AUDITOR SIZE AND AUDIT QUALITY REVISITED: THE ROLE OF MARKET SIZE AND LEGAL ENVIRONMENT

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

The Faculty of Graduate Studies

(Business Administration)

THE UNIVERSITY OF BRITISH COLUMBIA

July, 2009

ABSTRACT

The objective of this thesis is to revisit the notion of audit quality and investigate how it is related to auditor size and the structure of the auditing industry. Specifically, I propose a model of audit firm competition where both audit quality and auditor size are endogenous and predict how market characteristics, namely market size and investor protection regime, affect the structure of the auditing industry and differences between Big-4 and Non-Big-4 audit quality and fees. I show that Big-4 audit firms compete mostly on audit value (i.e., quality and price) through investments in audit technology, the level of which is increasing in both market size and investor protection.

Consistent with my predictions, empirical results for the U.S. audit market, where investor protection is held constant across local markets, confirm that the audit industry is characterised as a natural oligopoly dominated by the higher quality Big-4 audit firms. More importantly, I find that Big-4 audit value is increasing in market size. In particular, Big-4 audit quality, relative to Non-Big-4 audits is constant in market size while Big-4 audit fee premium is decreasing in market size. I also present detailed hypotheses adapted to a cross-country setting to empirically evaluate the impact of investor protection regimes on characteristics of the audit industry and the audit product. Although I leave to future research actual empirical testing, preliminary evidence reviewed from other studies generally supports my hypotheses.

My thesis has direct policy implications as it provides key insights about the audit industry, how audit firms compete and how the industry evolves. Taken together, my results imply that the audit industry is naturally concentrated yet remains overall competitive. That is, Big-4 audit quality and fees are not adversely affected, thus far, by the high level of auditor concentration and Big-4 market power. Accordingly, recent concerns about high auditor concentration, although warranted, may be overstated.

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ACKNOWLEDGEMENTS

I would first like to thank my advisor, Professor Dan A. Simunic, for his continuing support: thank you for bringing things back into focus as I more than occasionally wandered off; and for believing in the merit of my work and my capabilities as a researcher.

I wish to express my most sincere gratitude as well to the other members of my dissertation committee, Professors Thomas Ross and Kin Lo, for their helpful comments and suggestions.

I would also like to extend my appreciation to current and former members of the accounting department I have had the pleasure of knowing for fostering an intellectually stimulating and supportive working environment. Special thanks to Sandra Chamberlain and Serena Wu who listened to my endless complaining during my first year in the PhD program and who encouraged me to "stay the course".

My sincere thanks to my family and friends without whose support any of this would be possible. Most of all, loving thanks to Maryse for supporting me at every step. Special thanks also to David, Veikko and Sase for sharing what has been an incredible experience at UBC.

Finally, I gratefully acknowledge the financial support of HEC Montréal, the *Fondation des comptables agréés du Québec* (OCAQ), the University of British Columbia (University Graduate Fellowship) and the *Fonds québécois de la recherche sur la société et la culture*.

DEDICATION

À mon père,
qui m'a donné la soif de comprendre.

À ma mère,
qui m'a donné le goût de foncer.

À Maryse,
qui m'a donné la force de poursuivre.

1 INTRODUCTION

The objective of this thesis is to revisit the notion of audit quality and investigate how it is related to auditor size and the structure of the auditing industry. Specifically, I propose a model of audit firm competition based on Sutton [1991]'s endogenous sunk cost model (ESC) which builds on key features of the demand for audit services and where both audit quality and auditor size are endogenous. Using this "demand-based" approach to audit quality, I am able to predict how market characteristics, such as market size and investor protection regime, determine the concentrated structure of the industry and affect differences between Big-4[1] and Non-Big-4 audits (quality and fees). Specifically, I show that Big-4 audit firms compete mostly on audit value (i.e., quality and price) through fixed investments in audit technology, the level of which is increasing in both market size and investor protection. Big-4 audit firms are larger and control more market shares than Non-Big-4 auditors as a result of these investments, since the superior audit technology permits them to offer higher audit quality at a relatively lower price than Non-Big-4 auditors can.

The motivation for this thesis is two-fold. First, I revisit and present an alternative view of the auditor-size-audit-quality relationship by endogenising auditor size. Essentially, this view reverses the causal relationship generally assumed in the literature by which auditor size is exogenous and used to explain differences in audit quality. Rather, I argue that auditor size is determined as a result of the relative level of audit quality and fees offered by auditors. I argue that the ESC model complements the literature because it does not rely on assumptions about differences in auditors' costs functions that previous models of audit quality have made, the validity (and/or "strength") of which can be questioned. Nonetheless, my results are entirely consistent with those of the existing audit quality literature. Moreover, the model offers a formal framework to explore how

[1] I use "Big-4" to designate indistinctively all the international brand name auditors: Deloitte (or Deloitte & Touche), KPMG, Ernst & Young and PricewaterhouseCoopers. Throughout this thesis, this designation also refers to the former "Big-5" (pre-2002 with Arthur Andersen), "Big-6" (pre-1998 with Coopers & Lybrand) or "Big-8" (pre-1989) title used in previous literature. "Non-Big-4" simply refers to any other audit firm.

differences in market size and investor protection regimes affect differences between Big-4 and Non-Big-4 auditors.

Second, I formally and empirically investigate the link between Big-4 audit quality and fees and audit market structure. In particular, I address concerns raised by regulatory agencies, business associations and private interest groups over the current high level of market concentration and its potential adverse impact on the audit product (e.g., United States General Accounting Office (GAO) [2003b, 2008], The American Assembly [2005], Audit and Assurance Faculty (ICAEW) [2005], London Economics [2006], Oxera Consulting [2006, 2007], U.S. Chamber of Commerce [2006, 2007], Commission of the European Communities - Directorate General for Internal Market and Services (EC-DG) [2008] and Advisory Committee on the Auditing Profession (ACAP) [2008]). The ESC model provides a clear link between market structure and audit quality and fees which was previously difficult to establish.

The ESC model builds on the assumptions that client-firms value audit quality and that audit quality is a function of fixed and variable factors of production, respectively termed audit technology and effort. Based on these simple assumptions, the model predicts that audit firms will compete by investing in audit technology as a means to offer high-value, high-quality and competitively priced audits. Eventually, firms engage in a "race for quality" by investing ever more in technology in the hopes of capturing sales from rivals. This leads to the conclusion that the audit market evolves to a natural oligopoly where only a few, large, high-quality auditors dominate the audit market: the Big-4 auditors. By describing further how Big-4 and Non-Big-4 auditors differ with respect to their investment strategies in audit technology, I am able to explain the well documented dual market structure characteristic of the auditing industry. That is, the presence of a large number of smaller, lower quality auditors that control only a small portion of the market.

Besides the basic prediction that the audit industry is characterised as a natural oligopoly dominated by the Big-4 auditors, I make the following predictions. First, there are real differences in Big-4 and Non-Big-4 auditors' production processes which result from

differences in audit technology. Second, Big-4 audit quality is increasing in market size[2] and investor protection. Third, the Big-4 audit fee premium is actually decreasing in those parameters. As a result of this, I make the fourth prediction that Big-4 auditors' cumulative market share is increasing in market size and investor protection. Finally, I make the prediction that the relation between market size and auditor concentration may be non-monotonic[3].

I test the predictions from the ESC model for the U.S. local audit market, where institutional and other country specific factors such as investor protection are constant. This provides the strongest setting for testing predictions relating market size to market structure and characteristics of Big-4 audits. Results are consistent with my hypotheses.

I also present detailed hypotheses for testing the predictions of the ESC framework in an international cross-country study; however, I leave to future research actual empirical testing. The international cross-country study is primarily designed to test predictions of the impact of investor protection regimes on characteristics of the audit industry and the audit product. Preliminary evidence reviewed from other studies generally supports my hypotheses.

The remainder of this paper is organised as follows: Section 2 presents a review of the audit quality and audit value literatures, as well as the motivation for this thesis; Section 3 describes the ESC framework in detail; Section 4 presents the U.S. empirical study; Section 5 introduces the international empirical study and I conclude with Section 6.

[2] This is true only when comparing national audit markets (i.e., countries). However, within a given national market, Big-4 audit quality is constant.

[3] For the U.S. audit market, I actually make the more restrictive prediction that this relation is non-monotonic (Section 4).

2 MOTIVATION AND LITERATURE REVIEW

As reported earlier, the objective of this thesis is to revisit the notion of audit quality and investigate how it relates to auditor size and the structure of the auditing industry. Specifically, I propose a model of audit firm competition based on Sutton [1991]'s endogenous sunk cost framework (ESC) in which audit quality, auditor size and, consequently, market structure are endogenous. The model uses a demand-based approach to audit quality in the sense that it builds on exogenous attributes that characterise the demand for external auditing services to explain supplier (i.e., auditor) behaviour. This is very different from the traditional supply-based models of audit quality that take supplier characteristics, namely auditor size, as given to explain audit quality (and fees).

The key to understanding the well documented quality differential between Big-4 and Non-Big-4 auditors[4] and the Big-4s' domination of the industry may lie in thinking more clearly about what audit clients actually want (e.g., how do audits generate shareholder value?). In doing so, the focus is shifted from explaining auditing phenomena from the perspective of given supplier characteristics to one where these phenomena are thought to evolve as a result of competition between audit firms. Hence, differences in audit quality and auditor size, the high level of concentration in the industry along with differences in the concentration level across time and markets could simply be the result of how auditors choose to cater differently to audit clients' demands.

The ESC framework begins with a very simple assumption about client-firms' preferences for external audit services. Simply put, client-firms rank their preferences for audits according to the value, or benefit, they derive from an audit, net of fees paid. For this reason it is essential to understand what drives audit value. The objective of this section is to provide a brief review of the audit value literature and illustrate how it is related to the audit quality literature. Linking the two literatures is fundamental to the ESC framework since it clearly identifies the key attributes of the audit product and how

[4] See Moizer [1997], Watkins *et al.* [2004] and Francis [2004] for reviews.

these are valued by clients. As explained below, many attributes of the audit product, among which audit quality is one of the most important, generate client-firm value. I conclude this section by presenting the motivation for this thesis.

2.1 Audit Quality

Audit quality is a function of the audit process; i.e., the process by which an auditor forms and reports his opinion with respect to the accuracy of a client-firm's set of financial statements. There exist several definitions of audit quality but, generally, audit quality reflects the informational content of the audit report with respect to the corresponding financial statements. Audit quality is often defined as the "market-assessed joint probability that a given auditor will both *(a)* discover a breach in the client's accounting system, and *(b)* report the breach" (DeAngelo [1981b]). Consequently, quality is seen as a function of *(a)* auditor capability and *(b)* auditor independence.

On the one hand, the audit production process by which an auditor optimally selects costly production inputs, namely effort (e.g., audit hours) and technology[5], directly determines an auditor's capability to discover material misstatements. These two classes of inputs are neither perfect substitutes nor perfect complements. A minimum level of both effort and technology are always required to deliver an audit (of minimum quality). And while audit quality can be enhanced through increased effort, it is ultimately constrained by the extent of the auditor's technological investments.

On the other hand, auditor independence is not a production input. Rather, auditor independence is a "state of mind" that the auditor must attain and demonstrate (i.e., perceived independence). It is nonetheless necessary to insure the credibility of the audit product and, as such, is an essential part of the audit process. An independent auditor is less exposed to economic, social and personal pressures from a client-firm and is thus believed to report his findings more truthfully. This state of mind is a function of auditor

[5] This generally refers to auditor "know-how" or competence. More specifically, audit technology can take the form of, among other things: audit programs, training, IT equipment, software, databases and other electronic decision aids, in-house central research and accounting consultation units, etc. These are discussed in greater detail in Section 3.3.

and/or audit engagement specific characteristics, such as auditor size (DeAngelo [1981b]) and auditor tenure[6] (e.g., GAO [2003c]), and exogenous factors like regulation, legal regime and professional codes of conduct.

2.2 Audit Value

Shareholders are the end users of the audit product, as is evident from the wording of the auditor's report[7]. Consequently, the optimal choice of auditor is such that net client-firm value is maximised. The net benefit from auditing likely varies across firms. Yet, overall, audits generate firm value primarily from three components: (1) Assurance, (2) Insurance, and (3) Service value.

Assurance value is the most commonly recognised benefit of auditing. From this perspective, an audit is valuable because it reduces management reporting bias and adds credibility to a client-firm's financial statements. As a result, there is less information asymmetry between firm insiders and outside investors (e.g., Watts and Zimmerman [1983]). Essentially, greater assurance directly increases firm value by lowering the informational risk imposed on outside investors and thus the risk premium they command. There is ample evidence to support this hypothesis in the context of IPOs where several authors find that client-firms suffer less underpricing when they are audited by more reputable, higher quality auditors (e.g., Balvers *et al.* [1988], Beatty [1989], Hogan [1997] and Willenborg [1999]). Pittman and Fortin [2004] also find that young firms who retain a higher quality (i.e., Big-4) auditor significantly reduce their cost of debt capital.

[6] Auditor tenure is often seen by regulators as limiting auditor independence. As a result, mandatory audit firm rotation was considered as a reform to enhance auditor independence and audit quality during the congressional hearings that preceded the Sarbanes-Oxley Act of 2002; although it was not ultimately included in the act. However, a subsequent study by the GAO [2003c] concluded that mandatory audit firm rotation may not be the most efficient way to strengthen auditor independence and improve audit quality. It recommended against the short term implementation of such provision. Furthermore, in a review paper, Francis [2004] reports that the evidence thus far does not support the conjecture that auditor independence and audit quality is significantly compromised by the duration of the auditor-client relationship. A more recent review paper by Bedard *et al.* [2008] confirms that the archival evidence on the subject is mixed, yet notes that behavioural studies support the importance of independence in fact and in appearance achieved by auditor rotation.

[7] This includes current and potential shareholders. Other stakeholders such as banks and bondholders can also be considered as end users of the audit product.

Greater assurance also has a positive indirect effect on firm value. Specifically, an audit (or the expectation thereof) can lead to an upward revision in the magnitude of expected future cash flows (excluding audit fees). Here, the audit provides a control function[8] which limits the occurrence and degree of opportunistic wealth transfers from outside investors to firm insiders through fraud, theft, opportunistic earnings management, etc. Also, this control function can help improve the reliability of financial information used for internal decision making which in turn can improve future firm performance (i.e., higher expected future cash flows).

Auditors deliver greater assurance value essentially through higher audit quality. DeAngelo [1981b] argues that larger auditors are more economically independent from their clients and therefore deliver more reliable, higher quality audits. Her thesis stems from the assumption that audit services for a specific client are characterised by significant start-up costs and are subject to a learning curve over time (DeAngelo [1981a]). In a competitive setting, incumbent auditors will earn client-specific quasi-rents which, *ceteris paribus*, provide the client with more bargaining power vis-à-vis the incumbent auditor. In turn, this jeopardises the incumbent auditor's independence who can be pressured by an opportunistic client-firm into accepting erroneous financial statements for the sake of maintaining the business relationship and the associated future quasi-rents. Essentially, the incumbent auditor has an incentive to "cheat" and deviate from its chosen level of quality by delivering lower than expected audit quality[9].

Yet, building on Klein and Leffler [1981], DeAngelo [1981b] suggests that if an auditor is found cheating, clients who value, and pay, for high-quality audits will conclude that their auditor is no longer credible. Hence, the assurance value supplied by this auditor is discounted and some current and future clients will request lower fees, while others will

[8] This is similar to what Simunic and Stein [1987] call "*control* demand". See also Dopuch and Simunic [1980a, 1980b].
[9] Notice that true audit quality is not directly observable.

find it profitable to simply switch auditors[10]. Consequently, the auditor potentially loses important future quasi-rents and because these rents are client-specific, they are sunk and cannot be salvaged. In other words, an auditor who is tempted to cheat and not report truthfully to please one client must also consider the possible reputation cost associated with cheating. This reputation cost provides a strong *disincentive* to cheat, effectively acting as a collateral bond against auditors' opportunistic behaviour. DeAngelo concludes that because larger audit firms earn greater aggregate client-specific quasi-rents, they face greater reputation cost from cheating and therefore engage in less opportunistic behaviour. That is, larger audit firms are more independent from any one of their clients and deliver, on average, higher quality audits. This argument is commonly referred to as the "reputation hypothesis".

DeAngelo also makes the important point that it may be more accurate to consider the magnitude of a client's quasi-rents relative to an auditor's aggregate quasi-rents when evaluating threats to auditor independence. In that sense, audit fee and non-audit fee information can be useful in assessing independence. This suggests further that larger audit firms may be more independent since the total fees from any one client are likely small in proportion to the audit firm's total revenues. Nonetheless, receiving significant audit and/or non-audit/management-advisory service fees (NAS-MAS) from any one client can potentially compromise any auditor's independence. Finally, she extends her argumentation to explain how firms-specific sunk investments, such as "brand-name", may also serve as collateral against cheating (Klein and Leffler [1981]). This is similar to arguments made by Dopuch and Simunic [1980a, 1980b] and Simunic and Stein [1987] who suggest that auditors' credibility is associated with their brand-name. These authors

[10] For example, Firth [1990] reports that auditors criticised for their work in U.K. Department of Trade investigations suffer small losses in market shares based on listed clients and audit fees following report of the Department's criticism. Wilson Jr. and Grimlund [1990] report that auditors facing SEC disciplinary actions tend to lose market shares afterwards. Similarly, Davis and Simon [1992] find that SEC sanctions against an auditor negatively impact the firm's future audit fees and market shares. More recently, Hilary and Lennox [2005] assess the credibility of the pre-SOX peer review program of the AICPA. They find that audit firms gained clients after receiving clean opinions from their reviewers but lost clients after receiving modified or adverse opinions. Finally, Weber *et al.* [2008] find that the number of clients that dropped KPMG Germany as their auditor increased in the year the KPMG-ComROAD AG German accounting scandal surfaced.

argue that Big-4 auditors provide higher quality audits to maintain their higher brand-value.

Shareholders and other stakeholders also derive value from an external audit through an implicit financial claim on the auditor's wealth in the event of an audit failure. That is, stakeholders can take legal action against an auditor if the audited financial statements are later found to contain significant errors and hope to recover part of their wealth lost as a result of such errors. In that sense, the auditor is seen as providing financial statement users with an "insurance policy" that directly enhances firm value by increasing the magnitude of expected future cash flows. Termed the "insurance hypothesis", it is argued that the value of such insurance is a function of total auditor wealth. Accordingly, larger auditors with "deeper pockets" and more wealth at stake are viewed as providing greater insurance value than smaller auditors because stakeholders can expect to recover a greater share of their loss following an audit failure (e.g., Schwartz and Menon [1985] and Menon and Williams [1994])[11].

However, note that conditional on an audit failure being discovered, claims are only awarded if the court finds the auditor to be negligent or when the auditor settles out of court. Thus, the insurance value provided by an auditor is decreasing in audit quality simply because audit failure becomes less likely and/or the auditor is less likely to be found negligent. It is important to realise that, excluding audit quality, insurance value is entirely derived from auditor specific characteristics, not the audit process *per se*. From this perspective, shareholders can value a given auditor more because of, for example, audit firm size, even if the actual level of audit quality delivered is equivalent to that of other auditors.

The wealth (i.e., size) differential between Big-4 and Non-Big-4 auditors has led some researchers to investigate the insurance hypothesis further. These authors argue that the

[11] It may be more accurate to refer to an auditor's "wealth per client" when evaluating insurance value. In that sense, larger auditors also service more clients and this can reduce their insurance value. However, if audit failures are assumed to be randomly distributed across an auditor's client base (if well diversified), larger auditors with more clients can more effectively support the risk and are more capable to offer valuable insurance.

wealth differential provides an incentive for the larger Big-4 auditors to supply audits of higher quality and issue more accurate audit reports. They use this hypothesis to explain the well documented quality (and fee) differential between Big-4 and Non-Big-4 auditors.

Specifically, the argument states that larger, wealthier auditors face proportionally higher expected litigation costs because they, *ceteris paribus*, have more wealth at stake (Dye [1993]) and/or are sued more often (Lennox [1999][12]). Claims by the Big-4 auditors, anecdotal evidence and recent reports in the press certainly seem to confirm this conjecture (e.g., Arthur Andersen & Co. *et al.* [1992] and Public Accounting Report [2006]). This "'deep pocket' hypothesis" predicts that Big-4 audit firms who face proportionally greater penalties for incorrectly expressing an unqualified opinion will take "defensive action" by supplying, on average, an audit of higher quality to optimally minimise their total audit costs by lowering their expected liability costs (i.e., insurance value) (e.g., Dye [1993], Simunic and Stein [1996] and Lennox [1999]). In accordance with this, Francis [2004] reviews several empirical studies which confirm that auditor behaviour is directly affected by legal incentives[13].

The "deep pocket" hypothesis, however, does not speak directly to the insurance value of audits (i.e., insurance hypothesis). Rather, it is an indirect consequence of the negative relation between the insurance value of audits and audit quality[14]. Hence, it essentially provides an alternative mechanism by which auditor characteristics, size again, can lead

[12] This is in opposition to arguments made under the "reputation" hypothesis which suggests, and finds, that litigation rates are lower for Big-4 auditors than for Non-Big-4s (Palmrose [1988]). Yet, Stice [1991] finds no significant relation between auditor size and litigation while Lennox [1999] finds a positive relationship and concludes that this is supportive of the "deep pocket" hypothesis. Overall, the issue remains largely unresolved.

[13] For example, comparing audit fees across 20 countries, Taylor and Simon [1999] find that audit fees are positively correlated with a country-specific measure of auditor litigation exposure. For more recent evidence see also: Geiger *et al.* [2006] and Venkataraman *et al.* [2008] for differences in audit quality and pricing under different U.S. litigation regimes; and Choi *et al.* [2008a] and Francis and Wang [2008] for differences in Big-4 audit quality and pricing across countries with different liability regimes, when compared to Non-Big-4 auditors. See also London Economics [2006, Annexe 6] for a review of the literature on the effects of auditor liability regimes on auditor conduct.

[14] Recall, the "deep pocket" hypothesis states that audit quality is increasing in auditor wealth (i.e., size). This is valued by audit clients as it increases firm value through greater assurance value. On the other hand, the insurance hypothesis states that the value of an audit is an increasing function of auditor wealth (i.e., size). While firm value is enhanced through greater insurance value, it does not imply that audit quality is increasing in auditor size.

to the supply of greater assurance through increased audit quality. Nonetheless, the distinction between the "deep pocket" and reputation hypotheses has proven difficult to establish empirically. Consequently, when investigating quality differentials, researchers now loosely appeal to both hypotheses by simply stating that Big-4 auditors face both proportionally higher litigation and reputation costs than do Non-Big-4 auditors[15].

Finally, auditors also provide advice, formal and informal, to top management and audit-committees on issues ranging from best-practices on dealing with certain accounting standards to how the firm can improve its internal processes and controls. This advice is provided on top of the audit itself and is indistinguishable from it. Surveys indicate that managers and audit-committees consider the benefits of these value-added services when choosing an auditor (Oxera Consulting [2006]). Accordingly, these have a real, albeit limited, impact on firm value by improving internal firm decisions and resource allocation which increases the magnitude of expected future cash flows. Firms can also value the scope of an auditor's service line which can lead to real cost savings because of lower transaction costs in seeking service providers or other potential synergies as a result of (possible) economies of scope[16]. In addition, some attributes of auditors' service quality are positively correlated with client-firm's management satisfaction (Behn *et al.* [1997]). This can potentially reduce auditor switches[17] and thus limit associated future transaction costs. In fact, Behn *et al.* [1999] find that measures of client-firm's

[15] Interestingly, survey evidence indicates that Big-4 auditors view reputational damage as a far more powerful incentive to deliver audit quality than the threat of litigation (London Economics [2006, Section 27]), suggesting the "reputation" hypothesis outweighs the "deep pocket" hypothesis. If this is the case, however, it is not obvious that differences in legal environments (e.g., auditor liability cap, joint or proportional liability, etc.) would lead to differences in auditor conduct, or at the very least, to relative differences between Big-4 and Non-Big-4 audits across legal jurisdictions. Indeed, unless these differences in legal regimes are correlated with greater scrutiny and/or greater probability of detecting auditor errors, it is unclear how auditors', specifically Big-4 auditors', reputation would be more at risk under any specific legal regimes. Hence, it would appear worthwhile to distinguish between the two hypotheses. That is, the "probability" of detection (or investigation) becomes the relevant attribute of any legal environment when studying auditor conduct across different legal regimes, not the legal costs associated with such detection.

[16] For example, in a GAO [2003a, Figure 3] survey of Fortune-1000 chief financial officers, 36% stated that "Number of services offered" was an important factor for choosing a new auditor. However, the benefits from this may largely diminish following the implementation of SOX or other similar regulations which restrict auditors' ability to offer NAS-MAS.

[17] Anecdotal evidence suggests that client relationship management issues are the most common reasons why clients change auditors (AccountingWEB.com [2007]). This is also supported by survey data (Oxera Consulting [2006, Figure 3.1 and Table 3.9].

management satisfaction are associated with an audit fee premium for Fortune-1000 companies.

2.3 Limits of Current Hypotheses and Motivation

Up to now, the literature on audit quality has sought to explain audit quality, and more precisely differences in audit quality between types of auditors (i.e., Big-4 *vs.* Non-Big-4), from the perspective of differences in auditors' costs functions (i.e., reputation and litigation costs). Although the reputation and "deep pockets" hypotheses of audit quality provide strong arguments for the documented quality and fee differential between Big-4 and Non-Big-4 audit firms, both take auditor size as exogenous. Both theories implicitly assume the existence of distinct segments of the audit market where client-firms differ in their demand for audit quality. Yet, the arguments build essentially on supplier characteristics and auditors are assumed to cater to one specific segment of the audit market based on their "endowed" size. How key characteristics of the demand for audit services affect auditor behaviour are ignored. As such, the literature offers no explanation as to why any one segment of the audit market should dominate the other or why Big-4 auditor market shares have been increasing[18].

Overall, the literature on audit quality has been mostly supply-driven. The reasoning why some auditors specialise as high-quality suppliers is vague, if explained at all. Treating audit firm size as exogenous creates concerns about the true causal relation between audit firm size and audit quality. In other words, do bigger audit firms provide higher quality audits because they are bigger, as the existing hypotheses would suggest, or are larger audit firms bigger because they deliver higher quality, more highly valued audits? This classic "chicken or egg" problem can only be addressed with a new theory which considers demand-side factors.

[18] Likewise, the current hypotheses fail to explain the evolution from the Big-8 to the Big-4 auditors. Evidence of increasing Big-4 market shares is clear from recent reports (e.g., GAO [2003b, 2008], Oxera Consulting [2006] and London Economics [2006]).

To address these issues, I propose a model which builds on key features of the demand for audit services and where audit quality and auditor size are endogenous. Hence, the model offers important insight on how demand-side characteristics affect auditor conduct. Given recent regulatory changes to enhance audit quality (e.g., SOX), it is important to better understand the auditing industry and how market forces also affect real audit quality. For example, how does audit firm competition impact the level of investment in audit technology and audit effort?

