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$ dominates strategy $(\alpha(\beta), \beta)$ for all $\beta \in \{\beta | \beta \neq \beta^{t\circ} \; and \; \upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0\}$. The third step is to show that $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$ dominates strategy (α, β') for all $\beta' \in \{\beta | \upsilon^t(\beta) - \mathrm{K}^t(\beta) \leq 0\}$ and α.

Step 1: For a given β such that $\upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0$, consider any $\alpha' > \alpha(\beta)$. If firm B's strategy is such that $\sigma_B^t > \upsilon_A^t - \frac{\kappa_A^t}{\alpha'}$, then from Proposition 3.2 we know that firm A earns zero by using either α' *or* $\alpha(\beta)$. If B's strategy is such that $\upsilon_A^t - \mathrm{K}_A^t < \sigma_B^t \leq \upsilon_A^t - \frac{\kappa_A^t}{\alpha'}$, then firm A suffers a loss (i.e., negative economic profits) by using α', while it would earn zero by using $\alpha(\beta)$. If B's strategy is such that $\sigma_B^t \leq \upsilon_A^t - \mathrm{K}_A^t$, then firm A earns the same economic profits by using either α' *or* $\alpha(\beta)$. Since α' is arbitrary, $\alpha(\beta)$ dominates all $\alpha' > \alpha(\beta)$ for the given β.

Now consider any $\alpha' < \alpha(\beta)$. If firm B's strategy is such that $\sigma_B^t \leq \upsilon_A^t - \frac{\kappa_A^t}{\alpha'}$, then firm A earns at least the same economic profits by using $\alpha(\beta)$ as by using α'. If B's

strategy is such that $\upsilon_A^t - \frac{\kappa_A^t}{\alpha'} < \sigma_B^t < \upsilon_A^t - \mathrm{K}_A^t$, then firm A earns zero by using α', while it would earn positive economic profits by using $\alpha(\beta)$. If B's strategy $\sigma_B^t \geq \upsilon_A^t - \mathrm{K}_A^t$, then firm A earns zero by using either α' or $\alpha(\beta)$. Since α' is arbitrary, $\alpha(\beta)$ dominates all $\alpha' < \alpha(\beta)$ for the given β.

Since β is arbitrarily chosen from the given set, $(\alpha(\beta),\beta) = (\frac{\kappa^t(\beta)}{\mathrm{K}^t(\beta)},\beta)$ dominates strategy (α',β), for all $\alpha' \neq \alpha(\beta)$ and $\beta \in \{\beta | \upsilon(\beta) - \mathrm{K}(\beta) > 0\}$.

Step 2: Consider any $\beta \in \{\beta | \beta \neq \beta^{t\circ} \; and \; \upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0\}$. Note that $\upsilon^t(\beta^{t\circ}) - \mathrm{K}^t(\beta^{t\circ}) > \upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0$ by the definition of β^{to}. If B's strategy is such that $\sigma_B^t \leq \upsilon^t(\beta) - \mathrm{K}^t(\beta)$, then firm A earns more economic profits by using $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})},\beta^{t\circ})$ than by using $(\alpha(\beta),\beta)$. If B's strategy $\upsilon^t(\beta^{t\circ}) - \mathrm{K}^t(\beta^{t\circ}) > \sigma_B^t > \upsilon^t(\beta) - \mathrm{K}^t(\beta)$, then firm A earns zero by using $(\alpha(\beta),\beta)$, while it would earn positive economic profits by using $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})},\beta^{t\circ})$. If B's strategy is such that $\sigma_B^t = \upsilon^t(\beta^{t\circ}) - \mathrm{K}^t(\beta^{t\circ})$, then firm A earns zero by using either strategy. Since β is arbitrarily chosen from the given set, I can conclude that $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})},\beta^{t\circ})$ dominates strategy $(\alpha(\beta),\beta)$ for all $\beta \in \{\beta | \beta \neq \beta^{t\circ} \; and \; \upsilon^t(\beta) - \mathrm{K}^t(\beta) > 0\}$.

Step 3: Note that firm A earns nonnegative economic profits by using the strategy $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$, whereas it earns nonpositive economic profits by using strategy (α, β') no matter how firm B plays, where $\beta' \in \{\beta | \upsilon^t(\beta) - \mathrm{K}^t(\beta) \leq 0\}$. However, if firm B's strategy is such that $\sigma_B^t < \upsilon^t(\beta^{t\circ}) - \mathrm{K}^t(\beta^{t\circ})$, then firm A earns positive economic profits by using $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$. Thus, $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$ dominates strategy (α, β') for all $\beta' \in \{\beta | \upsilon^t(\beta) - \mathrm{K}^t(\beta) \leq 0\}$ and α.