Besides the obvious problem of causality, the reputation and "deep pockets" hypotheses offer few predictions on what impact external market factors may have on audit quality and audit fees. For example, the current literature offers no guidance with respect to how market characteristics like consumer demand, competition among audit firms, market size and audit production cost structure affect audit quality and fees. Also, taking auditor size as exogenous ignores the dynamics of the auditing industry; how audit quality and market structure evolve over time[19], and how auditor size and concentration may be linked to audit quality and fees (and *vice versa*). This last point is especially important given recent concerns expressed by government and regulatory agencies, professional accounting bodies, business associations and private interest groups over the current level of market concentration and the potential adverse impact on audit quality and fees[20]. For example, this is clearly illustrated in a recent report by the Institute of Charted Accountants in England & Wales:

> The *maintenance and enhancement of audit quality must remain the overarching policy objective*. Competition and choice is necessary to ensure that audit quality is maintained and enhanced. However, in assessing possible intervention in the audit market to stimulate further competition and choice, *the impact, if any, of any policy on overall*

[19] For example, DeAngelo [1981b] proposes a static model which only explains why differential quality levels are observed at a given point in time, given exogenous auditor characteristics. Moreover, her theory relies on a "mechanical" relationship between audit firm size and quality, which implies continuous quality differential across auditor firms. Obviously, this is inconsistent with the dual market-quality structure, i.e., Big-4/Non-Big-4 dichotomy, supported by empirical evidence. In fact, Francis and Wilson [1988] finds that a continuous "auditor size" variable fails to capture audit quality in their empirical model, while a dichotomous "Big-8/Non-Big-8" variable does.

[20] See for the U.S.: GAO [2003b, 2008], ACAP [2008], Center for Audit Quality (AICPA) [2008], The American Assembly [2005] and U.S. Chamber of Commerce [2006, 2007]. For the U.K.: Oxera Consulting [2006], ICAEW [2005] and Office of Fair Trading [2004]. For the European Union: London Economics [2006], Oxera Consulting [2007] and EC-DG [2008].

> *audit quality needs to be taken into account*. The absolute maximisation of competition may not be the objective that should be sought, but the *working party considers that further research is needed to understand* the actual levels of competition and choice and the views of business and end users of audited financial reports (ICAEW [2005, p. 6], *emphases added*).

Clearly, the current state of the literature on audit quality only paints a partial picture of this complex subject and more research is needed to understand the link between audit quality, audit fees and market structure. These are the central themes explored in this thesis.

Furthermore, there are several other objections that can be formulated regarding the existing supply-based hypotheses. For example, the application of the reputation hypothesis hinges on the assumption that auditors have incentives to "cheat". However, these incentives may be lower than assumed by the theory and/or simply be at the same relative level across all auditor types. This would seriously limit the application of the theory and question the auditor-size/audit-quality relationship as proposed by DeAngelo [1981b]. As pointed out by Simunic and Stein [1987, footnote 1 - Chapter 1)], the value of client-specific quasi-rents decreases over time and since auditor-client relationships tend to be long lived[21], the motivational impact served by the residual collateral bond that exists at any time is not obvious.

Empirically, it remains a largely unresolved issue whether *real* auditor independence (i.e., independence in fact) is actually compromised in situations where the theory predicts that the incentive for auditors to cheat is high (e.g., Beattie and Fearnley [2002]). For example, some studies use audit and NAS-MAS fee data to measure the economic bond between a client and its auditor. However, these studies yield conflicting results with some authors finding that *real* auditor independence is impaired when a (relatively) strong economic bond exists (e.g., Frankel *et al.* [2002]), while others fail to find such a

[21] Simunic and Stein [1987] state 20 years on average and more recently the GAO [2003c] reports an average auditor tenure for Fortune 1000 companies between 19 and 22 years. In a survey of E.U. companies, London Economics [2006] reports 31% of companies have had their auditor for over 15 years and that the length of the relationship is increasing in company size (tables 22 and 23).

relation (e.g., Ashbaugh *et al.* [2003][22]). In sum, the empirical evidence fails to support the idea that high NAS-MAS fees impair real auditor independence such that true audit quality is ultimately compromised (see Francis [2006] and Bedard *et al.* [2008] for brief reviews[23]).

Another key assumption driving the reputation hypothesis relies on the credibility of clients' dismissal threats. If these threats are not credible, then auditors have no incentive to compromise their independence to accommodate any one client. Lu [2006] shows that auditor switches send signals to outside investors who can then react in such a way that the benefits client-firm insiders can hope to gain from opinion shopping are eliminated. As a result, this limits the credibility of insiders' dismissal threats such that neither the predecessor nor the successor auditor will compromise their independence. There is in fact very little empirical evidence to suggest that client-firms successfully engage in opinion shopping (e.g., Chow and Rice [1982], Smith [1986] and Krishnan and Stephens [1995][24]). In addition, clients may be limited in their ability to switch because of high transaction costs[25] or regulatory issues[26].

[22] There are several recent papers which also conclude, overall, that auditor independence does not appear to be impaired even when economic bond is stronger: e.g., DeFond *et al.* [2002], Chung and Kallapur [2003], Kinney Jr. *et al.* [2004], Larcker and Richardson [2004] and Ruddock *et al.* [2006]. Also, when measuring economic bond as a client's size relative to the size of the auditor office that issues the audit report, Reynolds and Francis [2000] find no evidence that greater economic dependence causes Big-4 auditors to report more favourably for larger clients in their offices. Similarly, Craswell *et al.* [2002] find that auditor fee dependence (towards a client-firm), whether at the national or local office level, does not affect their independent judgement, measured as the propensity to issue unqualified opinions. Lastly, Li [2009] finds no statistically significant association between auditor-client economic bond at the local office level (i.e., audit and non-audit fee ratios) and *real* auditor independence (i.e., propensity to issue a going-concern opinion) in the period of her study preceding SOX. However, in the post-SOX period, she finds evidence consistent with *real* auditor independence actually being positively associated with the strength of the economic bond. Interestingly, this latter finding is inconsistent with prevailing theories.

[23] Yet, Francis [2006] also notes that the literature finds that NAS-MAS can adversely affect the *appearance* of auditor independence, even if *real* audit quality does not seem to be impaired.

[24] One notable exception would be Lennox [2000].

[25] For example, Chaney and Philipich [2002] report that most of Andersen's S&P 1500 clients stayed with the firm until after the indictment of March 15, 2002. While timing of the indictment is an issue, the fact remains that most clients stayed with Andersen even after it announced that it had shredded documents (January 10, 2002). The authors note that several companies reported that they preferred to stay with Andersen to save the potential cost of switching auditors and opted only to switch when it became clear Andersen would not survive.

[26] Because of auditor independence rules and restrictions on the joint provision of NAS-MAS, it may be difficult for some clients to switch auditor if other audit firms are already providing tax and consulting services, for example.

All these issues raise doubts about the magnitude of auditors' incentives to cheat and the reasonableness of the assumptions of the reputation hypothesis. If audit quality (via independence) does not seem significantly affected in settings where the benefits from cheating appear greatest, then it may simply be that the gains from cheating are over estimated. Overall, this questions the reputation hypothesis's ability to explain fully the auditor-size/audit-quality relationship and suggests that other forces are also at work to drive this phenomenon.

Finally, it is unclear whether reputation and litigation costs differentials between Big-4 and Non-Big-4 auditors are as significant as assumed by the "deep pockets" hypotheses[27]. This is important since a key assumption of this hypothesis is that non-proportional litigation costs lead to the quality differences between Big-4 and Non-Big-4 auditors (i.e., *ceteris paribus*, Big-4s face greater costs). Of course, the Andersen debacle challenges this conjecture. Yet, the events related to Enron and Andersen were unprecedented in nature and magnitude which may still suggest that any event that can lead to the fall of a Big-4 auditor (or a significant economic loss) must be proportionally greater than events which could lead to the fall of a Non-Big-4 auditor. Overall, Big-4 auditors hold better diversified portfolios of clients because of their size (Simunic and Stein [1990]). In turn, this limits the likelihood that one audit failure would jeopardise a Big-4 firm's survival. Furthermore, Big-4 audit firms certainly have bigger and better organised legal and public relations departments that can more effectively fight litigation or limit reputational damage resulting from an audit failure[28]. In sum, the incentives for Big-4 auditors to provide high-quality audits (as a "defence" strategy) are not necessarily as great as is implicitly assumed under the "deep-pocket" hypothesis[29].

[27] In a study of auditor liability in the U.K., a report by The Office of Fair Trade makes the point that "the liability position is symmetric as between all audit firms (…)" (Office of Fair Trading [2004, p. 10]). The report notes further that auditor liability is also, somewhat, limited either through professional insurance or varying forms of limited liability ownership structures (e.g., LLP).

[28] While this may not necessarily allow Big-4 audit firms to limit their relative litigation and reputation costs to a rate below that of the Non-Big-4 audit firms, it could nonetheless bring it to a more comparable level.

[29] The claim here is not that a Big-4 auditor's total litigation and reputation costs resulting from audit failure may be smaller than that of a Non-Big-4 auditor. Indeed, total litigation and reputation costs resulting from any legal action against a Big-4 auditor are likely greater than the total litigation and reputation costs a Non-Big-4 auditor would face. Rather, I make the argument that for every dollar of

In contrast with the reputation and "deep-pocket" hypotheses, the ESC framework I propose essentially relies on two less restrictive assumptions about the demand for audit services and the costs of providing those audits. Specifically, I assume that: (1) some significant proportion of audit clients value audit quality (i.e., increases shareholder value)[30]; and (2) audit services are provided by auditors through a combination of costly variable and fixed production inputs: audit effort and technology, respectively. I develop the ESC framework in relation to the auditing industry in the following section.

wealth at stake, it is unclear whether a Big-4 auditor stands to lose proportionally more than a Non-Big-4 auditor as a result of an audit failure. From this perspective, it is unclear that Big-4 auditors have an incentive to provide greater audit quality than Non-Big-4 auditors.

[30] This assumption is supported, in part, by historical evidence. Watts and Zimmerman [1983] find that external audits existed early in the development of business corporations and were "in demand" long before government regulations imposed statuary audits. This suggests that external audits fundamentally contribute to firm value. Besides the positive link that exists between shareholder value and audit quality (Section 2.2), the assumption that client-firms value audit quality is also strongly supported by survey data on auditor choice by client-firms. For example, in a GAO [2003a, Figure 3] survey of Fortune-1000 chief financial officers, "quality of service offered" ranked as the most important factor in choosing a new auditor (76% very great importance and 23% great importance). Other "audit quality" attributes also ranked very high. Similarly, a survey of U.K. FTSE-350 and FTSE Small Cap audit committee chairs reported that "technical accounting skill" ranked as the main factor influencing auditor selection (82% essential and 18% important) (Oxera Consulting [2006]). Again, other "audit quality" attributes ranked high.

3 DEMAND-BASED AUDIT QUALITY MODEL

While the bulk of the literature on audit quality relies on supply-based theories, there is, however, one notable exception. Dopuch and Simunic [1980a, 1980b], followed by Simunic and Stein [1987], propose a demand-based model of audit quality. The latter build on the former and propose a model in which the audit product possesses three characteristics valued by audit clients: a contribution to organisational control ("control" demand), credibility, and scope of product line[31]. Consistent with the audit quality literature, they note that clients present varying preferences for these attributes based on differences in firm characteristics, such as structure of ownership, age, financial performance, efficiency of internal controls, etc. Yet, clients can only rely on observable auditor characteristics to assess audit value since this value is not perfectly observable by them. The model suggests that brand-name, or reputation, is observable and serves as a surrogate for audit value. This argument is referred to as the "brand-name" hypothesis, or model.

Their model proposes that auditors have an incentive to specialise and uniformly deliver their chosen level of value (e.g., high or low) across clients (at a given point in time) to minimise clients' evaluation costs. Basically, auditors "position" themselves in a three dimensional product space in accordance to their ability to deliver value with respect to the three characteristics of the audit product. This "position" essentially corresponds to the auditor's reputation or brand-name. Simunic and Stein [1987] suggest that the prospect of earning monopoly rents is what motivates an auditor's positioning. They implicitly assume that auditors will position themselves at an earlier stage by building reputation and brand-name value through investments in audit technology, training and knowledge development, organisational control systems, etc. In a later stage, auditors will produce and deliver audits of the expected value since they wish to maintain their brand-name investments which are sunk and thus have no salvageable value. That is, the

[31] "Control" demand and credibility are apparent to "assurance" value as defined above while "product line" relates to what I have referred to as "service" value.

desire to maintain monopoly rents and quasi-rents from immovable resources (i.e., sunk) motivates an auditor to remain in his location over time.

The "brand-name" model presents several advantages over DeAngelo [1981b] and other reputation and "deep-pockets" arguments. While much of their arguments and conclusions are equivalent, Simunic and Stein [1987] recognise that auditor positioning is an essential business decision that is affected by demand characteristics and not just the result of some exogenous supplier attribute, i.e., auditor size. As well, contrary to DeAngelo [1981b] who focuses only on the truthfulness of auditors' reporting decision (i.e., independence), they allow explicitly for differences in auditors' capability to perform quality audits. This view is inherently a more positive one of the audit process, and possibly more accurate. In fact, Humphrey *et al.* [2006] argue that in light of past and recent regulatory reforms, most of the focus has been on auditor independence and perhaps not enough attention has been given to basic issues of auditor competence.

Despite the merits of the model, Simunic and Stein [1987] do not formally derive the mechanism which explains how auditors position themselves. This mechanism is assumed, but not well understood and an audit firm's "brand-name" investment decision at the earlier stage is not modeled. As a result, auditor size is, as in other models, exogenous. Furthermore, the model offers no obvious reason as to why auditor size would necessarily be positively associated with audit quality[32]. Hence, while insightful, their approach does not address the central questions of this thesis. As it turns out, explicitly modeling auditors' "positioning" is key for understanding how audit quality, audit fees, auditor size and market structure are related.

[32] The reasoning is as follows. While it is clear that Big-4 auditors have greater "reputational" capital, it is not clear that this reputation is one of supplying the highest valued audits. A strict interpretation of the "brand-name" model only implies that Big-4 auditors will offer a more constant level of audit value (and/or quality) and that their "brand-name" will serve as a better (more precise) signal of their true value to client-firms, relative to that of other auditors. Nonetheless, it could be that the chosen level of audit quality supplied by Big-4 auditors is not the highest on the market. In turn, the Big-4 auditors' market dominance could simply come from their reputation to provide a (more) "uniform" level of audit quality (in itself a valued attribute of the audit product), although not one of supplying superior audit quality. The parallel can be made with McDonald's Restaurants, which thrives on its reputation of supplying a uniform dinning experience across all its outlet… not one of "fine quality" dinning! Of course, Simunic and Stein [1987] implicitly assume, as is common in the literature, that the Big-4 auditors have chosen to specialize as high-quality auditors.

3.1 The Basic Model

I propose a model building on Sutton [1991]'s ESC model[33] of vertical product differentiation. Below, I present the details of the model and offer an interpretation that is specific to the auditing industry and directly in line with the key characteristics of the audit product and production process.

Demand for auditing services is modeled as follows. Client-firms maximise current shareholder value by optimally deciding how much total external auditing and how much alternative/complementary internal monitoring activities to purchase, subject to some optimal budget. To simplify the analysis, I assume a very simple setting in which all client-firms have the same benefit (i.e., client-firm market value) function with respect to monitoring activities:

$$\pi = f(EA_i, y) \tag{3.1}$$

where π corresponds to client-firm market value derived from monitoring activities[34], EA_i corresponds to an external audit purchased from auditor i, and y to other internal monitoring activities (in hours). Also, I assume firm value is increasing in monitoring activities (see Section 2.2), although realistically at a decreasing rate; that is:

$$\frac{\partial \pi}{\partial EA_i} > 0, \frac{\partial \pi}{\partial y} > 0, \frac{\partial^2 \pi}{\partial^2 EA_i} < 0 \text{ and } \frac{\partial^2 \pi}{\partial^2 y} < 0$$

While the "assurance", "insurance" and "service" components of external auditing all contribute to firm value, only assurance value is modeled for simplicity (i.e., audit

[33] Sutton's framework is also referred as the "Endogenous Fixed Cost" (EFC) model by other authors (e.g., Ellickson [2006, 2007]). Indeed, as is made clear below, it is the "fixedness" of investments in audit technology that is the driving force of the results presented here (Bresnahan [1992]), and the condition that such investments be sunk is nonessential. Besides, fixed costs are always sunk to some extent and the distinction between the two is merely one of degree, not one of nature (Tirole [1988, pp. 307-308]). Nonetheless, I refer to the ESC model throughout this thesis to remain consistent with Sutton's terminology.

[34] At this stage, client-firms are assumed identical and other determinants of client-firm market value are excluded from the model.

quality). Furthermore, auditor independence issues are excluded such that the assurance value of an external audit is essentially a function of the auditor's capability. Hence, total external auditing purchased is simply: $EA_i = f(\delta_i, x_i) = \delta_i x_i$; where x_i is equal to total audit "effort" (i.e., audit hours) purchased from auditor i, and $\delta_i \geq 1$ represents the audit "technology" used by that auditor. Technology δ_i is normalised to be equal to or greater than one, with $\delta_i = 1$ corresponding to the minimum audit technology required to perform a minimum standard audit. Consistent with DeAngelo's definition of audit quality (but ignoring auditor independence), the product $\delta_i x_i$ is referred to here as audit quality and is strictly increasing in effort and technology (see Section 2.1).

When a client-firm hires an external auditor at any given point in time, audit technology is taken as given. That is, in the short term, technology is a fixed input in the audit production process. In contrast, effort is a variable input. For simplicity, audit firms are assumed identical. Assuming further that unit effort cost is constant and independent of technology implies that marginal audit production cost is constant[35]: $c_i(\delta_i, x_i) = c > 0, \forall\ i$. Client-firms purchase an external audit from auditor i at a total cost of $p_i x_i$. That is, total audit fees is equal to auditor i's weighted average billing rate p_i multiplied by total audit hours x_i. Other monitoring activities can be purchased at an average hourly cost of p_y.

Because monitoring activities are costly and since their rate of contribution to client-firm value is decreasing (i.e., π concave), there will be a maximum "budget" that client-firms are willing to allocate to monitoring activities. This effectively imposes the following budget constraint on client-firms:

$$p_i x_i + p_y y \leq B \qquad (3.2)$$

where $B > 0$ is the optimal total monitoring budget. B is determined just like any other investment decisions the client-firm faces and is set at a previous stage. This decision process is not explicitly modeled here and B is simply taken as given.

[35] More specifically, c is the "weighted average marginal cost per audit hour". For the most part, this corresponds to labour costs per hour, weighted according to the "mix" of labour (i.e., differences in audit effort and expertise for audit work performed by partners, managers and staff auditors).

Adding structure to the model, client-firms' benefit function is modeled as a simple Cobb-Douglas function:

$$\pi = \alpha \ln(\delta_i \, x_i) + (1-\alpha)\ln(y) \qquad (3.3)$$

This benefit function maps external auditing to client-firm value. Notice that client-firm value is increasing in audit quality, although realistically at a decreasing rate. Also, in accordance with the indivisibility of audit engagements, client-firms will only purchase external auditing from one auditor *i* at a time.

Because client-firms take auditor characteristic vectors, $\vec{\delta}$ and $\vec{p}$, as given, the optimal auditor choice for clients is such that the technology-price ratio δ_i/p_i is maximised. That is, out of the set of available auditors, client-firms only choose the subset of auditors where δ_i/p_i is maximised since for a given average billing rate, client-firms strictly prefer more technologically capable auditors (i.e., higher audit quality). Therefore, in equilibrium, auditors enjoying positive sales must have set a price proportionate to their technological abilities: $\delta_i/p_i = \delta_j/p_j, \ \forall \ i, j \implies p_i = \lambda\delta_i, \ \forall \ i$, where λ is a constant determined by the budget constraint. I refer to the technology-price ratio as audit value. Clearly, the ESC framework illustrates that in selecting an auditor, client-firms seek to maximise audit value, not just audit quality[36].

A feature of the client-firms' benefit function is that total expenditure on external auditing is independent of the level of prices and audit technology. Client-firms spend a fraction $\alpha \in (0,1)$ of their optimal monitoring budget *B* on auditing and (1- α) on other monitoring activities (e.g., internal controls). Client-firm characteristics, such as size, will affect *B* and α. For example, larger client-firms will have larger overall *B*, and it may be optimal for client-firms with greater agency conflicts to attribute a larger portion α of

[36] To see this, notice that as per eq. (3.3), the optimal auditor choice is such that client-firms maximize the following:

$$\underset{\delta,x}{MAX} \ \delta_i x_i \qquad st: \alpha B = p_i x_i \ \Rightarrow \qquad \underset{\delta,p}{MAX} \ \frac{\delta_i}{p_i}\alpha B$$

Hence, it is clear that the optimal auditor choice is such that the δ_i/p_i ratio is maximized.

their budget to external auditing. External factors such as regulatory and legal environment may also affect B and α. The focus here is on audit quality so B and α are exogenous to the model and assumed constant across all client-firms and sufficient to satisfy mandatory (minimum) audit requirements. However, I explore in Section 3.5 what impact variations in B and α can have on the implications of the model.

Audit firm competition is modeled as a three-stage game. Auditors who decide to enter a given audit market at the first stage will incur exogenously determined entry cost $\sigma > 0$ (e.g., PCAOB registration fee and other corresponding expenses, licensing, basic professional insurance, etc.). In the second stage, each audit firm optimally chooses the level of technology it will employ for its audits. At this stage, the audit firm incurs an additional fixed cost:

$$A(\delta_i) = \frac{a}{\gamma}(\delta_i^{\gamma} - 1) \qquad (3.4)$$

where $\delta \geq 1$ is the technology index with $\delta = 1$ ($A(\delta=1) = 0$) corresponding to minimal technology[37], $a > 0$ is the unit cost of technology enhancing investments and $\gamma > 1$ determines how quickly fixed costs increase with technology δ. Higher values of γ correspond to more rapidly diminishing returns in technology.

Finally, audit production and delivery occurs in the third stage. At this stage, total costs incurred thus far are fixed and equal to: $F(\delta_i) = \sigma + A(\delta_i)$. For simplicity, competition is modeled as Cournot. With technology level fixed and assuming all audit firms possess equivalent technology $\bar{\delta}$, a deviant firm employing technology $\delta_i > \bar{\delta}$ will earn a variable profit in the final-stage of the subgame (Cournot equilibrium) equal to (adapted from Sutton [1991, p. 50], Sutton [1998, Appendix 15.1]):

[37] The fixed cost of achieving minimal audit technology is essentially considered an entry cost and is included in σ.

$$\Pi(\delta_i \mid \delta_{-i} = \bar{\delta}) = S\left\{1 - \frac{1}{\frac{1}{N-1} + \frac{\delta_i}{\bar{\delta}}}\right\}^2 \qquad (3.5)$$

where S is equal to market size (i.e., total industry sales) and N is the number of audit firms entering at the first stage. Notice that final-stage variable profit is increasing in S and δ_i (holding $\bar{\delta}$ constant), and decreasing in N. In the simple case where all auditors set $\delta_i = \bar{\delta}$, $\Pi = S/N^2$, independent of technology (i.e., no vertical product differentiation).

In equilibrium, it must be that all entrants earn a non negative final (net) payoff (strictly greater than 0 because of the integer effect):

$$\Pi(\delta_i \mid \delta_{-i}) - F(\delta_i) \geq 0, \forall\, i \qquad (3.6)$$

With respect to technological investments, entrants will face one of the following two situations. One possibility is that the marginal gain in variable profit Π for a deviant auditor that sets δ_i slightly above $\bar{\delta}=1$ is insufficient to recover the additional investment $A(\bar{\delta} + \epsilon > 1) > 0$. In this case, all entrants will offer simple audits with minimal technology $\bar{\delta}=1$ and incur total fixed costs $F(\bar{\delta}=1) = \sigma$. Alternatively, if this condition fails all entrants will engage in technology enhancing investments and employ a common level of technology $\bar{\delta} > 1$, such that the following condition holds (Sutton [1991, p. 54]):

$$\left.\frac{d\Pi}{d\delta}\right|_{\delta=\bar{\delta}} = \left.\frac{dF}{d\delta}\right|_{\delta=\bar{\delta}} \qquad \Rightarrow \qquad 2S\frac{(N-1)^2}{N^3} = \gamma\left[F - (\sigma - a/\gamma)\right] \qquad (3.7)$$

That is, entrants will engage in technological investments up to the point where the marginal profit from the investment is offset by its cost $A(\delta)$. A movement from the first situation to the next identifies key points at which technology becomes an essential element of competition between audit firms. These points will depend on market size S and fixed costs parameters σ, a and γ. Once it becomes profitable to invest in technology,

audit firms will compete by investing increasingly in audit technology and offer higher audit quality. Solving eq. (3.7) yields the equilibrium[38] price:

$$p = \left(\frac{N}{N-1} \right) c \qquad (3.8)$$

And quality:

$$\delta = \left(\frac{2S(N-1)^2}{N^3 a} \right)^{\frac{1}{\gamma}} \qquad (3.9)$$

This leads to the first observation:

Observation 1

Audit quality is increasing in market size: $\frac{\partial \delta}{\partial S} > 0$.

The proof of *Observation 1* follows directly from eq. (3.9) and the definition of audit quality: $\delta_i x_i$. Technological investments are increasing in market size S as these fixed costs can be more easily supported in larger markets. *Observation 1 makes the important point that audit quality is also driven by audit technology, rather than just audit effort as implicitly assumed in the audit quality literature.*

Eq. (3.8) indicates that audit firms will price their services as oligopolists according to average marginal cost c (e.g., cost of labour) and the number of entrants N. Interestingly, the additional fixed costs, $A(\delta > 1) > 0$, incurred by audit technology investing auditors are (for the most part) not directly passed on to client-firms. Rather, auditors who choose, at stage two, to invest above the minimum in audit technology can hope to recover these investments in stage three because of greater market shares. Competition for these market shares drives auditors entering a market to offer greater audit value by investing in audit

[38] To ensure simple, "well-behaved" solution with a symmetric equilibrium, Sutton also imposes: $\gamma > \underline{\gamma} = \max\left\{1, \frac{2a}{3\sigma}\right\}$; that is, $A(\delta)$ is sufficiently convex. This condition also guaranties that the first-order condition eq. (3.7) does indeed define a global maximum of eq. (3.6).

technology (i.e., increase audit quality), while pricing their audits at the most competitive rate (i.e., billing rate p close to average marginal cost c). Eq. (3.7) guaranties that auditors recover their total investments $F(\delta)$, given the number of entrants.

Furthermore, it is clear that offering higher audit quality only through greater audit effort x is not the optimal strategy for auditors. To see this, it is first important to understand that when a client-firm purchases an external audit, it essentially purchases a "bundle" of audit effort (i.e., hours) from a given auditor utilising a specific level of audit technology. While the total number of hours purchased is a function of client-firm characteristics, it is also affected by that auditor's technology. To illustrate, imagine a market with two auditors: auditor i with technology $\delta_i = 1$ (minimum technology); and auditor j with technology $\delta_j > 1$. In this setting, auditor i can "compensate" for its inferior technology by providing more effort on its audits such that total audit quality supplied by auditors i and j is equivalent; that is, $\delta_i x_i = \delta_j x_j$, with $x_i > x_j$. Yet, because average marginal costs are equal for both auditors, $c_i = c_j = c$, their average billing rates will also be equal, $p_i = p_j = p$. As a result, client-firms of auditor i will bear the full cost of the additional audit effort (i.e., $px_i > px_j$). Even if both auditors supply equal (total) audit quality, client-firms will opt for auditor j's services as total audit fees will be lower[39]. In other words, while supplying greater audit effort increases audit quality, it does not enhance audit value. Finally, auditor j is strictly preferred and will be able to recover its additional investment in audit technology from the additional market shares gained at the expense of auditor i.

The link that exists between auditor size and audit quality, as well as the concentrated structure of the auditing industry, follows directly from the discussion above. Specifically, this relation evolves from the fact that client-firms value audit quality (eq. (3.3)) and that the burden of enhancing audit quality falls predominantly on fixed investments in audit technology (eq. (3.4)). To see this, we solve audit firms' entry decision backwards to the first stage and observe that auditors will enter the market up to a point at which N is the largest integer satisfying (Sutton [1991 , eq. (3.2)]):

[39] Notice that in this setting, auditor j could still potentially charge a billing rate slightly above that of auditor i: $p_j > p_i$. However, as long as $\delta_j p_i > p_j$, auditor j is strictly preferred over auditor i and the results hold. This is explored further in Section 3.2 below.

$$\Pi(\delta_i = \bar{\delta}) = \frac{S}{N^2} \geq F^*(N,S) \geq \sigma \qquad (3.10)$$

That is, entrants earn a variable profit in the final-stage sufficient to recover total fixed costs, given the number of potential entrants. Recall that at stage two, all entrants will adopt the same investment strategy: $\bar{\delta}$ (i.e., symmetric equilibrium). Here $F^*(N,S)$ is the equilibrium value of total fixed costs implicitly defined under eq. (3.7). Setting eq. (3.10) as an equality and ignoring integer constraints, then substituting back in eq. (3.7) yields the equilibrium asymptotic number of audit firms as $S \longrightarrow \infty$, N_∞ [40]:

$$N_\infty = 1 + \frac{\gamma}{4} + \frac{1}{4}\sqrt{8\gamma + \gamma^2} \geq 2 \qquad (3.11)$$

Accordingly, as fixed costs increase, there will be a point when the number of audit firms does not increase with market size since further entry at stage one would drive variable profits below the total fixed costs that audit firms have engaged. That is, N converges asymptotically to a positive number, $N_\infty \geq 2$; which leads to a natural oligopoly (eq. (3.11)); formally:

Observation 2

> *The audit industry is characterised as a natural oligopoly and the minimum level of auditor concentration, as measured by the market share of the leading audit firm (C_1), does <u>not</u> converge to 0 as $S \longrightarrow \infty$: $1/N = C_1 > 0$.*

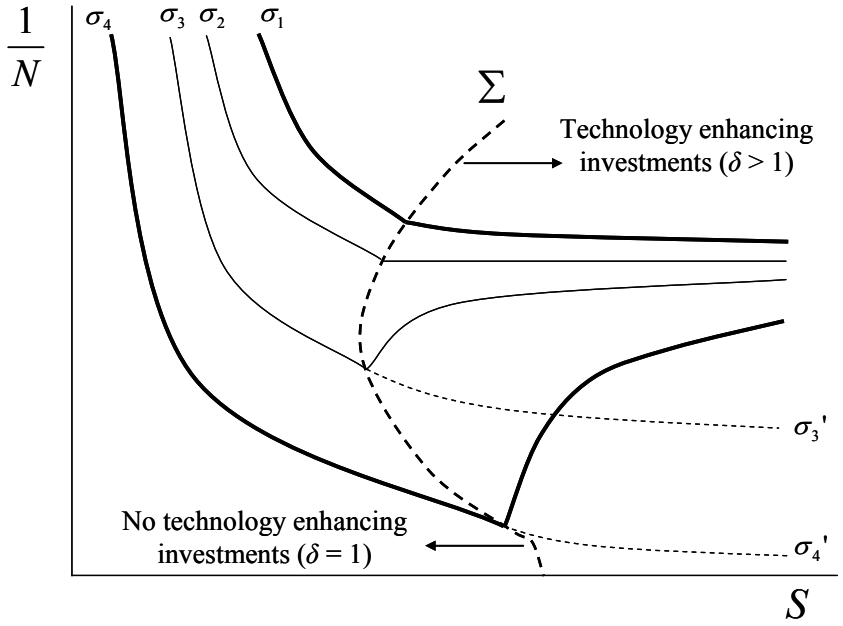
3.2 Interpretation and Implications

The key result from the model is that audit firms will compete on audit technology as a means to offer high-value, high-quality audits. However, because of the specific cost

[40] Specifically, when S $\longrightarrow \infty$, N_∞ solves the quadratic equation: $N + \frac{1}{N} - 2 = \frac{\gamma}{2} > 1$; the second root is always less than one.

structure audit firms face, they will only employ this strategy and start investing significantly in technology after the market reaches a minimum size. This result is illustrated below in Figure 3.1 (adapted from Sutton [1991, Figure 3.4]). For given fixed costs parameters a and γ, the graph relates market concentration[41] (vertical axis) to market size (horizontal axis) for varying levels of entry cost σ, with $\overline{\sigma} = \sigma_1 > \sigma_2 > \sigma_3 > \sigma_4 = \underline{\sigma}$. The dotted line identified by Σ represents the set of "switch" points at which audit firms move from one regime where they only invest in minimum technology ($\delta = 1$) to one where they start competing on quality by investing in technology such that $\delta > 1$. Audit technology level δ is increasing in market size S to the right of Σ, but is constant at $\delta = 1$ to the left.

Figure 3.1 Concentration and Market Size at Varying Levels of Setup Costs σ (where $\overline{\sigma} = \sigma_1 > \sigma_2 > \sigma_3 > \sigma_4 = \underline{\sigma}$)



(adapted from Sutton [1991, Figure 3.4])

As can be seen from Figure 3.1, audit firms' competitive behaviour and auditing cost structure will have a profound impact on the structure of the auditing industry. Increasing entry costs σ creates additional barriers to entry which increases market concentration.

[41] Because all N audit firms are identical, the ratio $1/N$ is equal to the C_1 concentration ratio; i.e., total market share of the leading audit firm (and equal for all audit firms).

However, as the market grows, it becomes profitable for additional audit firms to enter, thereby fragmenting the market. On the other hand, when market size increases further and reaches a critical size, an auditor *i* can gain much by undertaking audit technology investments to distinguish itself from its competitors and set $\delta_i > \overline{\delta}$ (i.e., vertical product differentiation). And because effort cost is constant at *c*, it is possible for that auditor to increase unit price just slightly above the current going billing rate, i.e., $p_i = \overline{p} + \epsilon > c$, while still providing a service that is more highly valued by clients[42]: $\delta_i / p_i \geq \overline{\delta} / \overline{p}$. Accordingly, the deviant auditor offers greater total audit quality $\delta_i x_i$ at an aggressive price and captures a given fraction of clients from other lower quality auditors. Greater market shares along with a marginally higher billing rate guaranty that the auditor will earn a positive variable profit Π in the final stage large enough to recover total fixed costs $F(\delta_i)$.

Of course, the optimal response of all other audit firms will be to engage in the same behaviour. Hence, as market size continues to increase, audit firms will compete on quality by investing ever more aggressively in audit technology. As firms try to gain market shares at the expense of others by developing audit technology and engaging larger fixed costs $A(\delta)$, some auditors will be forced to exit the market (or merge). Eventually, this "race for quality" leads to a natural oligopoly where only a limited number of large, technology intensive, high-quality audit firms service the market, no mater how large it gets. At this stage, market structure is independent of setup costs. Essentially, technological investments create an endogenous, strategic (i.e. behavioural) barrier to entry[43].

[42] This essentially represents a "quality premium" ϵ that the technology investing auditor can extract above the rates of non-investing, lower quality auditors. In equilibrium, technology investing auditors can price $N / (N\text{-}1)$ above the marginal cost *c* (eq. (3.8)).

[43] Because of the symmetric nature of the equilibrium in this version of the model, there will only be one type of auditor present in the market: large, technology intensive, high-quality audit firms. Consequently, there is no quality differentiation between the entrants and thus no potential for a "quality premium" in auditors' billing rate (see footnote 39). That is, competition for market shares drive billing rates closer to marginal costs (eq. (3.8)). Note, however, that limitations on entry created by endogenous investments will allow entrants in the high-quality market segment to extract some monopoly rents proportional to the number of entrants (i.e., $N / (N\text{-}1)$). In Section 3.5 I extend the model to allow for the presence of small, non-technology investing, lower-quality audit firms (i.e., Non-Big-4).

3.3 Competition in the Auditing Industry: Interpretation of "δ"

In the basic ESC model, δ is an indicator of the audit technology employed by an audit firm. Technology is broadly defined, but the key element is that it constitutes a costly input that is fixed at the time of production and delivery. More specifically, it represents capital investments which fall under one of three categories (not mutually exclusive): (1) *real* audit quality enhancing technology (i.e., product innovation); (2) advertising and other *perceived* audit quality enhancing investments; and (3) process innovation.

3.3.1 Real Audit Quality Enhancing Technology

The term "audit technology" commonly refers to this form of capital investment. As explored in Section 2.1, this technology refers to auditor "know-how", or competence. This directly enhances audit quality since it increases the auditor's capability to detect material misstatement in a client-firm's financial statements. Professional accounting boards and other legal requirements set minimum investment standards in audit technology for practicing auditors (for example, minimum training and "continuing professional education" requirements in the U.S.). However, as the ESC model suggests, audit firms have an incentive to invest in audit technology above the required minimum as this directly enhances audit quality and is genuinely valued by client-firms (i.e., assurance value).

The most obvious investment in *real* audit quality enhancing technology is in human capital. For example, audit firms invest a great deal of resources in recruitment[44] and training (internal and external training). This is especially true for the larger Big-4 audit

[44] Recruiting activities and promoting the audit firm to potential applicants is a costly operation (see Section 3.3.2 for more). For Big-4 audit firms especially, recruiting top talent is an important way by which they invest more in human capital. For example, U.S. accounting professors generally perceive the majority of their top students will seek employment for one of the Big-4 audit firms, with PricewaterhouseCoopers ranking first in 2007 (Public Accounting Report [2007]). This is a major advantage Big-4 audit firms have over other auditors. In fact, in a 2008 GAO study, Non-Big-4 auditors most often cite "ability to recruit/retain qualified staff" as a significant impediment they face to audit public companies (GAO [2008, Figures 8 and 10]). While this advantage partially comes at "no-cost" from their dominant market position, Big-4 auditors nonetheless maintained and enhanced this advantage in part through real direct investments.

firms (e.g., Firth [1985])[45]. Audit firms can also improve the effectiveness and efficiency of their audits by investing in IT equipment, software, databases, electronic work systems and other electronic decision aids (and specialised audit programs). In a review paper, Bedard *et al.* [2008] note that electronic practice tools have the potential to improve quality monitoring, risk management, decision quality and overall audit quality. Computer-assisted audit techniques can also improve the effectiveness and efficiency of audits (Stimpson [2006]). Again, the larger Big-4 audit firms will make greater use of these technologies given the significant capital and time investment required. Superior engagement risk and quality monitoring, along with greater support to audit engagement staff for dealing with complex accounting and auditing issues can be achieved with the creation of in-house central research and accounting consultation units (i.e., specialised internal groups to assist practice office or perform engagement quality reviews). These "support groups" are more frequently used and better formed among Big-4 audit firms (see Bedard *et al.* [2008] for a review).

Finally, even auditor independence can be improved through investments in technology. This enhances audit quality since a more independent auditor is believed to report his findings more truthfully (DeAngelo [1981b]). Monitoring the audit firm's (or members of the engagement team's) independence with respect to an engagement client can be a daunting task, especially in larger firms and given the complexity of post-SOX auditor independence rules. Audit firms must also train their staff to recognise situations where their, or the firm's, independence is compromised. For example, to achieve this more effectively, KPMG states in its 2004 International Annual Report that the firm "is relying increasingly on automated tools such as Sentinel and CEAC —(its) automated global Client & Engagement Acceptance/Continuance tool— to monitor and enforce global compliance with (its) policies and processes" (KPMG International 2004 Annual Report, p. 45).

[45] For example, WebCPA [2008] reports that "Deloitte plans to invest $300 million to create a learning and leadership development centre in Westlake, Texas (…)". The 750,000 square-foot campus is set to open in 2011.

3.3.2 Advertising and Other Perceived Audit Quality Enhancing Investments

In a more general setting, δ can be defined to include other attributes valued by clients. In Sutton's initial interpretation of the ESC model, δ is viewed as advertising (Sutton [1991]). Indeed, so long as increasing δ involves a fixed investment that also raises the (perceived) value of audits and clients' willingness to pay (i.e., δ_i/p_i ratio), the results will be identical to those described under the basic model.

Audit firms likely use alternative means to enhance the value of their audits. For example, they can engage in direct[46] and indirect (e.g., sponsorship, professorship, community involvement, etc.) advertising to stimulate brand name recognition. A more visible and known auditor is likely seen as more credible by clients and investors (i.e., persuasive advertising). Promoting brand value internally can also prove beneficial for audit firms as it can improve employee satisfaction and boost staff and client recruitment (Korney [2007])[47]. Again, this requires (fixed) capital investments in human resources departments and promotional campaigns. Likewise, well funded and functioning internal marketing and communications departments can assist audit partners in targeting clients and promote their firm's services. Some of audit firms' advertising and sales efforts can be informative and help client-firms in selecting the most suitable auditor[48]. This is valued by client-firms as it lowers transaction costs when choosing an auditor. Overall, Big-4 audit firms appear to make greater use of this type of investment strategy and are generally more effective in promoting their brand name[49].

[46] Direct advertising by auditors can be subject to restrictions depending on the jurisdiction.

[47] Big-4 audit firms are quite successful in promoting their brand and (superior) quality credentials. For example, the Big-4s systematically top the Public Accounting Report's *Annual Professor's Survey* on the "Global Seven" (i.e., Big-4s, Grant Thornton, BDO Seidman and RSM McGladrey). Survey respondents (i.e., U.S. accounting professors) perceive Big-4 audit firms as having superior reputation for client service, technical skills and staff training (Public Accounting Report [2007]). All Big-4 audit firms also made *Fortune's* 2008 list for the *100 Best Companies to Work For*; only another auditor, regional firm Plante & Morgan, made the list (Public Accounting Report [2008]).

[48] For example, a local client-industry expert auditor can advertise in specialised industry publications or be actively involved in the local chapter of an industry association.

[49] Big-4 investment to develop their global network and their global brand-image specifically is also valued by audit clients. This signals a uniform quality standard which reduces uncertainty about the quality of the audit performed by local Big-4 auditors.

Furthermore, audit firms regularly issue studies and analyses on economic and business issues and specific client-industries. They also organise briefings and training seminars on tax, accounting and corporate governance issues for current and prospective clients. While these mostly serve as promotional devices to demonstrate the audit firm's expertise and to recruit new clients, they also provide resources genuinely valued by existing clients (i.e., service value)[50]. Judging by major audit firms' web sites, this branding strategy appears, once again, to be more extensively employed by the Big-4 auditors.

3.3.3 Process Innovation

Alternatively, technological investments can also involve "process innovation" and production efficiency gains. Essentially, this allows an auditor to deliver an audit of equal quality as its competitors, but with less effort[51]. Such auditors face lower average marginal costs and can price just below competitors. As a result, they gain market shares at the expense of others and generate enough variable profit to recover their fixed investment. Sutton [1998] shows that this is equivalent to the basic model and that the conclusions regarding market structure remain the same.

Process innovation and production efficiency gains likely arise from varying sources. In fact, most investments in real audit quality enhancing technology likely lead to more efficient audits[52]. Such efficiency gains ultimately allow auditors to lower audit fees (i.e., eq. (3.8)). For example, investigating long term trends in Big-4 audit fees, Menon and Williams [2001] found that the magnitude of the audit fee model coefficients for accounts receivable and inventory had declined over their sample period (1980-1997). They conclude that the increasing use of computerised audit techniques and other innovations, such as the use of analytical procedures, has allowed Big-4 auditors to gradually expend less effort over time in verifying inventory and confirming accounts receivable.

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[50] To a lesser extant, this can help to maintain a good working relationship with existing clients. Improved client-auditor relations can also be achieved by other (costly) means; for example, audit staff training on effective client management, gifts and perks to corporate clients, etc.

[51] Another option is for a more technologically efficient auditor to provide greater audit quality at equal total fees by simply supplying more effort.

[52] Examples of such investments include: staff training, modern IT and hardware, standardised processes to reduce redundant costs, setting up international networks to lower coordination costs on large audits, etc.

3.3.4 Integrated Investment Strategy

Overall, it is likely that audit firms will engage in a combination of capital investment strategies when competing. Some of these investments will directly contribute to audit quality while others (e.g., advertising) will enhance the perceived value of the audit. Still, others will, to some degree, improve audit efficiency and help maintain lower billing rates. This is a realistic depiction of the audit industry and the results from the ESC model remain unchanged.

Fixed investments that enhance real and perceived audit quality are explicitly included in the model through δ. However, explicitly allowing for the possibility of process innovation requires some precision. It is important to recall that audit firms sink resources in audit technology as a means to improve the relative value of their product: δ_i/p_i. In the basic model, the optimal strategy is for audit firms to invest in audit technology to directly improve audit quality (real and/or perceived): δ_i. Yet, as Sutton [1998] shows, it is also possible for audit firms to successfully compete and improve the relative value of their product by lowering their average marginal cost of production through process innovation. Consequently, the ratio δ_i/p_i is improved by lowering p_i (i.e., lower weighted average billing rate resulting from lower marginal cost c, see eq. (3.8)).

Hence, it is more accurate to focus on the relative value, δ_i/p_i, of an audit firm's audits rather than just the level of audit quality (resulting from δ_i) when interpreting the results of the model. Because of this, however, it is difficult to predict which of audit quality or production efficiency is improving in market size. This is further complicated by the fact that investments can improve both audit effectiveness and efficiency. Specifically, whether investments predominantly enhance audit quality or production efficiency depends on the nature of competition, how audit markets are defined, how audit firms are organised and at what level costs are incurred (i.e., international network, national partnership or local practice). I briefly address this issue in the discussion on the Big-4/Non-Big-4 dichotomy in Section 3.5. Formal empirical predictions on how market size relates to audit quality and audit fees are derived in Sections 4 and 5 (U.S. and

international empirical studies). For the moment, however, I simply reformulate *Observation 1* to allow for the possibility of process innovation and production efficiency gains. This is formalised in *Observation 1'*:

Observation 1'

Audit value, or relative audit quality, is increasing in market size: $\frac{\partial A}{\partial S} \Rightarrow \frac{\partial\left(\frac{\delta}{p}\right)}{\partial S} > 0$.

That is, investments in audit technology (represented here as fixed costs A) are increasing in market size, with some of these investments improving real (and perceived) audit quality (i.e., δ) while other may lower marginal audit production costs (i.e., effort costs)[53].

Finally, it is important to note that capital investments in audit technology, advertising and branding quickly erode[54]. Indeed, high staff turn-over rates implies that audit firms' stock of human capital must constantly be replenished. IT technologies also become quickly obsolete and have to be replaced. It is also important to maintain brand value which takes years to build, but can collapse very quickly. And because an audit firm always has the option to preserve or not to preserve its status as high-quality (highly-efficient) auditor, simply sustaining this status becomes an endogenous (i.e., strategic) decision. This leads to the very important distinction between exogenous and endogenous fixed costs.

3.4 Audit Production Process: Exogenous vs. Endogenous Fixed Costs

The nature of audit firms' operating costs greatly affects the structure of the industry (Figure 3.1). For the most part, the concentrated structure of the audit industry and its domination by the Big-4 audit firms is argued to be the result of significant barriers to

[53] Recall from eq. (3.8) that billing rate p is decreasing in marginal audit production cost c, and so in the level of process innovation.

[54] Importantly, however, these capital investments do not erode so quickly that they would be considered variable production costs. They remain fixed inputs at the time of production and delivery.

entry (e.g., Rose and Hinings [1999] and The Economist [2004], see footnote 20 for additional references). These barriers arise from regulatory requirements, the high cost of legal liability, the complexity of engagements and accounting rules, the globalisation and the growing geographical spread of companies, the limited access to capital, etc. Indeed, there is little doubt these factors have had a significant impact on the structure of the audit industry by imposing technological and capital constraints on audit firms and raising the minimum efficient scale of audit production (i.e., minimum size of an audit firm needed to operate efficiently).

More often than not, however, these barriers to entry are assumed to evolve exogenously. That is, Big-4 auditor size and industry dominance is predominantly the result of a group of audit firms adapting to changing *exogenous* market conditions. Overall, the current literature generally fails to account for the dynamics of the industry and ignores the role competition among audit firms plays in raising fixed costs and (naturally) limiting entry in the industry. The ESC framework, on the other hand, explicitly takes into consideration the interaction between audit firms and allows for fixed costs to evolve endogenously as a result of competition.

The distinction between exogenous and endogenous fixed costs is important as it fundamentally characterises how audit product and process innovations are thought to evolve. Of course, the recent passage of SOX confirms that exogenous changes in the market do significantly alter the supply of audit quality[55]. However, competition for market shares motivates audit firm specific innovations, too. For example, Elliott [1983] describes Peat Marwick International's (now KPMG) "unique" audit methodology and how the firm made extensive use of judgment aids. Distinguishing between endogenous and exogenous fixed costs therefore becomes especially informative in light of the current debate over auditor concentration and the potential impact on audit quality and audit fees. This is illustrated below.

[55] For example, market participants generally acknowledge that audit quality has improved as a result of SOX (e.g., GAO [2008]).

If capital investments are mostly exogenously determined (i.e., exogenous barrier to entry), then they are taken as given by audit firms and incurred at the entry stage: $\sigma' = \sigma + A(\delta) > \sigma$. Here, the audit industry is characterised by large economies of scale where only larger audit firms can operate at an efficient scale. As a result, smaller, inefficient auditors are forced to exit the market and auditor concentration increases. Under this scenario, there is no escalation in technological investments as market size increases. Consequently, while concentration generally increases in intermediate ranges of market size, there will be an indefinite fall in the level of concentration, independent of σ, as market size increases and additional entrants have the opportunity to build profitable scale operations[56]. This is evident from curves σ_4' and σ_3' in Figure 3.1, with $\sigma_4 < \sigma_3$. More importantly, however, this implies that audit product and process innovations are not initiated by the audit firms, but are rather driven by client-firm characteristics and/or imposed through legislation and other exogenous factors.

The above view emphasises "efficiency" as the driving force for auditor concentration by assuming that opportunities for economies of scale are exogenously determined. On the other hand, the ESC model emphasises "strategy" as the driving force for concentration. Here, economies of scale still play a central role. Yet, the degree of economies of scale evolves endogenously, not exogenously, through the strategic decisions of audit firms and how aggressively they compete. Scale economies in equilibrium are determined by the extent to with technological fixed investments are effectively used to compete and enhance the value of audits. This view yields a potentially very different market size-structure relationship than the simple monotonic one suggested when technological investments are exogenous. Formally:

[56] To formalise, it is easy to construct a simple (one period) Cournot model, with identical firms facing sunk entry costs σ' and where there is no product differentiation (i.e., no endogenous fixed costs), which yields the following equilibrium number of entrants: $N = \left[\frac{aS}{\sigma'}\right]^{\frac{1}{1+\eta}}$; where a and η are both arbitrary positive constants. Clearly, the number of entrants is decreasing in entry costs σ' but is increasing in market size S, with $N_\infty \longrightarrow \infty$ as $S \longrightarrow \infty$ (Pepall *et al.* [2005]).

Observation 3

The relation between market size and auditor concentration, as measured by the market share of the leading audit firm, may be non-monotonic.

To see this, observe the different curves σ_1 to σ_4 relating market concentration to market size in Figure 3.1. This relationship critically depends on the fixed cost parameters of the model: σ, a and γ. If $\sigma > a/\gamma$, the equilibrium number of entrants asymptotically approaches N_∞ from above and market concentration is monotonically decreasing in market size (σ_1 in Figure 3.1). If $\sigma < a/\gamma$, the equilibrium number of entrants asymptotically approaches N_∞ from below and the market size-structure relationship is non-monotonic (σ_3 and σ_4 in Figure 3.1)[57]. Intuitively, at low values of σ relative to a (e.g., low exogenous entry costs relative to endogenous capital investments unit cost), it is easy for new audit firms to enter a market, pushing concentration levels downwards to values well below $1/N_\infty$. And since technological enhancements are more expensive relative to σ, audit firms will only find it profitable to start investing in technology (e.g., $\delta > 1$) in larger markets. Yet, once the race for better technology begins, increases in market size are accompanied by ever increasing capital investments. Eventually, equilibrium concentration becomes independent of setup cost in very large markets as σ becomes small relative to total fixed costs $F(\delta_i)$.

There is some evidence from the archival auditing literature supporting the view that endogenous capital investments play a decisive role in defining the structure of the auditing industry. First, in comparing accounting, advertising and law firms, Penno and Walther [1996] find that accounting firms are characterised by larger fixed discretionary (i.e. endogenous) expenditures. Second, Hogan and Jeter [1999] show that high auditor market concentration is not limited to regulated client-industries but extends to non-regulated industries as well in more recent years. Previous studies had found higher auditor concentration in regulated and capital intensive industries (i.e., Eichenseher and Danos [1981] and Danos and Eichenseher [1982]). The assumption behind these earlier findings is that opportunities for economies of scale are exogenously determined and that,

[57] As a special case, when $\sigma = a/\gamma$, the asymptotic equilibrium number of entrants when $\delta > 1$ is exactly equal to N_∞.

accordingly, some client-industries are "naturally" more concentrated than others. Although Hogan and Jeter [1999] do not make this point, their results emphasise the intuition behind the ESC model that "strategy", rather than "efficiency", is the driving force behind concentration. Indeed, it suggests that competition on the basis of technological investments is now an (increasingly) important strategy employed by audit firms across most (all) client-industry lines. As a result, economies of scale are endogenously determined and thus not limited to a few client-industry lines.

The ultimate question is not whether barriers to entry into the auditing industry (and more specifically the public company audit market segment) are high or not; but rather how these barriers "originate". Obviously, the distinction has important public policy implications as it can help regulators decide which form of intervention, if any, would stimulate audit quality and/or audit processes improving technological investments. Undoubtedly, both exogenous and endogenous (i.e., audit firm competition) factors play a role in market structure, the supply of audit quality and the level of audit fees. Yet, the role of audit firm competition has generally not been explored in the literature. Still, endogenous fixed costs provide crucial clues in explaining the well documented Big-4/Non-Big-4 dichotomy. I formally explore this issue in the next section.

3.5 Dual Market Structure: The Big-4 vs. Non-Big-4 Firm Dichotomy

Thus far, the ESC model has only explained the emergence of a natural oligopoly where only a limited number of large, technology intensive, high-quality audit firms provide audit services (Section 3.1). While this is a reasonable approximation of the audit market, it fails to account for the large number of small, lower quality audit firms present. Specifically, the model in its current form offers no explanation for the well documented "Big-4/Non-Big-4 firm dichotomy"; i.e., the quality differential between the few, large Big-4 and the numerous smaller Non-Big-4 audit firms. Interestingly, it turns out that the model can be easily modified to predict this phenomenon.