Similarly, I can show that $(\frac{\kappa^t(\beta^{t\circ})}{\mathrm{K}^t(\beta^{t\circ})}, \beta^{t\circ})$, $t \in \{S, C\}$, is the dominant strategy for firm B. A combination of dominant strategies is necessarily a Nash equilibrium. Clearly, in the dominant strategy equilibrium, the maximum shareholder surplus provided by competing auditors is the same for each client. It follows from Proposition 3.2 that in the equilibrium firms share clients of each type and earn zero economic profits. Q.E.D.

Proof of Proposition 3.4

Given the specializing sharing rules $\{\beta_A^* = \beta^{S\circ}, \beta_B^* = \beta^{C\circ}, \alpha_A^* = \alpha^{S\circ}, \alpha_B^* = \alpha^{C\circ}\}$, suppose conditions (A.10) and (A.11) hold.

$$\frac{\mathrm{K}^S(\beta^{S\circ}) + \upsilon^S(\beta^{C\circ}) - \upsilon^S(\beta^{S\circ})}{\kappa^S(\beta^{C\circ})} < \frac{\mathrm{K}^C(\beta^{C\circ})}{\kappa^C(\beta^{C\circ})} \tag{A.10}$$

$$\frac{\mathrm{K}^C(\beta^{C\circ}) + \upsilon^C(\beta^{S\circ}) - \upsilon^C(\beta^{C\circ})}{\kappa^C(\beta^{S\circ})} < \frac{\mathrm{K}^S(\beta^{S\circ})}{\kappa^S(\beta^{S\circ})} \tag{A.11}$$

We have

$$\upsilon_A^S - \mathrm{K}_A^S > \upsilon_B^S - \frac{\kappa_B^S}{\kappa_B^C}\mathrm{K}_B^C \text{ and } \upsilon_B^C - \mathrm{K}_B^C > \upsilon_A^C - \frac{\kappa_A^C}{\kappa_A^S}\mathrm{K}_A^S. \tag{A.12}$$

Note that

$$\sigma_A^S = \upsilon_A^S - \mathrm{K}_A^S,\ \sigma_B^C = \upsilon_B^C - \mathrm{K}_B^C,\ \sigma_B^S = \upsilon_B^S - \frac{\kappa_B^S}{\kappa_B^C}\mathrm{K}_B^C, \text{ and } \sigma_A^C = \upsilon_A^C - \frac{\kappa_A^C}{\kappa_A^S}\mathrm{K}_A^S \tag{A.13}$$

Thus, (A.12) implies

$$\sigma_A^S > \sigma_B^S \text{ and } \sigma_A^C < \sigma_B^C \tag{A.14}$$

(A.14) is equivalent to

$$\upsilon_A^S - \sigma_B^S > \mathrm{K}_A^S \text{ and } \upsilon_B^C - \sigma_A^C > \mathrm{K}_B^C. \tag{A.15}$$

(A.14) implies that firm A audits all S type clients and firm B audits all C type clients based on Proposition 3.2. (A.15) implies that firms earn positive economic profits from the clients from their niche markets. Given $\beta_A^* = \beta^{S\circ}$, $\beta_B^* = \beta^{C\circ}$, no firm can increase its welfare by unilaterally deviating from its current sharing rules. Therefore, conditions (A.10) and (A.11) are sufficient for the specializing sharing rules to form an equilibrium. Moreover, from Proposition 3.2 we know that in the equilibrium each firm earns positive economic profits as follows:

$$\Pi_A = n^S(\min\{\upsilon_A^S, \frac{\kappa_B^S}{\kappa_B^C}\mathrm{K}_B^C + \upsilon_A^S - \upsilon_B^S\} - \mathrm{K}_A^S), \Pi_B = n^C(\min\{\upsilon_B^C, \frac{\kappa_A^C}{\kappa_A^S}\mathrm{K}_A^S + \upsilon_B^C - \upsilon_A^C\} - \mathrm{K}_B^C).$$

Q.E.D.

Proof of Corollary 3.1

To show firm A's equilibrium strategy is undominated takes two steps. First, I identify the set of firm A's strategies other than the equilibrium strategy that gives firm A the same payoff as the equilibrium payoff, given that firm B uses its equilibrium strategy. Then, I show that, for any strategy from that set, there exists a strategy for firm B such that firm A's equilibrium strategy gives firm A strictly greater payoff.