It is generally accepted that Big-4 and Non-Big-4 auditors offer vertically differentiated products (e.g., Moizer [1997], Watkins *et al.* [2004] and Francis [2004]). That is, Big-4 audits are seen as higher quality and are more valued by client-firms (before audit fees). To formally account for this disparity, I assume that Big-4 and Non-Big-4 auditors fundamentally differ in their respective capital investment strategies in audit technology, as discussed in Section 3.3. Formally:

Assumption 1

a) $1 = \delta_{NB4} < \delta_{B4}$, *with* $\frac{\delta_{NB4}}{p_{NB4}} < \frac{\delta_{B4}}{p_{B4}}$;

b) $\frac{\partial\left(\frac{\delta_{NB4}}{p_{NB4}}\right)}{\partial S} = 0 < \frac{\partial\left(\frac{\delta_{B4}}{p_{B4}}\right)}{\partial S}$.

Assumption 1 follows directly from the ESC model and is consistent with the academic and professional auditing literature[58]. Essentially, *Assumption 1* states that all Big-4 auditors will invest more in audit technology[59] than Non-Big-4 auditors. Furthermore, Big-4 auditors will invest more in audit technology as market size increases (from *Observation 1'*). Notice that *Assumption 1* also directly implies the following observation:

Observation 4

The difference between Big-4 and Non-Big-4 audit value, or relative audit quality, is increasing in market size: $\frac{\partial\left(\frac{\delta_{B4}}{p_{B4}} - \frac{\delta_{NB4}}{p_{NB4}}\right)}{\partial S} > 0$.

[58] There is ample empirical evidence confirming the difference between Big-4 and Non-Big-4 audit quality. The assumption that Big-4 audit firms invest more in audit technology δ is also clear from the discussion and evidence presented in Section 3.3. *Assumption 1*, however, also implies that Big-4 and Non-Big-4 auditors will differ in their audit production processes. As evidence of this, Blokdijk *et al.* [2006] find that auditors exert the same amount of total audit effort (i.e., hours), independent of size. However, what varies is the mix of audit hours, with brand name Big-4 auditors allocating more effort to planning and risk assessment, and less to substantive testing and completion. Consistent with the ESC model, Blokdijk *et al.* [2006] conclude that Big-4 auditors actually deliver higher audit quality than Non-Big-4s as a result of the differences in their audit production processes.

[59] As discussed in Section 3.3, "technology" is defined broadly to include all endogenous capital investments which enhance real or perceived audit quality, and/or involve production efficiency gains.

Observation 4 states that the value of Big-4 audits is increasing in market size, relative to that of Non-Big-4 audits. This can occur either because Big-4 audit quality is increasing (more rapidly than Big-4 fee premium), or because Big-4 fee premium is possibly decreasing in market size (with constant or slightly improving audit quality).

Yet, if Big-4 auditors are assumed to always supply more valuable audits, under what conditions can Non-Big-4 auditors still hold positive market shares? For Non-Big-4 auditors not to be excluded from the audit market, it must be that some, possibly small, fraction $(1 - \theta)$, with $0 < \theta < 1$, of client-firms in the audit market do not benefit from the superior audit technology used by the Big-4 auditors (or at least, do not value Big-4 audits as much as other client-firms). Likewise, it could be that some proportion of client-firms simply cannot afford a Big-4 audit. Only if (at least) one of these conditions holds is it possible for less technical Non-Big-4 auditors to remain in operation while adopting a different investment strategy than the dominant Big-4 firms[60].

As a result, when $\theta \in (0,1)$, the audit market evolves as two independent submarkets of size θS for the Big-4 segment and size $(1 - \theta)S$ for the Non-Big-4 segment. The Big-4 segment will be naturally concentrated at any S since these audit firms strategically sink important resources in audit technology (*Observation 2*). On the other hand, because Non-Big-4 auditors do not engage additional fixed costs, further growth in S brings additional entrants to that segment. Entry cost to this submarket is limited to exogenous costs σ (i.e., no strategic investment in audit technology). This results in a dual market structure with a limited number of large, technology intensive, high-quality audit firms (i.e., Big-4s) and many, small, low-technology, minimum quality audit firms (i.e., Non-Big-4s). Contrary to Big-4 audit firms, the Non-Big-4 market segment is highly fragmented with virtually no (vertical) product differentiation among auditors. In other

[60] To see this, recall from the initial model that all audit firms adopt the same strategy. If some auditors cannot sustain the rate of audit technology investments, they are forced out of the market. This is because with constant (and equal across auditors) marginal audit cost c, high-technology auditors can always undercut lower-technology auditors and offer higher audit quality at a competitive price: $\delta_{hq}/p_{hq} > \delta_{lq}/p_{lq}$, with hq and lq equal high and low quality auditors respectively, or Big-4 and Non-Big-4 auditors respectively.

words, Non-Big-4 auditors operate in an almost perfectly competitive market segment and will price their audits at average marginal cost:

$$p_{NB4} = c_{NB4} \tag{3.12}$$

More important, however, for understanding how this dual market structure evolves is to focus on factors which affect θ. That is, what determines client-firms' demand for audit quality and/or what may constrain auditor selection? Moreover, how do changes in θ impact market structure, audit quality and audit fees?

Client-Firm Budget Constraint

The simplest argument for explaining the presence of Non-Big-4 auditors relates to budget constraints client-firms may face that can limit their ability to purchase Big-4 audits. This stems from the idea that audit technology and effort are not perfect substitutes. That is, while a Big-4 auditor can substitute some audit effort by employing superior audit technology, audits remain labour intensive and will always require a minimum amount of effort to comply with auditing standards[61]. Hence, even if possibly all client-firms strictly prefer a Big-4 audit (i.e., $\frac{\delta_{NB4}}{p_{NB4}} < \frac{\delta_{B4}}{p_{B4}}$), the (minimum) "quantity" x_{B4} of audit effort purchased is such that the total cost of a Big-4 audit may exceed some client-firms' optimal monitoring budget (i.e., the client-firm would purchase more audit quality than it optimally requires). In settings where audits are mandatory (e.g., public companies), these client-firms are forced to seek alternative, more affordable, lower quality auditors[62]. Formally:

$$0 < x_{\min} = x_{B4} \leq x_{NB4} \Rightarrow p_{B4}x_{B4} > p_{NB4}x_{NB4} = \alpha B > 0$$
$$with\ \delta_{B4}x_{B4} \geq \delta_{NB4}x_{NB4}.$$

[61] Although this is not modeled, the idea is straightforward. From eq. (3.3), it is clear that for a given level of audit quality $\delta x = k$: $\frac{\partial x_i}{\partial \delta_i} < 0$. The assumption here is that x_i is bounded below such that $x_{min} > 0$, whatever δ_i.

[62] More precisely: it is not optimal for every client-firm to allocate sufficient resources αB to pay for a Big-4 audit. Evidence that client-firms optimally select their auditor to maximize firm value net of audit fees paid comes from Hogan [1997]. She finds in a sample of IPOs that owners select the type of auditor (i.e., Big-4 *vs*. Non-Big-4) that minimizes the sum of underpricing and auditor compensation costs.

Of course, this assumes that the Big-4 billing rate is sufficiently higher than that of Non-Big-4 auditors: $p_{B4} > p_{NB4}$. There are two explanations consistent with the ESC framework which can account for this.

First, because they enhance the value of their audits through a series of capital investments, Big-4 audit firms successfully vertically differentiate their audits from those of Non-Big-4 auditors. Consequently, Big-4 auditors can extract monopoly rents proportional to the number of Big-4 auditors entering a market (recall eq. (3.8)), while still supplying more highly valued audits: $\frac{\delta_{NB4}}{p_{NB4}} < \frac{\delta_{B4}}{p_{B4}}$, with $p_{B4} > p_{NB4}$. In fact, Big-4 auditors will charge more than Non-Big-4 auditors for their audits ($p_{B4} > p_{NB4}$) even when average marginal costs are equal for both types of auditors: $c_{B4} = c_{NB4}$ (this is clear from eqs. (3.8) and (3.12)). Essentially, Big-4 audit firms optimally exclude some client-firms from their client-pool by increasing their mark-up on their remaining clients[63].

Second, it can be that average marginal costs are higher for Big-4 auditors than for Non-Big-4 auditors: $c_{B4} > c_{NB4} \Rightarrow p_{B4} > p_{NB4}$. For example, surveys suggest that auditors (i.e., employees) are more highly paid in Big-4 audit firms than Non-Big-4 firms (e.g., Robert Half International Inc. [2006], Public Accounting Report [2007] and Hays Specialist Recruitment [2008])[64]. Yet, importantly, it must be that Big-4 average marginal costs c_{B4} are not so high (relative to c_{NB4}) that it eliminates Big-4 auditors'

[63] This market power is one source of what is commonly referred as the "Big-4 fee premium" and is explored in greater detail in Sections 4 and 5.

[64] Labour expenses constitute the most important variable input in auditing. For example, according to the 2002 U.S. Economic Census – Business Expenses Survey, total U.S. annual payroll for offices of certified public accountants (NAICS 541211) represented close to 53% of total U.S. revenues (plus 8.2% for employer costs for fringe benefits) (Source: http://www.census.gov/csd/bes/19/part1.htm). Similarly, annual financial statements published by important U.K. audit firms reveal that annual staff related costs range from 40% to 50% of revenues. However, it is important to note that not all staff related expenses constitute a variable cost of producing an audit (i.e., effort costs). Indeed, some of audit firms' payroll relates to support staff (e.g., IT, HR and marketing departments, central research and accounting consultation units, etc.) which more accurately represents investments in audit technology.

competitive advantage. In other words, Big-4s' superior audit technology compensates for the higher prices such their audits are still more highly valued.

Differences in Big-4 and Non-Big-4 labour costs indicate differences in their respective audit production process and the "quality" of staff employed. One possibility is that Big-4 and Non-Big-4 auditors employ staff auditors, managers and partners in different proportions on their engagements (this is consistent with Blokdijk *et al.* [2006]; see footnote 58). Because individual auditor salaries are increasing in expertise and experience, Big-4 and Non-Big-4 audit firms' average marginal cost of labour must be weighted accordingly.

Another reason why average marginal costs may be higher for Big-4 than for Non-Big-4 auditors is because the majority of (real audit quality enhancing) capital investments are in human capital (e.g., training). As a result, Big-4 audit firms pay higher wages to recruit, high-quality, top candidates in whom it will be profitable for the firms to invest in[65]. Also, human capital developed by Big-4 audit firms is valuable to the firms but also to their employees. That is, ownership of human capital cannot be solely restricted to Big-4 employers. Indeed, skills and experience gained working for a Big-4 firm improves individuals' career perspective (inside and outside the firm) and consequently their reservation wage (i.e., more valuable "outside" employment options). As Big-4 audit firms invest more in human capital, they must also raise the wage they pay their auditors, which in turn increases c_{B4}.

Importantly, however, this need not alter the results of the ESC model. In fact, Sutton [1991] shows that in a more general setting, the results of the ECS model remain unchanged even if average marginal cost $c(\delta)$ is increasing in quality, just so long as the increase is small and limited. The argument here is that the additional variable costs are more than compensated by the superior audit quality (i.e., audit value) which comes from investing in human capital. Furthermore, note that "process innovations" resulting from

[65] This is consistent with comments from Big-4 audit firm representatives reported in Chan *et al.* [1993, p. 781].

investments in human capital will dampen the (small) rise in average marginal cost and perhaps even reverse it in the largest markets[66].

As stated in Section 3.1, what determines a client-firm's optimal budget for external auditing, αB, is almost entirely specific to that client. In the basic model, all client-firms are assumed identical. However, in a more realistic setting, these clients present different characteristics. For example, smaller client-firms will have overall smaller budget B for monitoring activities which can limit the ability of some firms to purchase a (possibly) more costly Big-4 audit. Likewise, private companies may find it optimal to allocate a larger proportion, $(1 - \alpha)$, of their budget for monitoring activities to improving internal financial systems and internal auditing. Indeed, these companies tend to use financial information mostly for internal decision making, rather than external financing. Overall, it is expected that θ will be smaller in the small to medium sized client-firm market segment (as well as the "private company" segment), which is consistent with the presence of Non-Big-4 auditors almost exclusively restricted to that market segment (e.g., GAO [2003b, 2008]).

Client-Firm Demand for Audit Quality

Another source of the disparity in the audit market originate from differences in "tastes" for audit quality (real and perceived) across client-firms; that is, the contribution to client-firm value derived from superior Big-4 audit technology can differ across client-firms. In the basic model, it is assumed that all client-firms value audit quality (δ parameter in eq. (3.3)). Yet, not all client-firms are identical and some may derive only limited value from external auditing. More specifically, the marginal contribution to client-firm value from a technology superior Big-4 audit over a Non-Big-4 audit is null or so small that it does not justify higher Big-4 billing rates. Formally, this can be modeled by assuming that a

[66] Overall, this suggests that higher Big-4 audit quality involves both fixed and variable costs components. However, as explained in Section 3.1, providing superior audit quality solely through greater audit effort (i.e., variable costs) is not the optimal strategy. Hence, capital investments will undoubtedly play an important part in higher-quality Big-4 auditors' differentiation strategy. The (potentially) higher Big-4 marginal costs can also be a source of the Big-4 audit fee premium. Again, "process innovation" will likely limit this Big-4 fee premium, especially in larger markets (see Sections 4 and 5).

proportion (1 - θ) of client-firms have the following benefit function (Sutton [1991, pp. 64-66]):

$$\pi_{-\theta} = \alpha \ln(x_i) + (1-\alpha)\ln(y) \qquad (3.13)$$

Eq. (3.13) is similar to eq. (3.3) but excludes audit technology parameter δ from client-firms' benefit function. That is, a proportion (1 - θ) of client-firms does not value high-quality, technical (Big-4) audits more than they do "standard" quality (Non-Big-4) audits. Using Sutton's approach to illustrate differences in client "tastes", a dual market structure similar to the auditing industry has been documented for other industries as well: Ellickson [2006, 2007] (U.S. retail food industry), Berry and Waldfogel [2006] (U.S. newsprint industry) and Dick [2007] (U.S. banking industry).

In the auditing industry, the demand for high-quality external audits is linked to the degree of information asymmetry (between client-firm insiders and outsiders) and the ability for shareholders (and other stakeholders) to monitor and protect their investments in a firm (e.g., Watts and Zimmerman [1983]). This is related to client-firm as well as country (i.e., jurisdiction) specific characteristics. For example, smaller client-firms which rely less on public financing may benefit less from a Big-4 audit. According to a GAO survey, 65% of representatives from large public companies cited "Reputation or name recognition" and 54% cited "Expectations or requirements of shareholders, banks, lenders, or underwriters" as significant reasons why their company would be unlikely to use a small or midsize (Non-Big-4) auditor (GAO [2008, Figure 8]). For representatives from small to medium public companies, these proportions fall to 46% and 45% respectively (GAO [2008, Figure 10]). While these proportions are still high, it nonetheless suggests that a smaller proportion of small and medium companies derive net positive value from Big-4 audits as there is less market incentive for them to choose a Big-4 auditor. Large public companies are also more likely to have international operations and financing needs and thus more likely to benefit from retaining an "internationally recognised brand-name" Big-4 external auditor (i.e., less uncertainty about audit quality). As well, the demand for high-quality Big-4 audits can be lower in

countries with less developed capital markets where private and bank financing is more important.

The demand for high-quality external auditing will likely differ between countries where investors' rights are more protected than in countries where the legal environment does not favour them. One possible explanation is that the assumption that client-firms' optimal auditor choice is such that firm value is maximised may not hold under all legal regimes. Rather, in certain circumstances it is more accurate to consider client-firm insiders' (e.g., management, majority shareholders, etc.) utility maximising decision with respect to auditor choice. This is true when insiders have a strong influence on auditor choice and when their incentives are not (well) aligned with those of outside investors. In these circumstances, firm insiders can strictly prefer less audit quality and impose the selection of an auditor which will allow them to opportunistically expropriate firm assets through earnings management, fraud, theft, etc. Of course, the selection of a lesser quality auditor is self revealing and it must be that personal gains outweigh the cost imposed by outside investors. This is likely to be the case only in countries with weak capital markets and low outside investor protection regimes (i.e., less strict legal regimes). As such, the proportion of client-firms that value high-quality Big-4 audits (i.e., θ) could be expected to be less important in these countries. I defer to Section 5, however, a more formal analysis on how θ is expected to vary across different legal regimes (specifically, the degree of investor protection).

Changes in θ and the Impact on Audit Value and Market Structure

From the above discussion, it is clear that the relevant measure of (sub)market size where Big-4 auditors operate is a function of total market size, S, and the proportion of client-firms that value high-quality Big-4 audits in that market, θ. That is, the size of the Big-4 submarket is equal to θS, while Non-Big-4 submarket size is equal to $(1 - \theta)S$. Hence, it is straightforward[67] to show that any change in proportion θ will have the same impact on Big-4 audit value as a change in total market size S. Formally:

[67] Essentially, an increase in θ is synonymous with greater investment opportunities for Big-4 auditors.

Observation 5

The difference between Big-4 and Non-Big-4 audit value, or relative audit quality, is increasing in θ: $\frac{\partial\left(\frac{\delta_{B4}}{p_{B4}}-\frac{\delta_{NB4}}{p_{NB4}}\right)}{\partial\theta}>0$.

Observation 5 is a simple extension of *Observation 4*. Intuitively, it states that Big-4 audit firms will invest more in audit technology when a greater proportion of the audit market demands highly technical, high-quality audits. Consequently, the value of Big-4 audits, relative to that of Non-Big-4 audits, increases with the demand for such audits. Interestingly, *Observation 5* is consistent with both Choi *et al.* [2008a] who find that Big-4 audit fee premium is decreasing in the strictness of a country's legal regime, and Francis and Wang [2008] who report that Big-4 audit quality is increasing, relative to Non-Big-4 audit quality, in the degree of investor protection. However, both studies use opposing theories to explain their results; I revisit this formally in Section 5.

Clearly, θ will have a significant impact on the value of Big-4 audits. Consequently, this will impact the structure of the auditing industry, and more specifically the total market shares of the Big-4 auditors. This is reflected in *Observation 6*:

Observation 6

a) *The minimum level of auditor concentration, as measured by the market share of the leading audit firm C_1, is increasing in θ:* $\frac{\partial C_1}{\partial\theta}\geq 0$.
b) *The combined market shares of the Big-4 audit firms, C_{B4}, is increasing in θ:* $\frac{\partial C_{B4}}{\partial\theta}>0$.

Holding market size constant, investments in audit technology will be at least equal and possibly greater (if S is large enough) following a rise in θ. This is stated in *Observation 5* and is clear from Figure 3.1, where a rise in θ amounts to a leftward shift in Σ and an upward shift of the asymptotic C_1 concentration measure[68]. As per *Observation 5*, Big-4

[68] To see this, imagine a market of size S where two equal size high-quality Big-4 auditors both have market shares of $(\theta S)/2$, and $n \geq 2$ equal size lower-quality Non-Big-4 auditors all have market shares of $((\theta-1)S)/n$, with θ and/or n large enough to ensure $C_{1\text{-}B4} > C_{1\text{-}NB4}$ (i.e., any Big-4 audit firm is larger than any

audits become relatively more valuable than those of Non-Big-4 auditors as θ increases. Accordingly, Big-4 auditors will gain additional market shares at the expense of Non-Big-4 auditors as θ approaches 1 (i.e., $\theta \to 1 \Rightarrow C_{B4} \to 1$). I explore this in greater detail in Section 5.

Finally, note that, in equilibrium, the dual market structure is stable as there is no incentive for Non-Big-4 auditors to "catch-up" to Big-4 auditors. Holding S and θ constant, competitive pressures in both Big-4 and Non-Big-4 market segments guaranty that the zero-profit condition holds (eq. (3.7)). Of course, treating the number of audit firms N as an integer implies that firms will earn a positive profit in equilibrium; but an additional entrant in any segment would push profits below zero. For example, if some Non-Big-4 audit firms were to merge, invest significantly in audit technology and compete directly against the Big-4s, profit margins in that market segment would fall such that at least one audit firm would be forced to exist the market.

3.6 Robustness and Extensions

Sutton [1991] demonstrates that the general results of the ESC model are robust to a wide range of models and that several refinements are possible. For example, strategic asymmetries, such as first mover advantage, can be modeled using sequential entry (for some or all firms). Specific outcomes vary and depend on the parameter values γ, a, σ and S (Sutton [1991, pp. 66-68]); although, generally, strategic asymmetries result in an asymmetric and more concentrated equilibrium market structure where one or a few firms clearly dominates the market. In fact, this accentuates the dual market structure result discussed previously. For example, Big-4 auditors' long established reputations essentially grant them a first mover advantage over other auditors. In turn, this imposes an additional, yet "artificial", barrier to entry for smaller audit firms (e.g., GAO [2003b, 2008], The American Assembly [2005] and ICAEW [2005]). An additional strategic

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of the Non-Big-4 audit firm). C_1 is then equal to $(\theta S)/2$. Because only Big-4 auditors are sinking relatively more resources in audit technology as θ increases by, say, $\varepsilon > 0$, the number of Big-4 auditors stays the same (*Observation 2*) and $C_1' = ((\theta + \varepsilon)S)/2 > C_1$. This also holds for any cumulative measure of market shares of the dominant firms.

advantage Big-4 auditors may have over smaller audit firms is their (suspected) ability to attract and retain higher quality personnel (e.g., GAO [2003b, 2008]) merely as a result of their dominant position. However, it is unclear how long these advantages can last as brand capital can quickly erode. In fact, Big-4 audit firms continuously invest in advertising and branding which suggests that their domination of the auditing industry is not simply the result of strategic advantages gained a long time ago. In other words, these strategic advantages must be maintained though endogenous capital investments (recall, the decision to maintain "reputation" through these investments is endogenous).

Furthermore, results hold for varying levels of competition intensity or "toughness" of price competition. This refers to pressures that push prices closer to average marginal cost and is usually modeled using either Cournot or Bertrand oligopoly models, with the latter representing more intense competition[69]. In the simple homogenous product case, Sutton [1991, Chapter 2] shows that market concentration is increasing (not decreasing) in the toughness of price competition. This seemingly counter intuitive result occurs because when unit profit margins are low, a larger market is required to accommodate additional entrants. The implication of this is that a concentrated market structure is possible, and perhaps more likely (all else equal), in a highly competitive environment.

For the heterogeneous (vertically differentiated) product case, the implication of more intense competition on market structure, audit quality and production efficiency is not as clear. Nonetheless, it is reasonable to conjecture that a more concentrated market structure will be observed in a more competitive auditing market. Evidence of this can be found in Buijink *et al.* [1998]. They perform a detailed review of the regulatory environment of the Dutch and German audit markets and calculate concentration, market-share mobility and audit firm entry and exit statistics in each market over the 1970-1994 period. Their results suggest that while the Dutch market is more liberal and overall characterised by a higher degree of competition than the German audit market, it is also

[69] The Cournot model (along with the other assumptions of the model presented in Section 3.1) will have the advantage of yielding a symmetric equilibrium, while Bertrand models typically lead to asymmetric equilibira. A symmetric outcome where there is no difference within a group of auditors (i.e., Big-4) is closer to the observed structure of the auditing industry. Accordingly, there is little, if any, empirical evidence to suggest audit quality differentials (on average) between Big-4 audit firms.

more concentrated. They conclude that high market concentration can go hand in hand with more intense competition, although they do not provide any theoretical explanation for this phenomenon.

The intuition developed by Sutton [1991] regarding market structure and competition intensity is crucial. Not only does it allow for a theoretical explanation of the phenomenon reported by Buijink *et al.* [1998], but it also challenges the classical structure-conduct-performance paradigm that guided earlier criticism over auditor concentration (e.g., Subcommittee on Reports [1977]). Indeed, while concerns over the high degree of concentration have some merit, the evidence to date suggests nonetheless that the auditing industry is overall competitive (e.g., Dopuch and Simunic [1980a], GAO [2003b, 2008], ICAEW [2005], Oxera Consulting [2006] and Global Public Policy Symposium [2006]).

Finally, general results of the ESC model also hold when accounting for horizontal product differentiation and multiproduct firms. As is common in models with horizontal product differentiation and multiproduct firms, firms can adopt several strategies and multiple equilibria are possible. Yet, the market concentration-size schedule in Figure 3.1 still holds, but now specifies a lower bound to equilibrium concentration given market size[70].

Overall, it is important to realise that varying degrees of strategic asymmetries, market maturity, competition intensity and horizontal differentiation all have an impact on the observed market structure. These factors vary across markets and are difficult to control for. As such, Sutton [1991] warns that researchers should not expect to uncover a tight functional relationship between concentration and market size as suggested in Figure 3.1. Rather, the focus is shifted to the predictions that are robust. Hence, it is possible to observe, in equilibrium, concentration levels directly above the concentration-size schedule in Figure 3.1, but not below it. This is the motivation for using the lower bound

[70] Specifically, greater horizontal product differentiation will shift downwards and to the left the market concentration-size schedule. This occurs because horizontal product differentiation lowers (price) competition intensity while rendering technology investments more effective.

(i.e., minimum level of concentration) approach developed by Sutton [1991] and widely employed in subsequent studies. This is explained further in Section 4.5.1.

3.7 Conclusion

In arguing the need to stimulate competition to increase auditor choice, proponents must realize that vigorous competition itself, on both audit quality and audit fees, has significantly contributed to the highly concentrated structure of the industry (The Economist [2004]). Yet, despite isolated claims (e.g., Grant Thornton LLP [2007]) it appears that the industry is still overall competitive and that the Big-4 auditors have been responsible for a great deal of audit quality innovations and efficiency gains, quite possibly above levels that would have otherwise been exogenously driven.

Nonetheless, the threat of reduced competition is always present and could have significant adverse consequences in the future on the level of audit quality and audit fees. In this sense, all efforts to stimulate or maintain healthy competition are always warranted. However, any direct intervention may be counter productive (even detrimental) and would not likely resolve the issue of auditor concentration and auditor choice – high market concentration, as the ESC framework suggests, is the natural structure of the industry. Whether the Big-4 audit firms have evolved to a position that grants them unfair advantages is an open question. A more fundamental question is, however, whether this induces monopoly like, sub-optimal, behaviour which threatens audit quality (or at least innovation) and fair audit fees. In the next section I empirically test the predictions of the ESC framework in the U.S. auditing industry to directly address this question.

4 U.S. LOCAL AUDIT MARKETS

The ESC framework suggests that exogenous market characteristics have clear implications for the structure of the auditing industry and the level of audit quality and fees. Hence, the empirical analysis will focus on identifying the correlations between specific observable market characteristics and: (1) the structure of the auditing industry, and (2) the level of audit quality and audit fees. The objective of this is to validate the intuition behind the ESC model and offer critical insight on how audit firms compete; more specifically on how Big-4 and Non-Big-4 audit firms differ and how market characteristics affect audit quality and audit fees.

In this section, I describe the first of two empirical studies design to test the implications of the ESC model as described previously.

4.1 Motivation

The objective of this study is to offer key insights into the U.S. audit industry by answering the following question: How do audit firms compete? Building on the intuition of the ESC framework presented in Section 3, the conjecture is that the largest U.S. audit firms, the Big-4s, compete on audit value through endogenous capital investments in audit technology. Moreover, it is suggested that the level of such investments varies with specific market characteristics. Here, the focus is on the relation between market size and the level of endogenous capital investments in audit technology. Yet, because the level of investment is not directly observable, this competitive behaviour can only be inferred from variations in the observed market structure, audit quality and fees across markets of different size. As such, this study also makes the specific contribution to the auditing literature by demonstrating and documenting how market size impacts market structure, Big-4 audit quality and fees. To my knowledge, these interactions remain unexplored in the literature.

Testing the implications of the model at the U.S. local audit market level offers several advantages. The main advantage is that institutional and other country specific factors which clearly affect market structure, audit quality and audit fees are held constant (e.g., Taylor and Simon [1999], Choi *et al.* [2008a] and Francis and Wang [2008]). This is crucial because the predictions of the model are sensitive to country specific characteristics like legal and investor protection regimes, capital market development, professional, auditing and accounting standards, etc. (see Sections 3.5 and 5). Therefore, this provides the strongest setting to test *Observations 1'* through *4*, i.e., the relation between market size, industry structure, audit quality and audit fees.

Second, there are genuine concerns recently expressed by U.S. authorities and market participants about the potentially negative effects of a highly concentrated U.S. audit market (GAO [2003b, 2003a, 2008], The American Assembly [2003, 2005], U.S. Chamber of Commerce [2006, 2007], ACAP [2008] and AICPA [2008]). Although recent reports by the GAO suggest that the high level of market concentration has not adversely impacted audit quality and fees, the GAO stresses that its "(…) findings should not necessarily be viewed as definitive or as proof that the market for audit services is competitive" GAO [2008, p. 94]. The general consensus is that more research is needed to better understand the dynamics of the audit industry.

Third, the U.S. audit market is undoubtedly the largest and most active audit market in the world. Detailed audit fee, client-firm and local market data is available. The national market is also sufficiently large that subdividing the market at the local level is possible. Local markets correspond here to specific Metropolitan Statistical Areas (MSA) and are described in detail in Section 4.3. These markets also vary sufficiently in size to properly test the implications of the ESC model. Overall, there is a strong data driven incentive to study U.S. local audit markets.

Fourth, focusing only on the U.S. facilitates comparisons to other studies. Many of the studies on audit quality, audit fees and on the structure of the audit industry are based on U.S. data (e.g, Danos and Eichenseher [1986], Doogar and Easley [1998], Hogan and

Jeter [1999], see Hay *et al.* [2006, Table 1-C] for a review of the audit fee literature). Also, many industry specific studies investigating the application of Sutton's ESC model to other industries are done for the U.S. (e.g., Ellickson [2006, 2007], Berry and Waldfogel [2006] and Dick [2007]).

Lastly, this research adds to the growing literature investigating audit and auditor characteristics at the local office/city level. As such, there is mounting evidence suggesting that auditor office specific characteristics are an important determinant of audit quality and fees, although more research is needed to understand this relation (e.g., Francis *et al.* [1999], Ferguson *et al.* [2003], Francis *et al.* [2005], Ferguson *et al.* [2006], Choi *et al.* [2007], Choi *et al.* [2008b], DeFond *et al.* [2008], see Francis [2004] for a discussion). This point is clearly expressed in Francis *et al.* [1999]: "Results from [*their*] study indicate that fundamental auditing phenomena such as market structure, audit pricing, auditor reporting, and independence issues should be investigated in city-specific markets (…)", where audit contracting occurs.

4.2 Summary of Findings

Results of this study are entirely consistent with predictions derived from the ESC framework that the auditing industry is naturally concentrated and dominated by a small set of large, high-quality auditors (i.e., Big-4s), whose product value increases with market size. Focusing on the small to medium sized company audit market segment, I find that the minimum level of auditor concentration (as measured by the market shares of the top n auditors) does not converge to 0 as market size becomes very large. Moreover, auditor concentration in relation to market size is non-monotonic. The empirical evidence also supports the conjecture that Big-4 audit value is increasing in market size. I argue and find that Big-4 audit value is increasing in market size as a result of additional investments in process innovating audit technology and more important economies of scale. Specifically, I report that with respect to market size: (1) cumulative Big-4 market share is increasing; (2) Big-4 audit quality, as measured by the level of abnormal accruals, is constant; and (3) the Big-4 audit fee premium is decreasing.

4.3 U.S. Audit Industry and Market Definition

Overall, the U.S. audit industry is highly concentrated. In 2006, the Big-4 audit firms collected 94% of all audit fees paid by SEC registrants and the Hirschman-Herfindahl Index (HHI) for that year was 0.23 (GAO [2008]) [71]. However, the level of concentration varies significantly across different segments of the audit market, as defined by client-firm size. For example, the Big-4 audit firms audited 98% of public companies with annual revenues above $1 billion and the HHI for this market segment was about 0.25 in 2006. Yet, the HHI for the audit market for small public companies with annual revenues of less than $100 million fell to about 0.08 and just below 0.18 for public companies with annual revenues between $100 million and $500 million.

Local audit markets for this study are defined on two dimensions: first, on a geographical dimension; and second, on the basis of client-firm size. Both are described below.

4.3.1 Local Market Definition: Geographical Dimension

Local audit markets are defined initially on a geographical dimension, with markets corresponding to specific Metropolitan Statistical Areas (MSA) defined in the 2000 U.S. Census[72]. This is consistent with other studies investigating market structure across local U.S. markets (e.g., Penno and Walther [1996], Ellickson [2006, 2007] and Dick [2007]) as well as the auditing literature on audit and auditor characteristics at the local office level (e.g., Francis *et al.* [1999], Francis *et al.* [2005] and Choi *et al.* [2007]). Auditor engagement offices are associated to a given MSA based on the City-State location of the

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[71] HHI a is measure of market concentration and is equal to: $\sum_{i=1}^{N} s_i^2$, where N is the number of firms operating in a market and s_i is the market share of firm i. HHI ranges from $1/N$ to 1 when market shares are expressed as percentages, or from $10{,}000*(1/N)$ to 10,000 when percentages as expressed as whole numbers. Throughout this thesis I express HHI based on percentages. A HHI of $1/N$ indicates that all firms in a market are of equal size (i.e., equal market shares), while a HHI of 0.18 is generally viewed as a highly concentrated market.

[72] A metropolitan area contains a core urban area of 50,000 or more population. Each metropolitan area consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. See http://www.census.gov/population/www/estimates/metroarea.html.

engagement office as reported in the auditor report (i.e., contracting office). This information is obtained from the *Audit Analytics* database.

Although the Big-4 auditors are organized in well structured national and international networks, many decisions are made at the individual office level. As Francis *et al.* [1999] point out, "it is the city-based practice offices of these firms [*the Big-4s*] which contract for and oversee the delivery of audits, and which issue audit reports (…)".And even if investments done at the national level likely "spillover" across local audit markets (e.g., national quality control activities, national branding efforts, national training, standardized audit program development, etc.), there is a fair degree of independence between markets. Indeed, local offices also make some strategic and investment decisions adapted to local market characteristics, such as developing local client-industry expertise.

4.3.2 Local Market Definition: Large vs. Small to Medium Sized Companies

As documented in the GAO survey, the Big-4 audit firms' dominance of the audit market varies greatly across segments of the audit market, as defined by client-firm size. In the large company market segment, the Big-4s' relative dominance can be linked to several factors. First, smaller auditors generally lack the capacity and expertise to audit large public companies given the size and complexity of their operations. Second, the lack of a significant international network can also limit smaller auditors' ability to effectively audit larger multinational companies. These factors are for the most part specific to large public companies and auditors must develop adequate audit expertise and capability before entering this segment of the market[73]. As a result, the market for large company audits is characterised by higher exogenous entry costs relative to entry costs into the small to medium sized company audit market segment. In terms of the ESC model: $\sigma_l > \sigma_{sm}$, where *l* and *sm* stand for the large and small to medium sized company audit markets respectively. Put differently, there are significant exogenous barriers to entry into the

[73]For example, according to a GAO survey, 92% of representatives from large public companies cited "Ability to handle size and complexity of company operations" and 66% cited "Geographical presence" as significant reasons why their company would be unlikely to use a small or midsize Non-Big-4 auditor (GAO [2008, Figure 8]). For representatives from small to medium public companies, these proportions fall to 65% and 33% respectively (GAO [2008, Figure 10]).

market for large public company audits (GAO [2003b, 2008]). As discussed in Section 3.4, this implies that the market for large (public) company audits is naturally more concentrated as only larger audit firms can operate at an efficient scale in this market segment.

Furthermore, differences in market concentration between the two segments can result from differences in the proportion θ of client-firms in each market segment that do not benefit from the superior audit technology offered by the Big-4 auditors (or values it less), or simply cannot afford a Big-4 audit. As argued previously in Section 3.5, a smaller proportion of small and medium companies potentially derive net positive value from Big-4 audits as there is less market incentive for them to choose a Big-4 auditor; formally: $\theta_l > \theta_{sm}$. Following *Observation 6* (Section 3.5), this partially explains why the Big-4 auditors are relatively more dominant in the large company audit market segment (see Section 3.5 for a more complete discussion).

Hence, given that exogenous model parameters σ and θ are partially driven by client-firm size, it is preferable to consider the large company and the small to medium sized company segments as distinct audit markets for testing the theory[74]. The objective here is to provide a more powerful setting to test the ESC model by focusing only on the small and medium public company market segment. Specifically, I only retain client-firm-year observations with total assets below $500 million and exclude client-firm-year observations where the number of reported geographical segment is above one. In this setting, auditor choice is not naturally limited to large auditors because of high exogenous entry costs or other constraints. Accordingly, client-firms can (more freely) choose between auditor types based on the relative value they derive from their audits. This offers several advantages for testing the theory.

First, the small to medium sized company market is the most competitive segment where both (assumed) large technology-investing Big-4 auditors and smaller non-technology-

[74] In the same vein, the European Union segmented the audit market according to market index and company size in its reviews of Big-4 audit firm mergers (Oxera Consulting [2007]).

investing Non-Big-4 auditors are actively present. When testing the theory, it is important to recognise that local market characteristics potentially correlated with market size, such as labour and office rental costs, can significantly affect audit firms' decisions, most notably on audit pricing. As such, the smaller non-technology-investing Non-Big-4 auditors act as a control group for unobservable market characteristics assumed common to all auditor types. This is described in Section 4.5.4.

Second, there is an implicit assumption that the local audit engagement office manages and performs the majority of the audit engagement. This is important because local geographical market characteristics are associated with the location of the local engagement office. If multiple offices are involved in an engagement, different markets are involved and it becomes difficult to associate audit fees and audit quality to characteristics of one specific market. Audits for small to medium companies with only one reported geographical segment are less likely to involve multiple offices and thus less subject to this concern.

4.3.3 Client-firm Industry and Market Definition: A Note

Large audit firms increasingly organise their audit practice along client-industry service lines (Hogan and Jeter [1999]) and surveys confirm the importance client-firms place on auditor industry specific expertise when choosing their auditor (GAO [2003a, 2008] and Oxera Consulting [2006]). Furthermore, there is an extensive literature documenting significant differences between industry specialists and non-specialist auditors in terms of audit pricing and audit quality (see Gramling and Stone [2001], Watkins *et al.* [2004], Francis [2004] and Hay *et al.* [2006] for reviews). Consequently, the national U.S. audit market is often divided into submarkets based on client-firm industries (e.g., Eichenseher and Danos [1981], Danos and Eichenseher [1982, 1986], Hogan and Jeter [1999] and GAO [2003b, 2008]). Only a few studies, however, segment markets simultaneously on client-industry and geographical dimensions (i.e., engagement office) (e.g., Francis *et al.* [1999], Ferguson *et al.* [2003] and Francis *et al.* [2005]).

Therefore, the relevant question is whether or not audit markets for this study should also be defined with respect to client-firm industries? There are, however, several reasons why it is preferable for this study to partition markets only on the bases of client-firm size and geography, without considering client-firm industry as an additional criterion.

First, this study seeks to better understand how and why Big-4 and Non-Big-4 auditors differ. Yet, not considering audit fees and/or client-firm industry membership, it can be reasonably assumed that most, if not all, client-firms would strictly prefer a Big-4 audit over a Non-Big-4 audit. As such, Big-4 and Non-Big-4 audits are said to be vertically differentiated. The simple version of the ESC model presented in Section 3 captures this. Incorporating horizontal product differentiation, such as auditor industry specialisation[75], simply complicates the analysis and contributes little to understanding the Big-4/Non-Big-4 dichotomy. As such, defining audit markets on the bases of client-firm industries as well is unnecessary. Note, however, that the results from the ESC model are robust when considering horizontal product differentiation in a more general setting (Sutton [1991]).

Second, if Big-4 auditors specialise along client-firm industry lines through capital investments (i.e., fixed costs) in specific audit technologies (e.g., industry specific audit programs, staff training along industry lines, membership to industry associations, corporate sponsorship of industry venues, etc.), the distinction between vertical and horizontal product differentiation becomes trivial. What is relevant to the interpretation of the simple ESC model presented before is the aggregate amount of audit technology investments across the Big-4 audit firms in any given (local) market.

Third, partitioning markets both geographically and by client-firm industry would reduce the power of the tests. Many markets would end up with too few observations to accurately draw any inferences about audit quality and audit fees. Also, there would likely be strong "spillover" effects between different client-firm industries in the same cities (MSA) such that the assumption of market independence would fail. Finally, the

[75] Auditor industry specialisation can be thought of "horizontal product differentiation" because although a specialist auditor is generally preferred, the optimal choice of an auditor depends on the client-firm (i.e., client-firm industry membership).

measure of size for a jointly defined city-industry market would not be as objective and reliable as a simple measure of market size based on, for example, population or local GDP.

Nonetheless, to control for potential client-firm industry effects on audit quality and audit fees I exclude financial institutions (SIC 6000-6999) from the sample. This is common in the literature because of the difficulties in estimating audit quality and audit fees for these firms. I also control for industry effects in the audit quality and audit fee tests performed below.

4.3.4 Local Market Size

Local market size is defined as the average Metropolitan Statistical Area Gross Domestic Product (GDP in millions of 2001 dollars) from years 2001 to 2005, as reported by the Bureau of Economic Analysis (U.S. Department of Commerce)[76]. MSA GDP is the most objective and accurate measure available of the size of a local economy and therefore presents a fair estimate of local commercial opportunities available to auditors[77]. The number of audits and total market audit fees in a given market would be a misleading measure as private and large public companies are excluded from the sample. Furthermore, some audit clients, albeit a few, come from a different MSA as their auditor[78].

[76] Source: http://www.bea.gov/regional/gdpmetro/. The Bureau reports annual GDP figures. I use constant 2001 dollars to limit the effect of inflation. Furthermore, I take the average of MSA GDP over a five year period (the study spans from 2002 to 2005) to limit noise as there is arguably a lag between changes in local market size and audit firms' investments decisions.

[77] Sutton [1991], Berry and Waldfogel [2006] and Dick [2007] use population to measure market size. This is more appropriate in their setting as they focus on consumer products and services. Ellickson [2006, 2007] uses total MSA "income" (population multiplied by average personal income) to study the food retailing industry. GDP is more appropriate for this study since company financial audits are a "business product". All these measure are almost perfectly correlated to GDP with Pearson correlation coefficients of 0.998 for income and 0.991 for population. Results reported hereafter are quantitatively identical when using any of these alternative measures of market size (not reported).

[78] In any case, GDP is highly correlated to the number of audits and total market audit fees with Pearson correlation coefficients of 0.88 and 0.86 respectively.

4.4 Hypotheses

The hypotheses are derived directly from the observations stated in Section 3. The first three hypotheses refer to the market structure of the U.S. audit market while the last three refer to characteristics of the audit product provided by the Big-4 audit firms.

4.4.1 Market Structure

A detailed analysis of the market structure reveals critical information about the nature of audit firms' production costs, how these firms compete and the value of their products. Such a review, therefore, is the first step to confirm or inform the validity of the ESC model as a framework for investigating audit firm conduct. The first hypothesis states the non-convergence result of auditor concentration (formulated in alternative form):

> US-H1$_1$: The minimum level of auditor concentration does <u>not</u> converge to 0 as market size becomes very large ($S \rightarrow \infty$): $C_1 > 0$.

US-H1 is simply a reformulation of *Observation 2*. The non-convergence result is an essential property of the ESC model and stems from the assumption that Big-4 audit firms compete mostly on relative audit value by investing in audit technology.

As for the form of the market size-structure relationship, *Observation 3* only states that it <u>may</u> be non-monotonic. The precise form of this relationship depends on cost parameters σ, a and γ which are difficult to observe. Yet, based on prior work, it is possible to narrow this prediction for the U.S. market. First, Dopuch and Simunic [1980a] argue that entry costs to the U.S. auditing profession are overall low and that, as such, exogenous entry barriers to the practice of auditing are generally weak (i.e., low σ). As explained above (Section 4.3.2), this is especially the case for the small to medium sized company audit market segment. Second, Penno and Walther [1996] find that measures of auditor concentration are positively correlated with market size. Noting that their data covers only 49 of the largest 60 U.S. MASs[79], this finding is entirely consistent with the market

[79] Their data consists of employment information of the largest 10 to 27 audit firms (median 25) per MSA for calendar year 1990.

size-structure relationship illustrated by curves σ_3 and σ_4 in Figure 3.1, but is inconsistent with the argument that exogenous barriers to entry are high. Hence, I conjecture that the market size-structure relationship is non-monotonic and state the following, stricter hypothesis (formulated in alternative form):

> US- $H2_1$: Auditor concentration in relation to market size is <u>non-monotonic</u>: Auditor concentration is initially decreasing in market size over the range of small to intermediate markets, but increasing in market size in the largest local audit markets.

Rejecting US-$H1_0$ alone does not provide sufficient evidence to support the ESC model. Indeed, non-convergence could simply result from the lack of sufficiently large markets in the sample, especially if real exogenous entry costs are very high. Generally, though, this is unlikely to hold when investigating small to medium sized companies in the U.S. with local markets the size of New York, Los Angeles and Chicago. US-H2 offers stronger evidence to support the ESC model as the non-monotonic relation between market size and market concentration is unique to the ESC model.

US-H1 and US-H2 only give general support for the ESC model and make no predictions about which audit firms invest in audit technology. The underlying assumption thus far is that Big-4 and Non-Big-4 auditors differ with respect to their audit technology investment strategies. More specifically, the larger Big-4 audit firms are the ones competing on audit value by investing more heavily in audit technology as market size increases. If this assumption holds, than offices of the Big-4 audit firms are expected to grow with market size while the size of Non-Big-4 auditors should generally remain the same on average as it is the number of Non-Big-4 entrants that increases with market size. Hence, although it is expected that local market leaders often be a Big-4 auditor in any market, it should be the case that leaders in large markets be almost exclusively Big-4 auditors. This is stated formally in the following hypothesis (formulated in alternative form):

> US-$H3a_1$: Big-4 auditor office size is <u>increasing</u> in market size;
> US-$H3b_1$: Big-4 auditors lead <u>more often</u> in larger markets.

This hypothesis is merely stated for completeness, as evidence from the academic literature and professional press suggest it is true. Nonetheless, it is important since it is in line with the logic of the ESC model.

4.4.2 Audit Product

The second set of hypotheses relates to characteristics of the audit product, that is, audit quality and audit fees. If Big-4 and Non-Big-4 audit firms differ with respect to their audit technology investment strategies, there should be differences in the quality and/or pricing of Big-4 audits relative to Non-Big-4 audits. Indeed, this is explored in Section 3 and the existence of a Big-4 audit fee premium and evidence of higher quality Big-4 audits is well documented in the literature.

Yet, how Big-4 audit quality and pricing evolves with market size, more specifically relative to Non-Big-4 audits, has not been addressed in the literature. *Assumption 1b* from Section 3.5 states that Big-4 auditors invest more in audit technology as market size increases, while Non-Big-4 auditors (generally) maintain only the minimum level of investment in audit technology. Under this assumption, the following hypothesis should hold (formulated in alternative form):

> US-H4$_1$: The value of Big-4 audits relative to Non-Big-4 audits is increasing in market size.

US-H4 is simply a reformulation of *Observation 4* from Section 3.5. Because Non-Big-4 auditors are expected to maintain, on average, their investment in audit technology at the required minimum, the value of their audits is expected to be generally constant across all markets. Hence, it is the value of Big-4 audits that is strictly increasing in market size. As described in Section 2.2, this superior audit value can be associated, individually or in combination, to the insurance, assurance or service value components of the audit product.

Local member practices of a given Big-4 national network share a common brand name. As such, the insurance, assurance and, possibly to a lesser extent, service[80] value components of their audits should be constant across the network. For example, civil legal action against an audit firm is brought at the national (i.e., partnership) level, not against local practices. Hence, the insurance value associated with the potential wealth stakeholders can recover from civil legal action brought against an audit firm is constant across all local markets where the partnership operates in the U.S.[81].

The assurance value of Big-4 audits is also expected to be constant across local U.S. markets. Recall from Section 2.2. that assurance value is associated with the credibility of the audited financial statements. This attribute of the audit product is most commonly referred to audit quality in the literature. Yet, the only observable output from an audit is the auditor's report. Because this report is identical for all member local practices of a national Big-4 partnership (i.e., auditor brand-name), with the exception of the engagement office location, the output is undifferentiated among local practices[82]. Therefore, there is little incentive for a local practice to invest in audit technology to enhance the quality of its audits (i.e., assurance value) above the partnership's standard given that it is less likely to be perceived by audit clients and valued accordingly.

[80] Service value is more likely to differ across Big-4 local offices than the other components of audit value. This component is associated mostly to the professional relations that the engagement team maintains with the client's management team. Its contribution to firm value is limited as it is mostly company employees who benefit. For that reason, it is unclear how audit firms would align their investment strategy to directly enhance service value. For example, it is difficult to evaluate how service value directly impacts audit pricing. Also, this attribute of audit value is difficult, if not impossible, to evaluate empirically using conventional methods. Therefore, it is not addressed formally in this study.

[81] In the U.S., Big-4 audit firms are constituted as national entities (Limited Liability Partnerships). Furthermore, insurance value from audits is a function of the legal and regulatory environment. These two elements are constant across U.S. local markets (with the exception of generally minor differences in State laws).

[82] Engagement office location information offers some level of differentiation. Partial, evidence of this comes from Chaney and Philipich [2002] who find that market reaction to key event dates in relation to the Enron debacle was significantly more negative for clients of the Huston office of Andersen than for Andersen clients from other offices. This supports, as they argue, that markets viewed the Huston office as providing lower quality audits. However, this does not imply that audit clients (and markets) systematically view audit quality as varying across different offices of a same Big-4 auditor. First, the Enron fiasco was an extreme event. Second, the market's assessment of the quality of Huston office audits is expressed *ex post*; nothing suggests that the *ex ante* audit quality would have been assessed any differently. Moreover, the explanation for the "abnormal" negative market reaction for clients of the Andersen Huston is questioned by Nelson *et al.* [2008] and argued to be the result of confounding effects (i.e., the Huston office's particular client portfolio composition and a sharp decline in oil prices around the relevant dates).

Moreover, there is a strong incentive for members to constitute a national partnership with strong oversight powers of local members' auditing practices to ensure uniform (partnership-level set minimum) audit quality. In this case, partnership level audit standards and quality controls offer two significant benefits. First, it limits the "free rider" problem within the partnership. Second, it adds value to the audits of all member offices by lowering transaction costs as there is less information asymmetry over the true quality of the audits provided by local offices[83]. Hence, the quality of Big-4 audits is expected to remain constant across all local markets[84].

As a result, and focusing exclusively of the assurance component of audit value, I formulate the following hypothesis with respect to Big-4 audit quality (null hypothesis):

US-H5$_0$: Big-4 audit quality is constant in market size.

However, for US-H4 and US-H5 to jointly hold, it must be that the average cost of a Big-4 audit is decreasing in market size, all else equal. That is, Big-4 audit fees, for an equal level of audit quality, is decreasing in market size. Consistent with *Observation 4* from Section 3.5, this implies that Big-4 audit value is increasing because the quality-price ratio of their audits is increasing. In this case, investments in audit technology are associated with process innovation, as explained previously (Section 3.3.3). In other words, Big-4 offices in larger markets achieve greater economies of scale and lower their fees accordingly[85]. This is stated formally in the following hypothesis (formulated in alternative form):

[83] Transaction costs are reduced both internally (i.e., between member local practices) and externally (i.e., clients of the audit firm). In the first case, multiple offices participating on an engagement adhere to standard audit practices that lower coordination and evaluation/review costs. In the second case, it is easier for existing and potential clients to assess the quality of a Big-4 audit firm, rather than local offices individually. In fact, this is a significant benefit of sharing a common brand name.

[84] Because Big-4 audit firms are international brand names and national partnerships are organised as international networks, this argument also holds somewhat at the international level. However, these international networks are not as integrated and restrictive as national partnerships so that member national partnerships remain independent. Also, country specific characteristics, such as legal and regulatory environments, affect the level of audit quality provided at the national level. Hence, it is not obvious that audit quality for any one Big-4 firm would be constant across its national partnerships. This point is explored further in Section 5.

[85] Interestingly, results of a European survey reported by London Economics [2006, Table 13], indicates that Big-4 audit firm representatives ranked "Price" competition as more important than "Quality"

US-H6$_1$: Big-4 audit fees are decreasing in market size.

Importantly, if US-H6 holds, it suggests that an important portion of Big-4 fixed costs (i.e., audit technology) is incurred at the local office level (rather than just the national partnership level). Indeed, capital investments in audit technology incurred at the national level benefit every member office in the partnership. If investments only occur at this level, then Big-4 audit fees would not vary across markets and US-H6$_1$ would be rejected.

Importantly, the point made here is not that investments in audit technology at the national partnership level play no significant role in the Big-4/Non-Big-4 dichotomy. In fact, for Big-4 audit firms, most capital investments are likely developed and financed at the national level. In line with the logic of the ESC framework, Big-4 auditors perform such investments to compete against other Big-4 auditors, enhance and promote the value of their audits at a national scale[86]. As explained in Section 3, these investments contribute to the non-convergence result in market concentration and also drive the quality differential between Big-4 and Non-Big-4 auditors, but at the national level. That is, because such investments are, for the most part, uniformly shared across all the local offices of a national Big-4 partnership, they would not explain variations observed in local market structure and Big-4 audits across local markets. Consequently, because markets have been defined at the local office level for this study, differences across markets are assumed to be driven by local level investments. In other words, I make the point here that there are significant fixed costs (i.e., capital investments) also incurred at the local Big-4 office level[87]. This study essentially seeks to evaluate the importance and impact of these costs on local market structure, audit quality and audit fees.

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competition. This suggest that Big-4 audit firms will indeed be motivated to invest in audit technology to lower marginal production costs, especially when Big-4 auditors compete directly against each other.

[86] National level investments are likely to be more in *real* and *perceived* audit quality enhancing technologies.

[87] As explained in this section, investments at the local Big-4 office level are likely more in process innovation.