Step 1. We know from Proposition 3.4 that in the equilibrium, firm A's payoff is $\Pi_A = n^S(\min\{\upsilon_A^S, \frac{\kappa_B^S}{\kappa_B^C}\mathrm{K}_B^C + \upsilon_A^S - \upsilon_B^S\} - \mathrm{K}_A^S)$. Observe that, given firm B's equilibrium strategy, firm A is strictly worse off if it uses any liability-sharing rule other than $\beta^{S\circ}$. In other words, given firm B's equilibrium strategy, any strategy profile that gives firm A the same payoff must contain the liability-sharing rule $\beta^{S\circ}$. On the other hand, firm A gets the same payoff as long as its revenue-sharing rule α_A' is such that $\upsilon_A^S - \frac{\kappa_A^S}{\alpha_A'} > \sigma_B^S$ and $\upsilon_A^C - \frac{\kappa_A^C}{\alpha_A'} < \sigma_B^C$. Therefore, given firm B's equilibrium strategy, the set of firm A's strategies other than the equilibrium strategy that give firm A the same payoff as the equilibrium payoff is $\{(\alpha_A', \beta_A') \mid \beta_A' = \beta^{S\circ},\ \upsilon_A^S - \frac{\kappa_A^S}{\alpha_A'} > \sigma_B^S,\ \upsilon_A^C - \frac{\kappa_A^C}{\alpha_A'} < \sigma_B^C,\ \frac{\kappa_A^S}{\alpha_A'} \neq \mathrm{K}_A^S\}$.

Step 2. Consider any strategy from that set: $\{\alpha_A' > \alpha^{S\circ},\ \beta_A' = \beta^{S\circ}\}$. Clearly, $\sigma_A^S{}' > \sigma_A^S$ and $\sigma_A^C{}' > \sigma_A^C$. Consider firm B's strategy $\{\alpha_B' > \alpha^{C\circ},\ \beta_B' = \beta^{C\circ}\}$ such that $\sigma_A^S < \sigma_B^S{}' < \sigma_A^S{}'$. Note that $\sigma_A^C{}' < \sigma_B^C < \sigma_B^C{}'$. In this case, firm A will win the bids for the

S type clients but with negative payoff. In contrast, firm A would earn zero payoff if it used the equilibrium strategy.

Now consider any strategy from that set: $\{\alpha_A' < \alpha^{S\circ}, \beta_A' = \beta^{S\circ}\}$. Clearly, $\sigma_A^S' < \sigma_A^S$ and $\sigma_A^C' < \sigma_A^C$. Consider firm B's strategy $\{\alpha_B' > \alpha^{C\circ}, \beta_B' = \beta^{C\circ}\}$ such that $\sigma_A^S' < \sigma_B^S' < \sigma_A^S$. Note that $\sigma_A^C' < \sigma_A^C < \sigma_B^C < \sigma_B^C'$. In this case, firm A will forgo the profitable bids for the S type clients and get zero payoff. In contrast, firm A would win the bids for the S type clients with a positive payoff if it used the equilibrium strategy. Therefore, I have proved that firm A's equilibrium strategy is undominated.

Similarly, we can prove that firm B's equilibrium strategy is undominated. Q.E.D.

APPENDIX 2: TABLES

Table 1. Excerpt from "Appendix 7 Opinion Questionnaire" (Trompeter 1988, 184-187)

	WORLDWIDE MEAN (STD DEV)	OFFICEWIDE MEAN (STD DEV)
Legal liability is the greatest threat facing the profession today.	3.6 (1.7)	4.5 (1.5) $p = 0.03$
In our firm, office profitability is a major factor in determining partner compensation.	2.7 (1.9)	4.7 (1.8) $p \leq 0.001$
In our firm, a partner's compensation is tightly linked to his/her ability to develop new clients.	4.0 (1.5)	4.8 (1.3) $p = 0.03$
The loss of one of my most important clients would have a significant negative impact on my personal income.	2.6 (1.7)	3.9 (1.6) $p = 0.003$

Note: Partners' responses are made on a 7-point scale, with higher numbers indicating stronger degree of agreement.