Taken together, hypotheses US-H1 to US-H6 suggest that high concentration does not necessarily impair Big-4 audit quality and/or raise audit fees. This directly addresses recent concerns about the high level of Big-4 market power and provides a theoretical foundation for the lack of evidence to suggest that this has, thus far, adversely affected audit quality and fees (GAO [2003b, 2003a, 2008]). Of course, excessively high concentration poses a real problem regarding auditor choice and could potentially harm competition to a point where the incentive for Big-4 auditors to invest in audit technology is reduced. Ultimately, there could be a point where Big-4 audit quality may actually fall and/or audit fees increase as a result of excessive monopoly power by the Big-4 audit firms. The ESC model allows for such a possibility, but it is an empirical issue whether or not audit concentration in U.S. local markets has reached that point; the evidence by the GAO suggests that this point has not yet been reached however.

4.5 Methodology and Research Design

4.5.1 US-H1, US-H2 and US-H3: Market Structure Analysis

As explained previously in Section 3.6, because the observed market structures are driven by a number of factors which may vary across markets and are difficult to control for, I focus on predictions that are robust. As such, I use the lower bound approach developed by Sutton [1991] and widely employed in subsequent studies (e.g., Robinson and Chiang [1996], Sutton [1998], Giorgetti [2003], Robone and Zanardi [2006], Ellickson [2006, 2007] and Dick [2007], Marin and Siotis [2007]; see Sutton [2007] for a review). Following Sutton [1991], I formally test US-H1 and US-H2 by fitting a lower bound on a scatter plot of a logit transformation of the C_n concentration ratio and market size. As in other studies, the lower bound is assumed to have the following quadratic functional form:

$$\widetilde{C}_{nj} = a + \frac{b}{\ln(GDP_j)} + \frac{c}{(\ln(GDP_j))^2} + e_j \qquad (4.1)$$

where $\widetilde{C}_{nj} = \ln\left(\frac{C_{nj}+\varepsilon}{1-C_{nj}+\varepsilon}\right)$ and C_{nj} is the (cumulative) market share of audit fees of the n leading audit firm(s) in market j (MSAs)[88]. As in Ilmakunnas [2006], I calculate the logit transformation by adding a small constant, ε = 0.001, since the C_n concentration ratio is sometimes equal to 1 in some markets[89]. Finally, GDP_j is the size of the local audit market j and $e_j > 0$ are the residuals distributed as a two parameter[90] Weibull:

$$F(e) = 1 - \exp\left(-\frac{e}{s}\right)^{\alpha}, \alpha > 0, s > 0 \qquad (4.2)$$

I estimate eq. (4.1) separately for each year following the two-step minimum distance estimator proposed by Smith [1994][91]. To limit the influence of isolated yearly shocks (or data limitations) that can impact the level of concentration, I also estimate eq. (4.1) using the average concentration ratio, $\overline{C}_{nj}$, for years 2002 to 2005. Eq. (4.2) is estimated using maximum likelihood[92].

From eq. (4.1), the limiting concentration ratio C_n^{∞} as market size increases to infinity is equal to the intercept a. Hence, a formal test of US-H1 is to determine C_n^{∞} from the

[88] As common in the literature, I retain the one-firm (C_1) and four-firm (C_4) concentration ratios for the analysis. The leading firm is defined as the audit firm, Big-4 or not, with the most market share in a given market j, for a given year. Likewise, the C_4 concentration ratio represents the cumulative market share of the four leading audit firms, i.e., the four audit firms with the most market shares in a given market j, for a given year.

[89] This implies that the logit transformation equals 6.90875 when $C_{nj} = 1$. The constant ε cannot be too small, for when $C_{nj} = 1$, the logit transformation would be very large (i.e., $\widetilde{C}_{nj} \to \infty$ *when* $\varepsilon \to 0$) and could significantly affect the estimation of the lower bound. Nonetheless, the results reported below are robust to the use of alternative constants ε = 0.01 and ε = 0.0001 (not reported).

[90] The three parameter Weibull was rejected in all cases.

[91] This is standard in the literature. Smith [1994] shows that his two-step minimum distance estimator is consistent for all α and is asymptotically efficient for α < 2, where as the maximum likelihood estimator generally does not exist if parameter α ≤ 1. Since my estimates of α are all less than 1 (see Table 4.4 below), I use the minimum distance estimator throughout the analysis.

[92] Eq. (4.2) is estimated for statistical inference purposes. The standard errors and confidence intervals for parameters a, b and c are obtained from the parameters' empirical distributions. To do this, I run Monte Carlo simulations where the random noise is generated from a Weibull distribution with known α and s (estimated from eq. (4.2)).

intercept a. Since $C_n^{\infty} = \frac{\exp(a)}{1+\exp(a)}$, US-H1 clearly holds when C_n^{∞} is bounded well above 0: $a > 0 \rightarrow C_n^{\infty} > 0.5$. In fact, this is a very conservative cut-off point and US-H1 still holds for values below 0, for example, $a >$ -1,5 $\rightarrow C_n^{\infty} > 0.18$. As for US-H2, I formally test that $b < 0$ and $c > 0$ (Robinson and Chiang [1996].

Finally, I provide extensive summary statistics describing the market structure across markets of different size to supplement my analysis and formally test US-H3a and US-H3b.

4.5.2 US-H4: Big-4 Audit Value Analysis

Audit value is not directly observable. However, inferences can be made about the value of audit firms' audits from their respective market shares. That is, all other things equal, audit firms with the most "valued" audits should be successful in gaining a greater share of the audit market. From this perspective, if the value of Big-4 audits relative to Non-Big-4 audits is increasing in market size, the cumulative market share of the Big-4 auditors should also increase, but possibly at a decreasing rate. Hence, to formally test US-H4, I estimate the following regression:

$$B4SHARE_j = \beta_0 + \beta_1 LNGDP_j + \varepsilon_j \qquad (4.3)$$

Where, for market j, $B4SHARE_j$ represents the cumulative market share of audit fees of the Big-4 audit firms and $LNGDP_j$ is the natural log of market j average GDP over 2001 to 2005 (millions of 2001 dollars). Consistent with US-H4, the prediction is that the coefficient on market size $LNGDP_j$ is positive (i.e., $\beta_1 > 0$). I estimate eq. (4.3) separately for each year. Again, to limit the influence of isolated yearly shocks that can impact market shares, I also estimate eq. (4.3) using the average Big-4 cumulative market share, $\overline{B4SHARE}_j$, for years 2002 to 2005.

4.5.3 US-H5: Big-4 Audit Quality Analysis

Audit quality in general is difficult to measure. One common approach is to gauge audit quality by measuring how auditors "successfully" constrain (opportunistic) earnings management by client-firms. Essentially, higher quality audits are associated with higher quality reported earnings. As a formal test for US-H5, I assess the association between abnormal accruals and market size. Abnormal accruals offer estimates of *real* audit quality and are frequently used in the archival auditing literature.

I estimate abnormal accruals using a standard cross-sectional modified-Jones [1991] model, adjusted to control for the potential effects of accounting conservatism on the accrual quality metrics (Ball and Shivakumar [2006]). Formally, I begin by estimating the following regression:

$$\begin{aligned} TACC_{it} = {} & \xi_0 + \xi_1(1/lagTA_{it}) + \xi_2(\Delta REV_{it} - \Delta AR_{it}) + \xi_3 PPE_{it} \\ & + \xi_4 CFO_{it} + \xi_5 DCFO_{it} + \xi_6(DCFO_{it} * CFO_{it}) + \varepsilon_{it} \end{aligned} \qquad (4.4)$$

Where for client-firm *i* in year *t*:

$TACC_{it}$ = income before extraordinary items minus cash flows from continuing operations, scaled by beginning of year total assets;

$lagTA_{it}$ = beginning of year total assets ($m);

ΔREV_{it} = sales in year *t* minus sales in year *t – 1*, scaled by beginning of year total assets;

ΔAR_{it} accounts receivable in year *t* minus sales in year *t – 1*, scaled by beginning of year total assets;

PPE_{it} = net property plant and equipment, scaled by beginning of year total assets;

CFO_{it} = cash flows from continuing operations, scaled by beginning of year total assets;

$DCFO_{it}$ = 1 if $CFO_{it} < 0$, 0 otherwise.

Total accruals are calculated directly from the statement of cash flows as suggested by Hribar and Collins [2002]. Following Ball and Shivakumar [2006], I include CFO_{it} and $DCFO_{it}$ to account for the asymmetry in gain and loss recognition which results from conservative accounting. After winsorizing continuous variables at the 1st and 99th percentiles (per given year), I estimate eq. (4.4) separately for each year and industry[93]. Unadjusted abnormal accruals correspond to the residuals from eq. (4.4). I then performance-adjust abnormal accruals (Kothari *et al.* [2005]) using the same technique as Ashbaugh-Skaife *et al.* [2008][94].

To test US-H5, I analyse separately the signed values and the absolute values (unsigned) of the performance-adjusted abnormal accruals (*ABACC*) in relation to market size. To control for client-firm characteristics that potentially affect the magnitude of abnormal accruals, I use the following multiple regression model:

$$\begin{aligned} ABACC_{itj} = {} & \alpha_0 + \alpha_1 BIG4_{itj} + \alpha_2 LNGDP_j + \alpha_3 (BIG4_{itj} * LNGDP_j) \\ & + \alpha_4 LNTA_{itj} + \alpha_5 LEV_{itj} + \alpha_6 lagLOSS_{itj} + \alpha_7 \Delta PPE_{ijt} \\ & + \alpha_8 GROWTH_{ijt} + \alpha_9 NBS_{itj} + \alpha_{10} \sigma SALES_{itj} + \alpha_{11} \sigma CFO_{itj} + \varepsilon_{itj} \end{aligned} \qquad (4.5)$$

Where, for local market *j*:

$ABACC_{itj}$ = performance-adjusted abnormal accrual from eq. (4.4) for firm *i* in year *t* (% of client-firm total assets), and, for specific estimations of eq. (4.5), evaluated as:

$ABACC^{\pm}$ = signed values of *ABCC*;
$|ABACC|$ = absolute value of *ABCC*;
$|ABACC^{+}|$ = absolute value of positive only *ABCC*;
$|ABACC^{-}|$ = absolute value of negate only *ABCC*;

[93] Following Ashbaugh-Skaife *et al.* [2008], industry membership is based on three-, two-, or one-digit SIC codes conditional on having at least 20 observations in each SIC-year group and a minimum of five observations in each group with $DCFO = 1$.

[94] Specifically, I rank firm-year observations within each industry-year group into ten groups based on the client-firm's prior year return-on-assets ($ROA_{i,t-1}$). The performance-adjusted abnormal accrual is the difference between the sample firm's "unadjusted abnormal accruals" from eq. (4.4) and the median abnormal accruals for client-firms in the same industry-year "ROA decile group", where the median ROA value excludes the particular sample client-firm.

$BIG4_{itj}$ = 1 if client-firm *i* is audited by a Big-4 auditor in year *t*, 0 otherwise;

$LNGDP_j$ = natural log of market *j* average GDP over 2001 to 2005 ($\$_{2001}$m)

$LNTA_{itj}$ = natural log of year-end total assets of client-firm *i* in year *t* ($m);

LEV_{itj} = the ratio of year-end total liabilities to total assets of client-firm *i* in year *t*;

$lagLOSS_{itj}$ = 1 if client-firm *i* reported a net loss in year *t-1*, 0 otherwise;

ΔPPE_{it} = gross property plant and equipment (PPE) of client-firm *i* in year *t* minus PPE in *t-1*, divided by PPE in *t-1*;

$GROWTH_{itj}$ = sales of client-firm *i* in year *t* minus sales in *t-1*, divided by sales in *t-1*;

NBS_{itj} = natural log of one plus the number of business segments of client-firm *i* in year *t*;

$\sigma SALES_{itj}$ = standard deviation of client-firm *i* sales divided by total assets, where the standard deviation is calculated using the prior five years (*t-5* to *t-1*), requiring a minimum of three years of data;

σCFO_{it} = standard deviation of client-firm *i* cash flow from operations divided by total assets, where the standard deviation is calculated using the prior five years (*t-5* to *t-1*), requiring a minimum of three years of data;

As common in the literature, I winsorize continuous variables at the 1st and 99th percentiles[95] (per given year) to limit the effect of outliers[96]. I estimate eq. (4.5) separately for signed abnormal accruals ($ABACC^{\pm}$), absolute abnormal accruals ($|ABACC|$), positive abnormal accruals ($|ABACC^{+}|$) and negative abnormal accruals ($|ABACC^{-}|$)[97] to capture different aspects of audit quality. On the one hand, signed abnormal accruals considers both income decreasing (i.e., negative) and income increasing (i.e., positive) abnormal accruals. While signed abnormal accruals should on average be close to 0, a negative coefficient when the dependent variable is $ABACC^{\pm}$

[95] Except *NBS*, *σSALES* and *σCFO* which I winsorize at the 99th percentile only.
[96] I obtain $|ABACC|$, $|ABACC^{+}|$ and $|ABACC^{-}|$ from the winsorized values of signed *ABACC*.
[97] I use the absolute value of negative abnormal accruals to harmonise with other measures the interpretation of the results.

would indicate that the independent variable of interest is correlated with greater accounting conservatism. In general, more conservative earnings are associated with greater audit quality (i.e., earnings quality).

On the other hand, absolute abnormal accruals may capture more accurately client-firms' general propensity to manage earnings. Here, greater absolute abnormal accruals are associated with lower audit quality, indicating more widespread earnings management, whether it be to increase or to decrease earnings. Finally, regressing eq. (4.5) separately for $|ABACC^{+}|$ and $|ABACC^{-}|$ explicitly acknowledges the fundamental difference between income increasing and income decreasing accruals and allows regression coefficients to evolve accordingly.

I estimate eq. (4.5) using the full sample with both Big-4 and Non-Big-4 audits, even though the focus of US-H5 is on Big-4 audit quality. Including Non-Big-4 audits controls for unobservable market characteristics correlated with local market size which may affect the level of client-firms' abnormal accruals, regardless of auditor type[98]. For this reason, the relevant test for US-H5 is whether Big-4 audit quality relative to Non-Big-4 audit quality is constant in market size. Consistent with US-H5, therefore, I predict the coefficient on *BIG4*LNGDP* to be insignificantly different from zero: $\alpha_3 = 0$. I predict that Non-Big-4 audit quality is also uncorrelated with market size: $\alpha_2 = 0$. However, I also perform a more restrictive test for US-H5 to evaluate whether Big-4 audit quality in general is constant in market size: $\alpha_2 + \alpha_3 = 0$. Finally, *BIG4* reflects the difference in general audit quality between Big-4 and Non-Big-4 auditors. Consistent with the literature, I predict the coefficient on *BIG4* to be negative (i.e., $\alpha_1 < 0$) when the dependent variable is $ABACC^{\pm}$, $|ABACC|$ or $|ABACC^{+}|$ and positive (i.e., $\alpha_1 > 0$) when the dependent variable is $|ABACC^{-}|$.

I include other independent variables in eq. (4.5) to control for client-firm specific characteristics that affect earnings quality (e.g., Frankel *et al.* [2002], Francis and Wang

[98] For example, market size may be positively correlated with the "quality level" of the local work force available to all audit firms and client-firms. This can potentially improve the (general) level of audit quality and/or the quality of client-firms' financial accounting reporting system.

[2008] and Ashbaugh-Skaife *et al.* [2008]). First, I include *LNTA* to control for client-firms size. Prior studies suggest that larger client-firms tend to have lower relative abnormal accruals (i.e., % to total assets) than smaller firms. As a result, I predict α_4 to be negative, for all measures of abnormal accruals (i.e., $\alpha_4 < 0$). I use *LEV* and *lagLOSS* to control for client-firm financial distress and bankruptcy risk. Managers of financially distressed firms can have greater incentives to manage earnings[99]. Financial distress can also be associated with changes in client-firms operations that can lead to greater accrual estimation errors (Dechow and Dichev [2002]). I predict the coefficient on *LEV* and *lagLOSS* to be positive (i.e., α_5, $\alpha_6 > 0$) when the dependent variable is $|ABACC|$, $|ABACC^{+}|$ or $|ABACC^{-}|$ as firms facing financial distress tend to report larger abnormal accruals (e.g., Kothari *et al.* [2005]). However, I make no prediction on the sign of those coefficients when using signed abnormal accruals as the dependent variable because it is difficult to anticipate the net effect of positive and negative abnormal accruals. I also control for client-firm growth as it can increase the absolute level of reported accruals. Client-firm growth is captured by *ΔPPE* and *GROWTH*. Again, I predict the coefficient on these variables to be positive (i.e., α_7, $\alpha_8 > 0$) when using absolute abnormal accruals, but make no predictions when using signed abnormal accruals.

I use *NBS* as a proxy for operational complexity (Ashbaugh-Skaife *et al.* [2008]). Estimating accruals may be more difficult when client-firm operations are more complex. In turn, this could result in more volatile abnormal accruals and earnings of lesser quality (i.e., estimation errors). However, *NBS* also captures client-firm operational diversification which can result in less volatile abnormal accruals. Consequently, I make no prediction for the sign on *NBS* (i.e., $\alpha_9 = ?$). I also include *σSALES* and *σCFO* to control for the effects of operational volatility on accrual quality. Greater volatility can increase the likelihood and magnitude of estimation errors in accruals (Dechow and Dichev [2002]). Again, I predict the coefficient on these variables to be positive (i.e., α_{10}, $\alpha_{11} > 0$) when using absolute abnormal accruals, but make no predictions when using signed abnormal accruals. Finally, including *σSALES* and *σCFO* (and *LNTA*) is also

[99] These incentives can be to manage earnings upwards to avoid reporting a loss or an earnings decrease in the current year (or to limit a reported loss); or earnings can be manage downwards if the client-firm is restructuring its operations (e.g., "big-bath")

consistent with recommendations by Hribar and Nichols [2007]. They suggest directly controlling for abnormal accrual volatility when using absolute abnormal accrual models to identify earnings management. Indeed, Hribar and Nichols [2007] show that the expected value of absolute abnormal accruals is increasing in the variance of the error term from the first stage abnormal accrual estimation model (eq. (4.4)). Both $\sigma SALES$ and σCFO tend to be correlated with this variance.

4.5.4 US-H6: Big-4 Audit Fee Analysis

The relation between market size and Big-4 audit fees is complex. Indeed, local market characteristics are potentially highly correlated with the test variable, market size, and the dependent variable, Big-4 audit fees. Below I illustrate how the standard audit fee model can be adapted to accurately test US-H6.

First Stage: Estimating Market Specific Big-4 Audit Fee Premia

To begin, it is important to remember that an audit is an indivisible good. Hence, when a client-firm purchases an audit, it essentially purchases a "bundle" of audit effort (i.e., x_i in eq. (3.3)) associated to a given level of audit technology δ. So while a client-firm will only purchase one such "bundle" in a give year, the total amount of audit effort x_i composing this bundle may vary depending on the type of auditor hired, holding client-firm characteristics constant. To simplify, I assume, as is standard in the auditing literature, that the relative difference between Big-4 and Non-Big-4 auditors in the total amount of audit effort is constant in engagement characteristics[100]. This makes it possible to isolate the effects of engagement characteristics and auditor type on audit effort purchased. Formally:

$$EFFORT(\Phi_{it}, T) = X(\Phi_{it})LABOUR(T) \qquad (4.6)$$

Where *EFFORT* is the total amount of audit effort purchased by client-firm i in year t, with Φ_{it} representing a vector of engagement specific characteristics and T indicating

[100] Basically, in a standard audit fee model, this difference between Big-4 and Non-Big-4 auditors is captured as a component of the Big-4 audit fee premium in a Big-4 dummy variable.

auditor type (T = Big-4, Non-Big-4). On the left hand side, $X(\Phi_{it})$ is the total amount of "standard" audit hours purchased conditional on engagement characteristics, and $LABOUR(T)$ is a positive adjustment factor to audit effort to account for differences in audit production processes between Big-4 and Non-Big-4 auditors. Setting $LABOUR_{NB4} = 1$, $LABOUR_{B4} > 0$ represents the proportion of total standard audit hours a Big-4 auditor performs relative to a Non-Big-4 auditor.

Total audit fees paid by client-firm i for its year t audit is then equal to:

$$AUDFEE(\Phi_{it}, T = B4) = P_{B4}\left[X(\Phi_{it})LABOUR_{B4}\right] \qquad (4.7a)$$

$$AUDFEE(\Phi_{it}, T = NB4) = P_{NB4}X(\Phi_{it}) \qquad (4.7b)$$

That is, total audit fee is equal to total effort multiplied by the auditor's average hourly billing rate. Although the main focus is on Big-4 audit fees, I also consider Non-Big-4 audit fees since this group will be used to control for unobservable differences in Big-4 average marginal costs across markets. This is explained below.

From eqs. (3.8) and (3.12), auditors' billing rates are equal to:

$$p_{B4} = \left(\frac{N_{B4}}{N_{B4} - 1}\right)c_{B4} \qquad (4.8a)$$

$$p_{NB4} = c_{NB4} \qquad (4.8b)$$

Where N_{B4} is the number of entrants (i.e., Big-4 audit firms operating in a local market for a given year) and c_T is equal to average marginal costs; i.e., per audit hour cost of engagement specific inputs, with T = Big-4, Non-Big-4. Again, input costs are allowed to vary between auditor types to reflect differences in audit production processes.

The most significant variable input is undoubtedly labour (see footnote 64). I represent the cost of audit labour as SAL with no subscript because this corresponds to the average (hourly) wage on the labour market for auditors. Of course, there are differences between

the average auditor salary paid by Big-4 audit firms and salaries paid by Non-Big-4 audit firms (e.g., Robert Half International Inc. [2006], Public Accounting Report [2007] and Hays Specialist Recruitment [2008]). Most notably, the difference in average marginal labour cost can come from the different "mix" of labour that is used by Big-4 and Non-Big-4 auditors. Consequently, labour cost per auditor type must be weighted to reflect the relative audit effort supplied by staff auditors, managers and partners. Big-4 auditors can also differ from Non-Big-4 auditors with respect to the "quality" of the human capital employed, with higher quality (more specialised and experience) auditors costing more (see Section 3.5).

Therefore, total audit fees paid by client-firm *i* for its year *t* audit is equal to:

$$AUDFEE_{it}(T = B4) = \left(\frac{N_{B4}}{N_{B4} - 1}\right)(MIX_{B4}SAL)\left[X(\Phi_{it})LABOUR_{B4}\right] \quad (4.9a)$$

$$AUDFEE_{it}(T = NB4) = (MIX_{NB4}SAL)X(\Phi_{it}) \quad (4.9b)$$

MIX_T is a positive "weighting" factor; $MIX_T > 1$ indicates that the audit firm's weighted average labour cost is above the market average wage and implies that the audit firm employs a greater proportion of higher paid, high-quality specialised and experienced auditors on its audit engagements. I group $LABOUR_{B4}$ and MIX_{B4} and take the natural log to obtain:

$$LNFEE_{it}(T = B4) = \ln\left(\frac{N_{B4}}{N_{B4} - 1}\right) + \ln(MIX_{B4}LABOUR_{B4}SAL) + \ln(X(\Phi_{it})) \quad (4.10a)$$

$$LNFEE_{it}(T = NB4) = \ln(MIX_{NB4}SAL) + \ln(X(\Phi_{it})) \quad (4.10b)$$

Eqs. (4.10a) and (4.10b) show clearly how the standard audit fee model should be adapted for testing US-H6. $X(\Phi_{it})$ captures well known engagement specific fee determinants included in standard audit fee models. These are explored in greater detail below. Other terms, namely N_{B4} and SAL, are observable factors which the theory

suggests should be included, especially since these are expected to be correlated with market size.

Although all these factors are likely correlated with market size, they are not a strictly linear function of market size. Indeed, many other factors such as competition on the labour market and local economic conditions come into play. In other words, N_{B4} and *SAL* are market specific (and year specific as well for N_{B4}) and should be controlled for appropriately to create a more powerful test for US-H6. I explore N_{B4} and *SAL* in detail below:

Number of Big-4 entrants

As vertically differentiated natural oligopolies, Big-4 audit firms benefit from a certain degree of market power and can accordingly price their audits above average marginal cost c_{B4}. This is illustrated by the first term of eq. (4.8a) where Big-4 market power is a decreasing function of the number of Big-4 entrants, N_{B4}, albeit, at a decreasing rate. Although by definition the number of Big-4 auditors operating in a local market (in a given year) is limited to four, N_{B4} does vary across markets and is positively correlated with market size (see Tables 4.15 and 4.16 below). Failing to control for this would bias the results in favour of US-H6$_1$.

Average labour input cost

Labour cost is positively correlated with market size (see Tables 4.15 and 4.16). Failing to control for labour cost would therefore bias against US-H6$_1$. To control for differences in labour costs across markets, I construct an index of auditor average salary for market *j*: $CSTX_j$. I construct the index by dividing the MSA specific average annual wage for "Accountants and Auditors" (SOC code 132001) by the equivalent U.S. national average as reported for May 2005 by the Bureau of Labor Statistics (U.S. Department of Labor)[101]. $CSTX_j$ is used in the audit fee model without taking the natural log as it is already presented on a percentage base ($CSTX_{US}$ = 100). When regressing separately (4.10a) and (4.10b) for Big-4 and Non-Big-4 audits respectively, the coefficient on $CSTX_j$

[101] Source: Occupational Employment Statistics, http://data.bls.gov/oes/search.jsp.

provides an estimate for MIX_{B4}*$LABOUR_{B4}$ and MIX_{NB4} (unfortunately it is impossible to provide a separate estimate of MIX_{B4} and $LABOUR_{B4}$). Both coefficients are expected to be strictly positive.

Other engagement specific input costs and unobservable market characteristics

Market specific characteristics, other than $CSTX_j$ (and N_{B4}), may have an impact on audit fees. However, these characteristics are unobservable and not explicitly included in eqs. (4.10a) and (4.10b). And although uncorrelated with $CSTX_j$, they could possibly be correlated with market size[102]. To control for these I take advantage of the presence of Non-Big-4 audits. For this, I make the assumption that these unobservable factors have the same relative impact on Big-4 and Non-Big-4 audit fees. For example, if Non-Big-4 "other" engagement specific costs increase from \$100 to \$150 from market A to B (50% increase), Big-4 "other" engagement specific costs would increase from, say, \$200 to \$300 (also 50% increase). Although individual estimates for other engagement specific costs are not observable, they can be inferred from the audit fee regression model when eqs. (4.10a) and (4.10b) are jointly estimated with market specific intercepts and Big-4 market specific interaction terms. The interaction terms represent market specific Big-4 audit fee premia which are then used to test US-H6. I obtain these from the following regression model (joint estimation of eqs. (4.10a) and (4.10b)):

$$\begin{aligned} LNFEE_{itj} = \quad & \varphi_{1j} + \varphi_{2j} BIG4_{itj} + \beta_1 CSTX_j \\ & + \beta_2 (BIG4_{itj} * CSTX_j) + \beta_3 (BIG4_{itj} * LNBIG4_{tj}) \\ & + \phi_1 LNTA_{itj} + \phi_2 INVREC_{itj} + \phi_3 LOSS_{itj} + \phi_4 ROA_{itj} \\ & + \phi_5 LEV_{itj} + \phi_6 NBS_{itj} + \phi_7 NAS_{itj} + \phi_8 CONCERN_{itj} \\ & + \phi_9 NEWAUD_{itj} + \phi_{10} BUSY_{itj} + \phi_{11} IMR_{itj} \\ & + (fixed\ effects) + \varepsilon_{itj} \end{aligned} \tag{4.11}$$

[102] In a regression model, the coefficient estimate on *CSTX* will also control for variations in other (variable) costs across markets, at least for the portion that is correlated with *CSTX*. Variable costs other than labour, however, likely represent only a small portion of the per hour variable audit costs. These costs could include a fair allocation, based of audit hours, of office rental cost which is likely highly correlated with local market labour costs. The portion of these costs that is not correlated with *CSTX* is "unobservable".

Where for local market *j*:

$LNFEE_{ijt}$ = natural log of audit fee ($k) of client-firm *i* in year *t*;

$BIG4_{itj}$ = 1 if client-firm *i* is audited by a Big-4 auditor in year *t*, 0 otherwise;

$CSTX_j$ = auditor average salary index for market *j* ($CSTX_{US} = 100$);

$LNBIG4_{tj}$ = natural log of the ratio $\left(\frac{N_{B4}+\varepsilon}{N_{B4}-1+\varepsilon}\right)$, where N_{B4} is the number of Big-4 auditors operating in market *j* for year *t*, and ε is a small constant ($\varepsilon = 0.001$) added to avoid losing observations when $N_{B4} = 1$;

$LNTA_{itj}$ = natural log of year-end total assets of client-firm *i* in year *t* ($m);

$INVREC_{itj}$ = the sum of inventories and receivables scaled by year-end total assets of client-firm *i* in year *t*;

$LOSS_{itj}$ = 1 if client-firm *i* reported a net loss in year *t*, 0 otherwise;

ROA_{itj} = return on assets of client-firm *i* in year *t*;

LEV_{itj} = the ratio of year-end total liabilities to total assets of client-firm *i* in year *t*;

NBS_{itj} = natural log of one plus the number of reported business segments of client-firm *i* in year *t* (assumed 0 if no data available);

NAS_{itj} = the ratio of non-audit fees to total audit fees (audit fees + non-audit fees) expensed by client-firm *i* in year *t*;

$CONCERN_{itj}$ = 1 if client-firm *i* is issued a qualified audit report in year *t*, 0 otherwise;

$NEWAUD_{itj}$ = 1 if a different auditor from year *t-1* audited client-firm *i* in year *t*, 0 otherwise;

$BUSY_{itj}$ = 1 if firm *j*'s fiscal year end *t* is in December or January, 0 otherwise;

IMR_{itj} the inverse Mills ratio for endogenous auditor choice for firm *i* in year *t*;

Fixed effects = year and industry (2-digit SIC) fixed effects.

As stated above, I predict the coefficient on *CSTX* to be positive: $\beta_1 > 0$. β_1 captures MIX_{NB4}; a higher coefficient implies that Non-Big-4 auditors rely more on human capital to perform its audits. Essentially, this indicates that a greater proportion of specialised, higher paid (higher quality human capital) auditors are involved in the audit process. For example, $\beta_1 > 1$ implies that the audit firm's average labour cost is above the local market average (for an equivalent occupation). Of course, because *CSTX* is potentially positively correlated with other variable costs, β_1 may be biased upwards.

The coefficient on (*BIG4*CSTX*) captures the difference between MIX_{NB4} and (MIX_{B4}**LABOUR*$_{B4}$), and thus differences in Big-4 and Non-Big-4 audit production processes. Because it is impossible to distinguish between MIX_{B4} and *LABOUR*$_{B4}$, a positive coefficient would imply that Big-4 auditors, relative to Non-Big-4 auditors, exert greater overall audit effort either by allocating more audit hours to an audit (with equal mix) and/or having more specialised, higher paid (higher quality human capital) auditors involved in the audit process[103]. A significant β_2 coefficient would provide further validation of the ESC model by confirming that Big-4 and Non-Big-4 auditors' production processes do indeed differ. The model however offers little guidance as to predicting the sign of β_2. On the one hand, investments in audit technology can be a substitute for audit effort which would imply $\beta_2 < 0$. On the other hand, Big-4 auditors may supply higher audit quality overall through a combination of greater audit effort and audit technology.

Yet, two published studies help provide further guidance. Choi *et al.* [2008a] argue that Big-4 audit firms supply higher effort than Non-Big-4 auditors. Although not the focus of their study, they report partial evidence from a Korean sample of audit hours which supports their claim. Blokdijk *et al.* [2006] find, based on a survey of Dutch Big-4 and Non-Big-4 audit hours, that total audit hours are roughly the same for the two groups of auditors. However, they find that the mix of hours is different and that Big-4 auditors allocate more time to planning and risk assessment, and less to substantive testing and

[103] Of course, this is only the "net effect" as MIX_{B4} and *LABOUR*$_{B4}$ can work in opposite directions.

completion. Planning and risk assessment tasks are usually performed by more experienced and better trained auditors (e.g., managers and partners). Taken together, the evidence from these two studies would suggest that $MIX_{B4} > MIX_{NB4}$ and $LABOUR_{B4} > LABOUR_{NB4} = 1$. Moreover, as discussed previously in Section 3.5, auditor salaries tend to be higher in Big-4 audit firms than in Non-Big-4 firms. This can suggest that Big-4 audit firms hire "superior quality", more highly trained staff and reinforces the idea that $MIX_{B4} > MIX_{NB4}$. As a result, I predict β_2 to be positive: $\beta_2 > 0$

*BIG4*LNBIG4* is a proxy for Big-4 market power[104]. As per eq. (4.8a), Big-4 auditor billing rate is decreasing in N_{B4}. Accordingly, I predict the coefficient on *BIG4*LNBIG4* to be positive: $\beta_3 > 0$. Notice that as the theory suggests, the number of Big-4 and Non-Big-4 entrants does not affect Non-Big-4 audit firms' pricing strategy.

Other independent variables included in eq. (4.11) are commonly used control variables (see Hay *et al.* [2006] for a meta-analysis). These variables stand for $X(\Phi_{it})$ in eqs. (4.10a) and (4.10b). I include *LNTA* to control for client-firm size; *INVREC* to control for inherent risk; *LOSS*, *ROA*, and *LEV* to control for client-specific litigation risk to be borne by the auditor; and *NBS* to control for client-firm complexity. As is well documented in the literature, audit fees are positively associated to client-firm size, inherent risk, client-firm-specific risk factors and complexity. Therefore, I predict all coefficients on these engagement specific control variables to be positive, except for the coefficient on *ROA* which is expected to be negative (i.e., $\phi_1, \phi_2, \phi_3, \phi_5, \phi_6 > 0$, $\phi_4 < 0$).

I use *NAS* to control for the possible impact on audit fees of the joint provision of NAS-MAS. The provision of NAS-MAS can lead to lower audit fees as a result of the cross-subsidization of audit fees or synergies between audit and non-audit services. Alternatively, NAS-MAS may be associated with organizational problems or operational changes in the client-firm which can lead to higher audit fees. Accordingly, I offer no prediction for the sign of the coefficient on *NAS* (i.e., $\phi_7 = ?$). I also offer no prediction

[104] I also use $log(N_{B4})$ as an alternative control for Big-4 market power. Results from all tests using this control are equivalent to results using *LNBIG4* as defined previously, except that the sign on $log(N_{B4})$ is, as expected, negative.

for the sign of the coefficient on *NEWAUD* (i.e., ϕ_8 = ?) since it is unclear whether a change of auditor will lead to lower or higher audit fees, all else equal. For example, a new auditor may offer a discount to gain new clients (i.e., "low-balling"). In contrast, a new auditor may face significant start-up costs and charge higher audit fees as a result.

I predict both coefficients on *CONCERN* and *BUSY* to be positive (i.e., ϕ_9, $\phi_{10} > 0$). I use *CONCERN* to control for audit problems related to the engagement that are expected to be positively correlated with audit fees. *BUSY* represents the "busy-season" during which most client-firms have their fiscal year-end. Consequently, audit fees are expected to be higher during this period because audit firms may engage additional expenses (e.g., staff overtime) or because they may offer discounts at other periods when staff resources are less occupied.

Following Ireland and Lennox [2002] and Chaney *et al.* [2004], I include the inverse Mills ratio (*IMR*) in order to control for potential endogeneity problems associated with auditor choice[105]. I make no prediction for the sign of this coefficient (i.e., ϕ_{11} = ?). Finally, I include fixed effect dummies for industry (two-digit SIC codes) and years to control for potential variations in audit fees across industries and over time.

Second Stage: Testing US-H6 - Market Size and Big-4 Premia

From eq. (4.11), I obtain the market specific intercepts, φ_{1j}, and Big-4 audit fee premia, φ_{2j}. Intercept φ_{1j} measures the (average) relative difference in audit fees between market *j* and a "representative" base market[106], controlling for labour cost differences, *CSTX*, and

[105] To obtain the inverse Mills ratio, I estimate the following probit auditor-choice model in the first stage (this is similar to models used in the literature (e.g., Ireland and Lennox [2002], Chaney *et al.* [2004], Choi and Wong [2007] and Choi *et al.* [2008a]):

$$\Pr(BIG4_{itj}) = \xi_0 + \xi_1 LNTA_{itj} + \xi_2 INVREC_{itj} + \xi_3 LOSS_{itj} + \xi_4 LEV_{itj} + \xi_5 NBS_{itj} + \xi_6 LNGDP_{itj} + (\textit{year fixed effects}) + e_{itj}$$

I add *LNGDP* (market size) because under US-H4, Big-4 audit value is increasing in market size and this has an impact on auditor choice. This variable has the advantage of being excluded from the audit fee model, eq. (4.11) (Ireland and Lennox [2002]) and may also capture other market characteristics associated with auditor choice. I also include fixed year effects to control for the impact recent regulatory changes (e.g., SOX) may have had on auditor choice *and* client choice by auditors (Ettredge *et al.* [2007] and GAO [2008]). Variables are as previously defined.

[106] Eq. (4.11) is estimated without a *general* intercept so that one market (*j* = *base*) is set as the general intercept with $\varphi_{1j} = \varphi_{2j} = 0$.

engagement specific factors. As stated above, this captures market specific characteristics which are excluded from eq. (4.11). Some of these characteristics are strictly unobservable; but others, such as market size, can be estimated and could also explain some of the variations in audit fees (at least the portion uncorrelated with *CSTX*). Notice that by excluding market size, eq. (4.11) is estimated under the null hypothesis, US-H6$_0$, that audit technology investments are constant in market size. In other words, in eq. (4.11), audit firms are assumed to possess equivalent audit technology in every market and thus have a constant cost structure.

As the theory suggests, Non-Big-4 audit firms are expected to employ an equivalent audit technology across markets as their investments in audit technology are (mostly) constant in market size. Hence, any cross-market variation in φ_{1j} is essentially assumed to be caused by unobservable local market characteristics which impact both Big-4 and Non-Big-4 audit fees in the same way. In fact, estimates for φ_{1j} should not exhibit any distinctive pattern with respect to market size, except perhaps a weakly positive relation to account for possibly increasing operating costs in market size uncorrelated with *CSTX*.

Estimates of φ_{2j} capture the (average) relative difference between Big-4 and Non-Big-4 audit fees in each specific market *j*, holding engagement costs constant; i.e., controlling for fluctuations in marginal audit costs caused by engagement specific factors, and observable *CSTX* and unobserved (captured by φ_{1j}) market characteristics. If, however, Big-4 auditors do invest more in process innovating audit technology and achieve greater economies of scale as market size increases, any costs savings will be captured by estimates of φ_{2j}. In other words, if US-H6$_0$ is rejected, Big-4 auditors' audit production costs should decrease in market size and a negative relation between estimates of φ_{2j} (i.e., Big-4 audit fee premia) and market size should be observed. Therefore, to test US-H6 formally I estimate the following model:

$$\varphi_{2j} = \omega_0 + \omega_1 LNGDP_j + \varepsilon_j \qquad (4.12)$$

Where variables are as defined above.

To estimate φ_{2j} with enough accuracy, I require that there be in each local market *j* a minimum of five Big-4 and five Non-Big-4 audits, over the total sample period, with sufficient data to estimate eq. (4.11). Also, as φ_{2j} is, by construct, the *average* Big-4 premium for market *j*, eq. (4.12) is prone to heteroskedasticity. This is because estimates of φ_{2j} from smaller markets with fewer valid observations will be less precise (i.e., noisier) and the variance of the error term will be negatively correlated with *LNGDP*. To address this, I estimate eq. (4.12) using weighted least squares (WLS) where weights are equal to the number of Big-4 audits in market *j* used in estimating eq. (4.11). As Wooldridge [2003, pp. 274-275] points out, eq. (4.12) corresponds to a special case where exact weights needed for WLS are known. In line with US-H6$_1$, I predict the coefficient on *LNGDP* to be negative: $\omega_1 < 0$. Consistent with the auditing literature, I also predict the *average* Big-4 premium across all local markets to be above zero; that is: $\omega_1 > 0$.

The research design I propose makes several contributions to the auditing literature. To my knowledge, eq. (4.11) is the first audit fee model to include both: (1) a precise proxy of audit firm labour costs, and (2) an interaction term to allow for differences between Big-4 and Non-Big-4 audit production processes. This design offers a significant advantage over current models as it explicitly captures the relative difference in the mix and amount of audit effort between Big-4 and Non-Big-4 auditors, holding engagement characteristics constant. The inclusion of a control for Big-4 audit firm market power, *BIG4*LNBIG4*, is also an important addition[107]. Overall, these control variables improve our understanding of differences between Big-4 and Non-Big-4 audit firms and the sources of the Big-4 audit fee premium (i.e., audit production processes differences and/or Big-4 market power). In standard audit fee models, these differences are restricted to load in a single Big-4 interaction term. I recommend using the augmented audit fee

[107] Choi *et al.* [2008a] is the only other study of which I am aware which includes a comparable variable. They include a "Big-4 dominance" (country level) variable measured as the difference between the market share of the smallest Big-4 auditor and that of the largest Non-Big-4 auditors in a given country and year. As the theory suggests, however, this "market power" variable should only affect Big-4 audit firm pricing (i.e., specific Big-4 interaction term) and is possibly more accurately measured by the number of Big-4 entrants, N_{B4}.

model in eq. (4.11) as the inclusion of the additional control variables is well motivated by theory, especially when the focus is on differences in Big-4 audit fee premium across varying audit markets.

Finally, I also believe the introduction of a "two stage" approach to investigate the relation between market specific Big-4 audit fee premia and a test variable to be an important innovation. As argued above, this controls for unobservable market conditions that affect operating costs and audit pricing. Controlling for this is especially important given the recent rise in the number of studies investigating differences in audit pricing across markets (local and national). In fact, I am aware of no study in the auditing literature which includes market (or region) fixed effects (i.e., dummy variables) in their audit fee model. Including these would potentially control for unobservable market characteristics and is a common practice in the industrial organisation literature (e.g., Ellickson [2006] and Dick [2007]). Another advantage of this approach is to limit the effect of multicollinearity when market specific control variables are potentially highly correlated with the test variable (e.g., *CSTX* and *LNGDP* in this study). As such, it offers a more powerful research design.

4.6 Sample, Descriptive Statistics and Results

4.6.1 Market Structure Analysis

Sample and Descriptive Statistics

Audit fee and auditor information are obtained from *Audit Analytics*. The initial sample consists of all observations for fiscal years 2002 to 2005 with available audit fee and auditor information (i.e., name and location of the engagement office)[108]. Client-firm total assets, industry membership and geographical segment data is obtained from *Compustat*; the number of geographical segments is assumed to be equal to one when no information is available. As discussed above, financial institutions (SIC 6000-6999), along with firm-year observations with total assets above $500 million or with more than

[108] Fiscal year is as defined by *Compustat*. I choose 2002 as the starting year to retain only audits performed post-Enron.

one reported geographical segment are excluded. Observations with total assets equal to $0 (or missing) or with missing industry information are excluded[109]. This results in a total of 12,380 audit engagements from 140 different local U.S. markets (Table 4.1).

Table 4.1 Sample Selection (all years)

Panel A: Number of Markets	**Market Size Category**					**All Markets**
	25b or less	**25b – 50b**	**50b – 100b**	**100b– 300b**	**300b+** [a]	
Base Sample Selection						
Available Fee and Auditor Data (U.S. Audits)[b]	77	21	22	17	3	**140**
LESS: Market-years with less than 3 valid observations	52	1	2	-	-	**55**
	25	**20**	**20**	**17**	**3**	**85**
Audit Quality Sample Selection						
Base Sample	25	20	20	17	3	**85**
LESS: Insufficient engagement specific information[c]	5	-	-	-	-	**5**
	20	**20**	**20**	**17**	**3**	**80**
Audit Fee Sample Selection						
Base Sample	25	20	20	17	3	**85**
LESS: Insufficient engagement specific information[d]	1	-	-	-	-	**1**
LESS: Insufficient total market observations[e]	23	10	5	-	-	**38**
	1	**10**	**15**	**17**	**3**	**46**

[109] When possible, this information is obtained from *Audit Analytics* when it is not available from *Compustat*. If the SIC code is not available, financial institutions are identified from their NAICS code when reported.

Table 4.1 (cont'd)

Panel B: Number of Audits (% Big-4)	**Market Size Category**					**All Markets**
	25b or less	**25b – 50b**	**50b – 100b**	**100b– 300b**	**300b+** [a]	
Base Sample Selection						
Available Fee and Auditor Data (U.S. Audits)[b]	736 (20%)	1273 (35%)	1561 (50%)	5590 (44%)	3220 (27%)	**12380** (38%)
LESS: Market-years with less than 3 valid observations	207 (24%)	8 (0%)	7 (86%)	- -	- -	**222** (25%)
	529 (19%)	**1265** (35%)	**1554** (50%)	**5590** (44%)	**3220** (27%)	**12158** (38%)
Audit Quality Sample Selection						
Base Sample	529	1265	1554	5590	3220	**12158**
LESS: Insufficient engagement specific information[c]	382 (11%)	775 (20%)	743 (35%)	2895 (30%)	1798 (18%)	**6593** (25%)
	147 (38%)	**490** (59%)	**811** (64%)	**2695** (59%)	**1422** (39%)	**5565** (54%)
Audit Fee Sample Selection						
Base Sample	529	1265	1554	5590	3220	**12158**
LESS: Insufficient engagement specific information[d]	297 (5%)	580 (13%)	507 (27%)	2102 (24%)	1255 (14%)	**4741** (19%)
LESS: Insufficient total market observations[e]	215 (35%)	190 (76%)	170 (93%)	- -	- -	**575** (66%)
	17 (53%)	**495** (44%)	**877** (55%)	**3488** (56%)	**1965** (36%)	**6842** (49%)

[a] These three markets are: New York – Newark – Edison. NY-NJ-PA ($902.7b GDP and 18.6m population); Los Angeles – Long Beach – Santa Ana. CA ($538.4.2b GDP and 12.7m population) and Chicago – Naperville – Joliet. IL-IN-WI ($405.6b GDP and 9.3m population).

[b] All available *Compustat* observations from 2002 to 2005 with available audit fee, auditor and auditor location information from *Audit Analytics* that can be matched to a U.S. Metropolitan Statistical Area (excluding San Juan, Puerto Rico); excluding: financial institutions (SIC 6000-6999), firm-year observations with total assets above $500 m or equal to $0 and firm-year observations with more than one reported geographical segment.

[c] As per data requirement for estimating eqs. (4.4) and (4.5). Also excludes client-firms with two or more auditors identified for a given year ("joint audits").

[d] As per data requirement for estimating eq. (4.11). Also excludes observations with two auditors identified for a given year ("joint audits") and client-firms for which the first year of available auditor information in the *Audit Analytics* database falls between 2002 and 2005.

[e] Excluding markets with less than five Big-4 and five Non-Big-4 valid observations to estimate eq. (4.11).

Restricting the sample to metropolitan areas automatically excludes very small markets with population below 50,000. Furthermore, I impose a minimum of three observations per market-year. This requirement is to ensure that a minimum of audit activity occurs in

a given market, for a given year, and that there is sufficient data to draw reliable inferences about market structure and audit firm conduct. This excludes a further 222 audits from 55 markets. All but 3 of these markets are very small with average annual GDP below $25 billion (Table 4.1, Panel A) with the majority of audits performed by Non-Big-4 auditors (Table 4.1, Panel B). As a result, the total sample consists of 12,158 audit engagements from a total of 85 different markets (across all years). The majority of these markets have an average annual GDP below $50 billion.

The number of observations per year is roughly constant (Table 4.2). However, the proportion of audits performed by Big-4 auditors is constantly declining from 2002 to 2005. This coincides with an increase in the number of auditor switches by small and medium companies from the Big-4 audit firms to smaller-tier auditors following the passage of SOX (Ettredge *et al.* [2007] and GAO [2008]).

Table 4.2 Sample Year Distribution

	All Years	2005	2004	2003	2002
Base Sample					
Markets	85	76	77	79	78
Audits	12158	2869	3189	3198	2902
% Big-4	38.3%	29.8%	33.5%	39.8%	50.3%
Audit Quality Sample					
Markets	80	71	72	73	73
Audits	5565	1408	1360	1420	1377
% Big-4	54.1%	43.6%	50.8%	57.7%	64.4%
Audit Fee Sample					
Markets	46	46	46	46	46
Audits	6842	1587	1734	1828	1693
% Big-4	49.3%	40.9%	45.9%	52.4%	57.4%

Table 4.3 presents a snapshot of the U.S. audit industry, based on the data from the sample. It confirms the national dominance of the Big-4 audit firms. These firms have

cumulative market shares[110] ranging from 78.8% to 65.5% and are collectively present in almost every market. The decline in Big-4 market share of the small to medium company market segment is again associated to the passage of SOX. Over the same period, Big-4 firms have also exited a few markets. Nationally, individual Big-4 audit firms have roughly equal market shares, except perhaps Ernst & Young with about 25% of market share. Table 4.3 also shows that Grant Thornton and BDO distinguish themselves among Non-Big-4 auditors and have been gaining important market shares over the sample period. Other auditors have very limited market presence overall.

[110] Market share, concentration statistics and other measures of market dominance presented are all based on audit fees.

Table 4.3 Sample National Market Shares and Presence

	Full Sample		Year							
			2005		2004		2003		2002	
	Market Share	Markets Present	Market Share	Markets Present	Market Share	Markets Present	Market Share	Markets Present	Market Share	Markets Present
Big-4										
PWC	15.9%	50	14.5%	40	18.0%	47	16.0%	49	15.1%	51
EY	24.6%	54	24.0%	48	24.6%	51	25.5%	52	24.8%	52
DT	16.4%	56	14.5%	45	14.1%	48	19.3%	49	20.8%	54
KPMG	15.3%	60	12.5%	51	17.7%	51	14.6%	57	17.3%	55
All Big-4	**72.4%**[a]	**72**	**65.5%**	**63**	**74.5%**	**66**	**75.4%**	**70**	**78.8%**[b]	**70**
National Audit Firms										
GT	5.3%	34	7.9%	28	4.3%	28	3.7%	26	4.1%	30
BDO	4.4%	23	5.5%	20	4.7%	19	3.5%	19	3.0%	21
RSM-McGladrey	0.5%	16	0.9%	11	0.4%	11	0.3%	12	0.3%	11
All National	**10.3%**	**43**	**14.3%**	**37**	**9.3%**	**35**	**7.6%**	**35**	**7.4%**	**38**
All Small Auditors	**17.3%**	**76**	**20.3%**	**63**	**16.2%**	**68**	**17.0%**	**67**	**13.8%**	**67**
Max market share	0.7%		0.9%		0.6%		0.6%		0.7%	
Average market share	0.03%		0.06%		0.04%		0.04%		0.03%	
Total offices	639		409		424		481		492	
Total auditors	563		366		385		444		454	

[a] Includes market shares of 0.1% for Andersen.
[b] Includes market shares of 0.7% for Andersen.

Results

Lower bound parameter estimates for eq. (4.1) and Weibull parameter estimates for eq. (4.2) are reported in Table 4.4. For the sake of brevity, I present in the last two columns only the average coefficient estimates from year-specific estimations of the lower bound (2001 to 2005). Except for 2004, results are almost identical in every year.

Table 4.4 Lower Bound Estimates

Parameter estimates from eq. (4.1): $\tilde{C}_{nj} = a + \frac{b}{\ln(MKTSIZE_j)} + \frac{c}{(\ln(MKTSIZE_j))^2} + e_j$, where $\tilde{C}_{nj} = \ln\left(\frac{C_{nj} + \varepsilon}{1 - C_{nj} + \varepsilon}\right)$, C_{nj} is the share of audit fees of the *n* leading audit firms in market *j* and ε = 0.001. Standard errors are in parentheses.

Parameters (predicted sign)	**Lower Bound Estimates on Mean C_n** (full sample)			**Average of Lower Bound Estimates** (Year specific estimations)	
	C_1	***C_4***		***C_1***	***C_4***
a	1.9	17.3		5.7	14.1
(?)	(0.9)***	(1.4)***		(0.9)[b]	(2.0)[b]
b	-100.9	-435.3		-199.8	-349.9
(-)	(20)***	(27.9)***		(19.3)[b]	(43.1)[b]
c	714	2727		1332	2163
(+)	(108)***	(134)***		(106)[a]	(230)[b]
α	0.53	0.66		0.36	0.51
(+)	(0.05)***	(0.07)***		(0.04)[a]	(0.06)[a]
s	1.45	3.16		1.39	3.25
(+)	(0.3)***	(0.52)***		(0.43)[a]	(0.74)[a]
C_1^∞ / C_4^∞	0.87	1.00[†]		1.00[†]	1.00[†]
[95% interval]	[0.83, 0.99]	[1, 1]	**Average** C_1^∞ / C_4^∞	0.75	0.87
Number of markets	85		**Mean number of markets [min, max]**	77.5 [76, 79]	

*** Significant at the 0.1% (or less) significance level respectively, using two-sided tests (one-sided if sign predicted).

[†] Approximation of 1 - ϵ, where ϵ is an extremely small number.

[a] Year specific parameters significant at 1% level (or less) in every year.