Table 2. Number of clients by audit firm and by client type (U.S. Senate Survey 1975, 30-31, 421)

	Public corporations listed on NYSE or ASE	Other public corporations and private corporations	Total
AA	417	6,000	6,417
KPMG	331	23,245	23,576
Total	748	29,245	29,993

Table 3. Number of clients by audit firm and by client size ("Who audits America", 1986 edition)

Audit firm	Total sales audited $millions	Total clients audited	Number of clients in each sales category							
			1-25 Mil	26-50 Mil	51-100 Mil	101-250 Mil	251-500 Mil	501Mil-1Bil	1-5 Bil	5 Bil and over
AA	$568,486	1,138	429	134	133	160	95	73	95	19
KPMG	$430,397	1,099	454	155	135	134	78	53	77	13
Total	$998,883	2,237	883	289	268	294	173	126	172	32

Table 4. Number of clients by audit firm and by client size ("Who audits America", 1994 edition)

Audit firm	Total sales audited $millions	Total clients audited	Number of clients in each sales category							
			1-25 Mil	26-50 Mil	51-100 Mil	101-250 Mil	251-500 Mil	501Mil-1Bil	1-5 Bil	5 Bil and over
AA	$824,333	1,254	371	133	169	192	127	105	123	34
KPMG	$729,898	1,296	447	156	170	205	107	92	94	25
Total	$1,554,231	2,550	818	289	339	397	234	197	217	59

Table 5. Descriptive statistics for sample firms

Variable		No. of Obs.	Freq.	Mean	Std. Dev.	Median	Range (Min., Max.)	Chi-Square Statistic (test for frequency difference)	T Statistic (test for mean difference)	Z Statistic (test for median difference)
Lat	AA	2702		18.61	1.89	18.5	(11.66, 24.37)			
	KPMG	2137		18.38	1.88	18.31	(8.85, 24.13)		4.25***	2.97***
Fcf	AA	2702		-0.96	41.43	0.01	(-2152.5, 7.75)			
	KPMG	2137		-0.21	1.87	0.01	(-44.79, 12.9)		-0.93	-0.5
Issuance	AA	2702	80%							
	KPMG	2137	82%					2.59		
Lmv	AA	2702		18.65	1.91	18.55	(9.8, 26.03)			
	KPMG	2137		18.59	1.97	18.57	(11.46, 25.59)		0.98	-0.45
Exchg	AA	2702		2.44	1	3	(1, 5)			
	KPMG	2137		2.52	0.96	3	(1, 5)			-2.49***
Indnum	AA	2702		1.61	1.13	1	(1, 10)			
	KPMG	2137		1.57	1.1	1	(1, 9)			1.99**
Geonum	AA	2702		3.15	0.73	3	(2, 5)			
	KPMG	2137		3.18	0.74	3	(2, 5)			-1.21

Note: Lat and Lmv are in millions;
* indicates statistic is significant at 0.10 level, based on a two tailed test;
** indicates statistic is significant at 0.05 level, based on a two tailed test;
*** indicates statistic is significant at 0.01 level, based on a two tailed test.

Table 6. Correlation matrix for independent variables

Variable	Fcf	Issuance	Lmv	Exchg	Indnum	Geonum
Lat	0.03	0.09	0.83	-0.55	0.33	0.23
Fcf		-0.01	0.01	-0.01	0.01	0.01
Issuance			0.27	-0.01	-0.03	0.06
Lmv				-0.48	0.21	0.26
Exchg					-0.26	-0.14
Indnum						0.15

Table 7. Logistic regression results for Model 1

Independent Variable	Parameter Estimate	Standard Dev.	T-statistic	Pr> | t |
Intercept	-0.253	0.412	-0.61	0.539
Lat_{t-1}	0.17^{***}	0.031	5.42	0.000
Fcf_{t-1}	-0.002	0.003	-0.58	0.56
$Issuance_t$	-0.024	0.081	-0.29	0.769
Lmv_{t-1}	-0.124^{***}	0.03	-4.13	0.000
$Exchg_{t-1}$	-0.043	0.034	-1.20	0.229
$Indnum_{t-1}$	-0.022	0.028	-0.77	0.444
$Geonum_{t-1}$	-0.063	0.041	-1.52	0.129

Log Likelihood (LL) =-3298.
Likelihood Ratio (LR) =45.53^{***} (d.f.=7, $p<0.001$).
Percentage of correct prediction =55%.

Note: * indicates statistic is significant at 0.10 level, based on a two tailed test;
** indicates statistic is significant at 0.05 level, based on a two tailed test;
*** indicates statistic is significant at 0.01 level, based on a two tailed test.

Table 8. Logistic regression results for Models 2-4

	Model 2		Model 3		Model 4	
Independent Variable	Parameter Estimate	T-statistic	Parameter Estimate	T-statistic	Parameter Estimate	T-statistic
Intercept	-0.627**	-2.11	-0.977***	-3.4	-0.04	-0.14
Lat_{t-1}	0.174***	6.16	0.066***	4.23		
Lmv_{t-1}	-0.127***	-4.61			0.015	0.98
	LL=-3301; LR=39.57*** (d.f.=2, p<0.001); Percentage of Correct Predication =55.1%.		LL=-3312; LR=18.04*** (d.f.=1, p<0.001); Percentage of Correct Predication =56.3%.		LL=-3321; LR=0.96 (d.f.=1, p>0.30).	

Note: * indicates statistic is significant at 0.10 level, based on a two tailed test;
** indicates statistic is significant at 0.05 level, based on a two tailed test;
*** indicates statistic is significant at 0.01 level, based on a two tailed test.

Table 9. Prediction table for Model 2

	Actual	
Predicted	AA	KPMG
AA	2457 (91%)	1930 (90%)
KPMG	245 (9%)	207 (10%)
	2702	2137

Table 10. Classification of clients based on total assets

		No. of Clients		No. of Clients	Total
		AA	Percentage	KPMG	
Group 1	*Assets* ≥ 378.591*M*	695	57%	515	1210
Group 2	99.526*M* ≤ *Assets* < 378.591*M*	708	59%	502	1210
Group 3	28.517*M* ≤ *Assets* < 99.5261*M*	694	57%	516	1210
Group 4	*Assets* < 28.5171*M*	605	50%	604	1209
	Total	2702		2137	4839

Note: M stands for millions.

Table 11. Descriptive statistics for each size group

	Variable		No. of Obs.	Freq.	Mean	Std. Dev.	Median	Range (Min., Max.)	Chi-Square Statistic (test for frequency difference)	T Statistic (test for mean difference)	Z Statistic (test for median difference)
G1	Laccr	AA	659		18.27	1.45	18.28	(12.28, 22.87)			
		KPMG	494		18.14	1.37	18.15	(13.25, 22.15)		1.48	1.16
	Lat	AA			21.02	1.03	20.79	(19.75, 24.31)			
		KPMG			20.86	0.91	20.62	(19.76, 24.13)		2.76***	2.59***
	Fcf	AA			0.01	0.99	0.09	(-10.86, 6.38)			
		KPMG			0.06	1.1	0.1	(-15.17, 12.9)		-0.73	-0.5
	Issuance	AA		81%							
		KPMG		89%					14.68***		
	Neg	AA		85%							
		KPMG		85%					0.00		
	Exchg	AA			1.5	0.93	1	(1, 5)			
		KPMG			1.64	0.99	1	(1, 5)			-2.72***
G2	Laccr	AA	687		16.31	1.33	16.48	(10.04, 18.97)			
		KPMG	485		16.37	1.25	16.45	(11.45, 20.66)		-0.69	0.42
	Lat	AA			19.09	0.4	19.1	(18.42, 19.75)			
		KPMG			19.05	0.39	19.05	(18.42, 19.75)		1.77*	0.65
	Fcf	AA			-0.07	0.9	0.04	(-11.11, 7.75)			
		KPMG			-0.05	0.74	0.04	(-5.91, 3.31)		-0.43	0.18
	Issuance	AA		82%							
		KPMG		82%					0.05		
	Neg	AA		77%							
		KPMG		74%					0.84		
	Exchg	AA			2.41	1	3	(1, 5)			
		KPMG			2.55	0.94	3	(1, 5)			-2.16**

Table 11—continued

	Variable		No. of Obs.	Freq.	Mean	Std. Dev.	Median	Range (Min., Max.)	Chi-Square Statistic (test for frequency difference)	T Statistic (test for mean difference)	Z Statistic (test for median difference)
G3	Laccr	AA	681		15.1	1.32	15.23	(10.46, 18.86)			
		KPMG	501		15.25	1.26	15.43	(9.1, 18.87)		-2.1**	-1.82*
	Lat	AA			17.8	0.37	17.81	(17.17, 18.42)			
		KPMG			17.81	0.38	17.84	(17.17, 18.42)		-0.36	-0.53
	Fcf	AA			-0.19	2.17	0.007	(-50.21, 2.98)			
		KPMG			-0.33	2.94	–0.002	(-44.79, 2.95)		0.91	0.41
	Issuance	AA		82%							
		KPMG		84%					0.66		
	Neg	AA		70%							
		KPMG		69%					0.07		
	Exchg	AA			2.9	0.62	3	(1, 5)			
		KPMG			2.85	0.69	3	(1, 5)			1.28
G4	Laccr	AA	592		13.98	1.45	14.2	(6.9, 17.44)			
		KPMG	593		13.83	2.18	14.1	(-22.92, 17.39)		1.39	-0.84
	Lat	AA			16.19	0.8	16.35	(11.66, 17.16)			
		KPMG			16.2	0.94	16.46	(8.85, 17.17)		-0.14	2.3**
	Fcf	AA			-4.06	88.46	-0.17	(-2152.5, 3.53)			
		KPMG			-0.49	1.92	-0.12	(-31.99, 7.16)		-0.98	1.6
	Issuance	AA		75%							
		KPMG		75%					0.003		
	Neg	AA		69%							
		KPMG		70%					0.21		
		AA			2.98	0.5	3	(1, 5)			
	Exchg	KPMG			2.98	0.58	3	(1, 5)			-0.45

Table 11—continued

Note: Laccr and Lat are in millions;
* indicates statistic is significant at 0.10 level, based on a two tailed test;
** indicates statistic is significant at 0.05 level, based on a two tailed test;
*** indicates statistic is significant at 0.01 level, based on a two tailed test.

Table 12. OLS regression results

Dependent variable: $Laccr_t$=log of the absolute value of accruals for the year t.

	Group 1		Group 2		Group 3		Group 4	
Independent Variable	Estimate	T Statistic	Estimate	T Statistic	Estimate	T Statistic	Estimate	T Statistic
Intercept	-1.99	-1.1	4.63	1.22	0.3	0.1	-6.58***	-3.73
Lat_{t-1}	0.91***	10.73	0.57***	2.91	0.81***	4.58	1.24***	12.09
$Issuance_t$	0.66***	2.5	0.61***	2.82	0.11	0.56	-0.09	-0.41
Fcf_{t-1}	-0.24***	-2.85	-0.19	-1.26	0.07	0.64	-0.04	-0.55
Aud_t	**-0.01**	**-0.07**	**-0.17**	**-1.11**	**-0.33*** **	**-2.49**	**0.4** **	**2.25**
$Exchg_{t-1}$	-0.03	-0.34	0.03	0.43	0.08	0.78	-0.05	-0.27
Neg_t	-0.84	-0.43	-5.69	-1.31	-2.22	-0.59	9.13***	4.33
$Neg_t \times Lat_{t-1}$	0.08	0.92	0.34	1.5	0.15	0.72	-0.6***	-4.89
$Neg_t \times Issuance_t$	-0.54**	-1.94	-0.64***	-2.65	-0.13	-0.58	0.45*	1.82
$Neg_t \times Fcf_{t-1}$	0.19**	2.16	0.08	0.5	-0.08	-0.69	0.04	0.56
$Neg_t \times Aud_t$	**0.01**	**0.08**	**0.08**	**0.46**	**0.25**	**1.56**	**-0.32**	**-1.53**
$Neg_t \times Exchg_{t-1}$	0.21***	2.45	0.06	0.73	0.02	0.15	0.34*	1.69
	Adj. R^2=0.50; F=108; p<0.0001.		Adj. R^2=0.08 F=11; p<0.0001.		Adj. R^2=0.11 F=14; p<0.0001.		Adj. R^2=0.20; F=27; p<0.0001.	

Note: * indicates statistic is significant at 0.10 level, based on a two tailed test;
** indicates statistic is significant at 0.05 level, based on a two tailed test;
*** indicates statistic is significant at 0.01 level, based on a two tailed test.

Table 13. Proportion of lawsuits against KPMG or AA involving public companies for services rendered during 1960-1985

	KPMG	AA	Total
Litigation	104	76	180
No Litigation	1,352	1,589	2,941
Total	1,456	1,665	3,121
Litigation rate	7.1%	4.6%	

Table 14. Proportion of lawsuits against KPMG or AA involving public companies not listed on NYSE or ASE and private corporations for services rendered during 1960-1985

	KPMG	AA	Total
Litigation	83	51	134
No Litigation	23,162	5,949	29,111
Total	23,245	6,000	29,245
Litigation rate	0.36%	0.85%	

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