[b] Year specific parameters significant at 1% level (or less) in every year except 2004 (non significant)

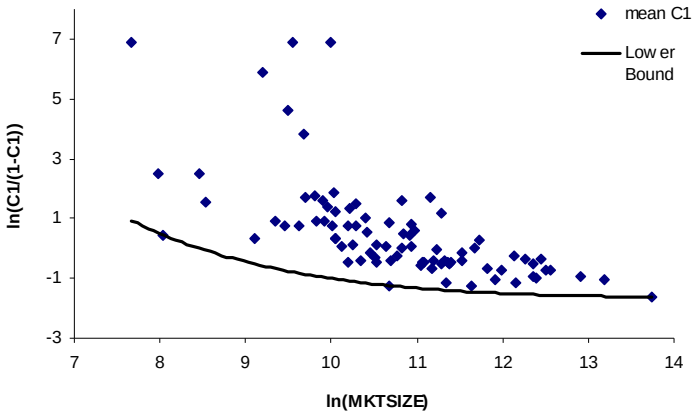
Figure 4.1, Panel A fits the lower bound estimates to the one-firm concentration ratio. The left side is based on the average one-firm concentration ratio for years 2002 to 2005 ($\overline{C}_1$). The right side shows year-specific one-firm concentration ratios and presents the

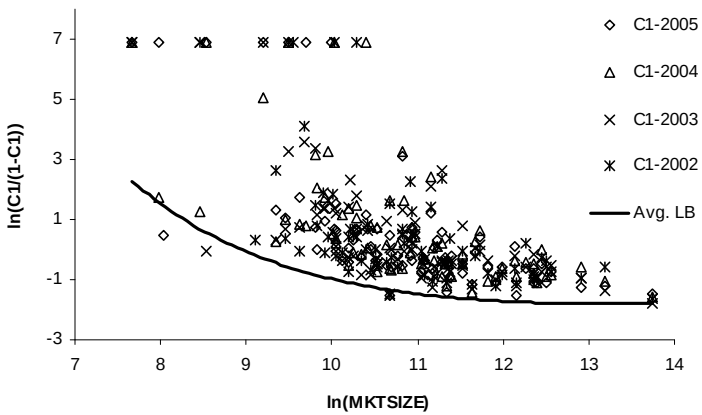
average lower bound (i.e., average lower bound coefficients). Panel B presents the four-firm concentration ratios in the same manner. The scatter of points in Figure 4.1 is consistent with the multiplicity of equilibria expected in the audit industry, although there appears a clear lower bound to concentration. Indeed, the intercept a of the lower bound is strictly positive in every estimations ($a > 0$), with the exception of the lower bound estimated for 2004 (C_1 and C_4). By any measure, the limiting level of concentration as market size goes to infinity is bounded well above 0 (i.e., $C_n^{\infty} > 0$). Overall, the evidence rejects the null hypothesis US-$H1_0$ that auditor concentration converges asymptotically to zero.

Estimates for parameters b and c of the lower bound are consistent with predictions; in all cases (except 2004) b is strictly negative ($b < 0$) and c is strictly positive ($c > 0$). Again, the empirical evidence rejects the null hypothesis US-$H2_0$ that the market size-structure relationship is monotonic.

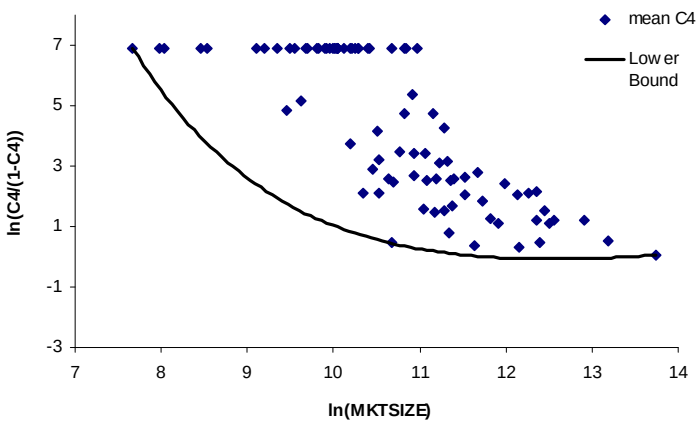
Figure 4.1 Quadratic Lower Bound to Concentration

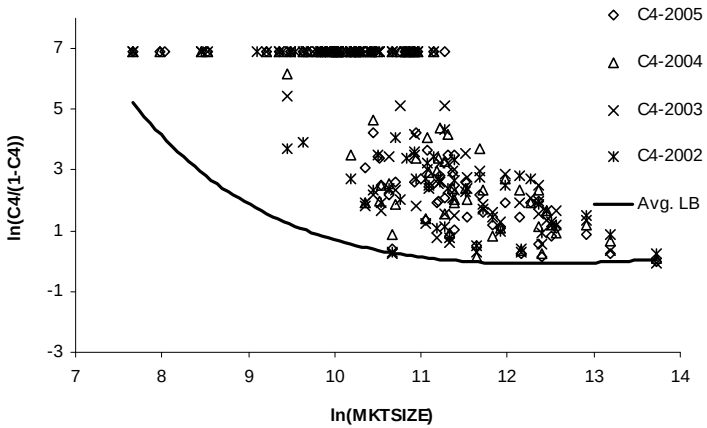
Panel A – One-firm Concentration Ratio (C_1)





Panel B – Four-firm Concentration Ratio (C_4)





From Table 4.5, it is also clear that the audit industry remains highly concentrated in all markets with the average (median) one-firm concentration ratio, C_1, per market size category never falling below 23% (26.2%)[111]. The average (median) size of Non-Big-4 auditor local offices across different markets is roughly constant at about $300,000 ($100,000) annual office audit fee revenues (from small-medium, non-financial company audits). Not surprisingly, the number of Non-Big-4 auditors entering is greater in larger markets. On the other hand, as expected, the size of Big-4 auditor local offices is steadily increasing in market size. In the smallest markets, average (median) annual Big-4 office audit fee revenues were about $600,000 ($400,000). Local Big-4 office revenues increase to an average (median) of $3.2 million ($2.1 million) in markets with average annual GDP between $100 billion and $300 billion. And in the three largest markets, respectively Chicago, Los Angeles and New York, local Big-4 offices generated on average (median) $7 million ($5.9 million) in audit fees from small-medium, non-financial company audits. Clearly, the evidence supports US-H3a$_1$ that Big-4 office size increases with market size.

[111] Although concentration and Big-4 cumulative market share is slightly decreasing from 2002 to 2005, individual year results are equivalent. For parsimony, I only present the results from the pooled sample.

Table 4.5 Mean (Median) Market Structure by Market Size Category (all years)

Market Category	25b or less	25b – 50b	50b – 100b	100b – 300b	300b+ [a]	All Markets
C1 (%)	80.6 (82.7)	53.7 (51.1)	50.1 (39.7)	36.2 (33.2)	23.7 (26.2)	56.2 (51.6)
C4 (%)	100 (100)	95.5 (99.3)	92.4 (94.8)	80.3 (82.3)	63.8 (62.9)	91.9 (97.8)
Big-4 Cummulative Market Shares (%)[b]	44.3 (48.8)	71 (80.6)	82.6 (88.7)	76.9 (76.7)	62.9 (62.9)	66.8 (81.1)
HH Index	0.74 (0.73)	0.42 (0.38)	0.38 (0.29)	0.23 (0.24)	0.13 (0.14)	0.46 (0.38)
Number of Big-4 Auditors per Market-Year	0.6 (1)	2.4 (2.4)	3.1 (3.1)	4 (4)	4 (4)	2.4 (2.8)
Number of Non-Big-4 Auditors per Market-Year	1.6 (1.5)	2.8 (1.6)	4 (2.9)	12 (9.3)	46.6 (42.3)	6.1 (2.3)
Big-4 Market Total Annual Fees ($m)[c]	0.6 (0.4)	0.6 (0.4)	1.2 (0.7)	3.2 (2.1)	7 (5.9)	2.1 (1)
Non-Big-4 Market Total Annual Fees ($m)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.3 (0.1)	0.5 (0.1)	0.3 (0.1)
Total Big-4 Audits[b]	99	440	780	2458	878	4655
Total Non-Big-4 Audits	430	825	774	3132	2342	7503
Number of Markets	25	20	20	17	3	85

[a] These three markets are: New York – Newark – Edison. NY-NJ-PA ($902.7b GDP and 18.6m population); Los Angeles – Long Beach – Santa Ana. CA ($538.4.2b GDP and 12.7m population) and Chicago – Naperville – Joliet. IL-IN-WI ($405.6b GDP and 9.3m population).

[b] Includes a total of 99 Andersen audits performed in 2002.

[c] Excludes annual total fees for Andersen (2002 only) given that the firm only performed a few audits in that year before it ceased its operations following the Enron debacle.

Finally, Big-4 auditors' relative dominance of local audit markets is evident from Table 4.6. For example, the leading auditor (i.e., auditor with the most market share in a given market) was a Big-4 in 67 of the 85 markets represented in the sample (78.8%)[112]. However, local Big-4 dominance varies with market size. As predicted, Big-4 auditors dominate less often in smaller markets. In the 28 smallest markets (bottom 30%), a Big-4 auditors is the local market leader in less than 50% of the markets (13 markets). In the 28 largest markets (top 30%) the Big-4 auditors dominate and lead in all markets. The

[112] Big-4 dominance of local markets decreases in 2005 but remains high (75% of markets). Overall, individual year results are equivalent. For parsimony, I only present the results from the pooled sample (ranking based on auditor average market share from 2002 to 2005).

conclusion is the same when considering the second leading auditor and, to a lesser extent, the third leading auditor. Overall, there is strong support for US-H3b that Big-4 auditors lead more often in larger markets.

Table 4.6 Leading Auditors per Market (all years)

	Auditor Rank (based on market share)			
	1st	**2nd**	**3rd**	**4th**
Panel A: All Markets				
Number of top auditors	85	82	70	62
PWC	7.1%	17.1%	20.0%	12.9%
DT	15.3%	22.0%	18.6%	11.3%
EY	32.9%	9.8%	11.4%	11.3%
KPMG	23.5%	19.5%	15.7%	9.7%
% Big-4[a]	78.8%	69.5%	67.1%	46.8%
Average (median) market share	53.1% (48.9%)	25.9% (25.4%)	15.9% (15.2%)	10.1% (9.7%)
Panel B: Small Markets ($26.6b and less)				
Number of top auditors	28	25	14	9
% Big-4[b]	46.4%	28.0%	35.7%	0%
Average (median) market share	75.9% (74.1%)	27.6% (27.2%)	17.6% (17.2%)	11.7% (10.6%)
Panel C: Mid Markets ($26.7b – $72.6b)				
Number of top auditors	29	29	28	25
% Big-4[c]	89.7%	82.8%	60.7%	44.0%
Average (median) market share	50.3% (46.3%)	29.0% (29%)	15.7% (14.9%)	8.7% (7.3%)
Panel D: Large Markets ($72.7b and above)				
Number of top auditors	28	28	28	28
% Big-4	100.0%	92.9%	89.3%	64.3%
Average (median) market share	33.1% (31.9%)	21.2% (20.2%)	15.3% (14.2%)	10.8% (10.2%)

[a] Includes Andersen (one 2nd rank, one 3rd rank and one 4th rank).
[b] Includes Andersen (one 2nd rank and one 3rd rank).
[c] Includes Andersen (one 4th rank).

Robustness Tests and Discussion

Results of the market structure analysis are consistent with predictions derived from the ESC framework. That is, the auditing industry is naturally concentrated and dominated by a small set of large, high-quality auditors (i.e., Big-4s), whose product (relative) value increases with market size. Other models could, however, offer alternative explanations for the documented market structure (e.g., Ellickson [2006] and Dick [2007]). I formally address these possibilities here.

One such possibility is that horizontal product differentiation may drive the observed market structure without endogenous capital investments playing a significant role. Indeed, models of pure horizontal product differentiation with sequential entry allow for persistent concentration resulting from product proliferation. In such settings, entrants isolate themselves to dampen the effect of price competition by carving out continuous segments of the product space. Essentially, firms operate as local monopolies within their segment of the product space, making it difficult for new entrants to compete "locally" with the dominant firm. Hence, concentration remains high even as market size increases. A direct consequence of this is that firms do not compete head to head and operate essentially in isolation in different submarkets. This is in sharp contrast with the ESC model which implies that firms compete head to head locally[113].

In the auditing industry, horizontal product differentiation can be thought of as auditor client-firm industry specialisation. Specific industry knowledge and expertise is a significant factor considered by client-firms when choosing an auditor (e.g., GAO [2003b, 2008] and Oxera Consulting [2006]). Furthermore, Big-4 auditors organise their audit practices along client-industry lines. The fundamental question, however, is whether horizontal, rather than vertical, product differentiation explains the current structure of the auditing industry. That is, do Big-4 audit firms operating in a given geographic market strategically concentrate their operations in client-industries where

[113] In fact, under the ESC framework, it is precisely because firms compete head to head that they embark on a "race for quality" (and/or production efficiency) through a series of fixed-cost investments to enhance the value of their products. If, on the other hand, firms successfully isolate themselves from their competitors by monopolizing specific segments of the product space, there is less need to vertically differentiate their products through fixed-cost investments.

other Big-4 audit firms are not present? If such a product differentiation strategy were widespread and successful, it could question the merits of the ESC framework and the importance of endogenous fixed costs for explaining the structure of the auditing industry. Specifically, if industry specialisation is the dominant strategy and is achieved with little or no capital investment, the quality (and production efficiency) escalation mechanism which drives the natural oligopoly result would falter, and so would the positive link between market size and Big-4 audit value[114]. I formally test for this link in the next section; but for now, I focus on market structure and on the form of local competition between Big-4 audit firms.

To assess whether Big-4 auditors compete head to head in local geographical markets, I subdivide each local MSA market into client-firm industry submarkets. Client-firm industry segments are as defined in Frankel *et al.* [2002][115]. In Table 4.7, I present the distribution of national market shares by client-firm industry segments, based on the full sample (i.e., pooled across all years). On a national scale, industry specific market shares are overall evenly distributed between Big-4 auditors, especially in the largest industries. With the exception of a few industry lines, no Big-4 auditor clearly dominates an industry with more than 40% of the cumulative Big-4 market share for that industry (i.e., Big-4 *i* market share of industry *k*, divided by total Big-4 market share of industry *k*). "Utilities" is clearly dominated by Deloitte, although this is a small industry group in the sample. Only one large industry segment, "Pharmaceutical", could potentially qualify as being dominated by one Big-4 auditor with Ernst and Young obtaining 54% of the Big-4 market share for that segment (43% in total). On a national scale at least, it appears that

[114] As explained previously (Section 4.3.3), if developing client-firm specific industry expertise is achieved mostly through capital investments, the distinction between vertical and horizontal product differentiation becomes trivial and the intuition behind the simple ESC model presented still holds. The concern raised here is if auditor industry specialisation is achieved (mostly) without cost, for example, simply from the experience gained performing audits in a given industry (i.e., learning by doing). If this were the case, audit quality would evolve from experience rather than investments in technology, and audit firms would organise around separate client-industry submarkets.

[115] Using 2-digit SIC code would be too fine of a division resulting in artificially small and highly concentrated local submarkets. The classification proposed here results in 14 client-firm industry segments which closely match the description (and number) of the industry sectors that Big-4 audit firms present on their U.S. corporate websites.

Big-4 audit firms do compete head to head in different client-firm industry segments[116, 117].

Table 4.8 presents the frequencies of each possible market-submarket configuration for local MSA market-years where two or more Big-4 auditors operate (with at least two audits performed in any submarket-year). If Big-4 auditors entering a local market compete head to head, the occurrence of local submarket Big-4 monopolies should be relatively infrequent. In Panel A, Big-4 auditors are identified as operating in a given submarket-year if they perform locally at least one audit in the client-firm industry segment for that year. I use a more restrictive classification criterion in Panel B, where a Big-4 auditor is identified as operating in a given submarket-year if they have at least a 15% share of total Big-4 audit fees from the local client-firm industry segment for that year. In any case, submarkets where only one Big-4 auditor audits client-firms from a given industry segment are rare when two or more Big-4 auditors are present in an MSA (in a given year). Most often, submarkets are defined as duopolies and 3-opolies.

[116] Interestingly, all Big-4 auditors present themselves on their U.S. corporate websites as "industry experts" in roughly all the same, broadly defined, industry lines. Hence, it seems difficult to clearly identify an industry leader, as Big-4 auditors can usually claim industry experience in most industry segments.

[117] GAO [2003b] analyses national market shares by client-firm industry segments. They use 2-digit SIC code and find that most submarkets are usually dominated by two Big-4 auditors. While their market segmentation is very fine, the evidence still suggests that client-firm industry submarkets are, at the very least, structured as oligopolies, not monopolies. This is consistent with the ESC model.

Table 4.7 National Market Shares by Industry (full sample)

Industry	Audit Fees ($m) (audits)	Market Share: % of Audit Fees					
		Big-4[a]	PWC	EY	DT	KPMG	Non-Big-4
Agriculture	8.6 (66)	70%	34%	18%	8%	11%	30%
Mining and construction	46.5 (424)	67%	20%	22%	10%	14%	33%
Food	41.2 (280)	63%	17%	10%	26%	10%	37%
Textile and printing/publishing	78.8 (401)	81%	12%	25%	26%	18%	19%
Chemicals	22.2 (244)	52%	8%	14%	21%	9%	48%
Pharmaceutical	244.0 (1291)	79%	15%	43%	9%	13%	21%
Extractive	81.2 (614)	54%	8%	19%	7%	21%	46%
Durable Manufactures	376.1 (2253)	65%	18%	20%	17%	11%	35%
Transportation	178.6 (737)	78%	20%	26%	13%	18%	22%
Utilities	85.2 (234)	85%	6%	3%	69%	7%	15%
Retail	340.0 (1416)	80%	16%	22%	23%	19%	20%
Services	379.4 (2046)	73%	16%	27%	11%	19%	27%
Computers	353.1 (1752)	70%	18%	27%	10%	15%	30%
Other	15.5 (400)	27%	3%	11%	7%	6%	73%
Total	**2 250.5 (12158)**	**72%**	**16%**	**25%**	**16%**	**15%**	**28%**

Industry membership is defined as in Frankel *et al.* [2002] and is determined by SIC code as follows: agriculture (0100–0999), mining and construction (1000–1999, excluding 1300–1399), food (2000–2111), textiles and printing / publishing (2200–2799), chemicals (2800–2824, 2840–2899), pharmaceuticals (2830–2836), extractive (1300–1399, 2900–2999), durable manufacturers (3000–3999, excluding 3570–3579 and 3670–3679), transportation (4000–4899), utilities (4900–4999), retail (5000–5999), services (7000–8999, excluding 7370–7379), computers (3570–3579, 3670–3679, 7370–7379) and other (9000-9999). Financial institutions (6000-6999) are excluded.

[a] Does not always add to the sum of individual Big-4 auditors' market share because of rounding and because of the inclusion of 99 Andersen 2002 audits.

Table 4.8 Big-4 Local Market-Submarket Configuration: Frequency (submarket-year)

Panel A: Count when a Big-4 auditor performs at least one audit in submarket-year

Big-4 auditors operating in industry submarket-year	Big-4 auditors operating in market-year				
	2	**3**	**4**	**Total**	
Monopoly	22	14	61	97	13%
Duopoly	27	50	257	334	44%
3-opoly	-	13	183	196	26%
4-opoly	-	-	132	132	17%

Panel B: Count when a Big-4 auditor has at least 15% of total Big-4 audit fees for submarket-year

Big-4 auditors operating in industry submarket-year	Big-4 auditors operating in market-year				
	2	**3**	**4**	**Total**	
Monopoly	31	23	140	194	26%
Duopoly	18	50	349	417	55%
3-opoly	-	4	127	131	17%
4-opoly	-	-	17	17	2%

Table 4.9 investigates monopolistic submarkets further. From the table it is clear that the vast majority of monopolistic submarkets identified in Table 4.8 are vey small, with only 2 or 3 audits performed in the client-firm industry local submarket segment for a given year. For the most part, these submarkets are probably too small anyway to accommodate more than one Big-4 auditor. This confirms further that Big-4 auditors do not shy away from direct competition with other Big-4 auditors operating locally and do not isolate themselves in separate client-firm industry submarkets.

Table 4.9 Number of Big-4 Audits in Big-4 Monopolist Submarkets

Number of Big-4 audits in submarket-year	Big-4 auditor performs at least on audit	Big-4 auditor has at least 15% of total Big-4 audit fees for submarket-year
2	69 (71%)	105 (54%)
3	22 (23%)	35 (18%)
4	6 (6%)	17 (9%)
5		9 (5%)
6		8 (4%)
7+		20 (10%)
Total monopolistic submarket-years	**97**	**194**

This is a significant finding in itself as it suggests that Big-4 auditor expertise, while an important attribute of the audit product, is not the dominating (or only) force driving competition between Big-4 auditors[118]. In other words, all Big-4 auditors develop and advertise industry expertise but offer, in reality, a relatively homogenous (high-quality) product and all may generally be well positioned to compete locally in most industry segments. The point here, again, is not that industry expertise does not play a role in Big-4 audit firm competition. Rather, I argue that vertical product differentiation and the mechanism proposed by the ESC framework should also be considered when investigating Big-4 audit firm competition and its implications on market structure, audit quality and audit fees[119]. This is an important point to consider given the recent rise in studies investigating the role of Big-4 audit firm national *and* local market industry expertise (e.g., Ferguson *et al.* [2003], Francis *et al.* [2005] and Ferguson *et al.* [2006]).

[118] This is different for Non-Big-4 auditors. Given their small size, it is usually optimal for these audit firms to specialise in niche markets. However, the focus here is on Big-4 audit firms' competition strategies.

[119] The ESC framework proposes that while Big-4 auditors all offer homogenous high-quality audits in equilibrium, it is the "desire" to vertically differentiate their products from their peers that drives fixed-costs investments in audit technology (note: Big-4 audits are vertically differentiated from Non-Big-4 audits). As explained throughout this thesis, this mechanism has significant implications on market structure, audit quality and audit fees.

Indeed, this literature implicitly builds on the assumption that Big-4 audit firms compete through horizontal product differentiation[120].

Furthermore, the implications that Big-4 audit firms compete head to head suggest that competition in the auditing industry is healthy and dynamic, despite the high level of concentration. In fact, concerns that the choice of Big-4 auditors with specific client-firm industry expertise available to client-firms is too limited may be exaggerated (e.g., GAO [2003b, 2008]).

Another explanation for the high level of market concentration is if Big-4 audit firms' entry costs into local markets are very significant. This is equivalent to models where exogenous scale economies limit market entry. As explained in Section 3.4, however, this type of model cannot account for the escalation in Big-4 audit value as market size increases. Even without considering this correlation, the results from the market structure analysis alone do not support the hypothesis that exogenous local setup costs are high. Indeed, Big-4 auditors are not restricted to only large markets and the number entering a local market converges to at least three relatively quickly (Table 4.5).

Alternatively, fixed costs (exogenous or endogenous) could be incurred almost exclusively at the national partnership level and "financed" by local Big-4 audit practices according to their respective size. In this setting, entry in local markets would not be as constrained but the auditing industry would remain highly concentrated nonetheless in all markets given the significance of fixed costs at the national level. While a great deal of

[120] In fact, the argument presented here is consistent with findings from this literature. For example, Ferguson *et al.* [2003, 2006] for Australia, and Francis *et al.* [2005] for the U.S., document that (Big-4) industry expertise audit fee premium exists only when the Big-4 auditor is the industry leader *both* locally (i.e., city) and nationally. When the auditor is only a national industry leader or a city-level industry leader, the fee premium is insignificant. Menon and Williams [2001] also find no evidence that Big-4 auditors obtain any price premium from industry specialisation. Overall, this demonstrates that horizontal product differentiation, measured by industry leadership, to successfully dampen the effects of price competition is very difficult to achieve. That is, Big-4 auditors can only hope to effectively shield themselves from price competition in limited industry segments where they truly dominate at all levels (nationally and locally). Given the distribution of Big-4 market shares across client-firm industry segments, this strategy of horizontal product differentiation seems limited and likely implies that other forms of competition are also important. Of course, a more formal test would be needed to investigate whether Big-4 industry specific market shares are static over time. This is outside the scope of this thesis.

investment initiatives are indeed decided at the national level, this setting, however, cannot explain the escalation in Big-4 audit value as local market size increases (see Section 4.4.2). This is because all local member firms of a Big-4 partnership would be expected to have the same cost structure across all markets. Results from the audit fee analysis below reject this possibility.

Moreover, local market structure would generally closely resemble the market structure at the national level. This is generally not the case as there is much variation in market structure across different local markets, suggesting that some level of strategic investments (i.e., endogenous) occurs locally. Nationally, individual Big-4 audit firms have roughly equal market shares. Based on the data presented in Table 4.3, a Hirschman-Herfindahl Index (HHI) calculated on Big-4 audit firms' market share only would be equal to 0.261, which is close to the theoretical HHI of 0.25 (i.e., ¼) if all Big-4 audit firms had an equal share of total Big-4 audit fees. Yet, in most markets, HHI calculated on Big-4 audit firms' market share only (HHI^{B4})[121] is different from the theoretical HHI^{B4} when all Big-4 entrants have equal market shares (i.e., 1 over the number of Big-4 audit firms entering the local market). The average difference between the two HHI^{B4} is 0.088.

Finally, results from the market structure analysis are generally robust to research design choices. Although not reported, results are robust to: (1) alternative "cut-off" points for the minimum number of valid observations required by market-year; (2) different constant ε added to determine $\widetilde{C}_{nj} = \ln\left(\frac{C_{nj}+\varepsilon}{1-C_{nj}+\varepsilon}\right)$ used to estimate eq. (4.1) (i.e., ε = 0.01 or 0.0001); (3) alternative definitions of audit firm market share (i.e., total audit fees, number of audits and total assets); and (4) the inclusion of financial companies (SIC 6000-6999).

[121] Specifically, I calculate the HHI based on individual Big-4 auditor's share of total Big-4 audit fees in a given market-year. This is equal to a Big-4 audit firm's market share based on all audit fees in a market (i.e., "real" market share), divided by the cumulative market share of audit fees of all Big-4 audit firms in the market. In other words, HHI^{B4} is a measure of concentration within the Big-4 market segment.

4.6.2 Big-4 Audit Value Analysis

Results

Parameter estimates for the regression of Big-4 cumulative market shares on market size (eq. (4.3)) are presented in Table 4.10. Because heteroskedasticity is potentially a problem, I report t-statistics based on heteroskedasticity-consistent standard errors[122]. I also report eq. (4.3) coefficient estimates for the average Big-4 cumulative market shares from 2002 to 2005 using weighted least squares (WLS), where weights are defined as the number of years used in deriving the average cumulative market share for a given market. In all cases, the coefficient on *LNGDP* is greater than zero at the 5% or lower significance level; i.e., $\beta_1 > 0$.

[122] However, given the small sample size (between 76 and 85 observations), standard White heteroskedasticity-consistent standard errors (known as HC0) are inappropriate. Rather, I use HC3 standard error known to perform well in samples with less than 250 observations (Long and Ervin [2000]). I use HC3 for all OLS regressions thereafter with small samples and when heteroskedasticity is a potential problem.

Table 4.10 Regression of Cumulative Big-4 Market Shares on Market Size – eq. (4.3)

Parameters (predicted sign)	Regression Estimates (t-stats)[a]						
	Average Big-4 Market Shares[b]		Year Specific (OLS)				
	WLS	OLS	Average (avg. t-stat)	2005	2004	2003	2002
Intercept	-0.377	-0.550	-0.366	-0.707	-0.424	-0.114	-0.220
(?)	(-0.95)	(-1.44)	(-0.9)	(-1.87)†	(-1.0)	(-0.25)	(-0.48)
LNGDP	0.098	0.113	0.097	0.120	0.103	0.077	0.088
(+)	(2.79)**	(3.32)***	(2.59)	(3.56)***	(2.74)**	(1.89)*	(2.19)*
R^2 *(avg. R^2)*	0.12	0.15	*(0.12)*	0.16	0.13	0.07	0.10
Observations	85	85	4	76	77	79	78

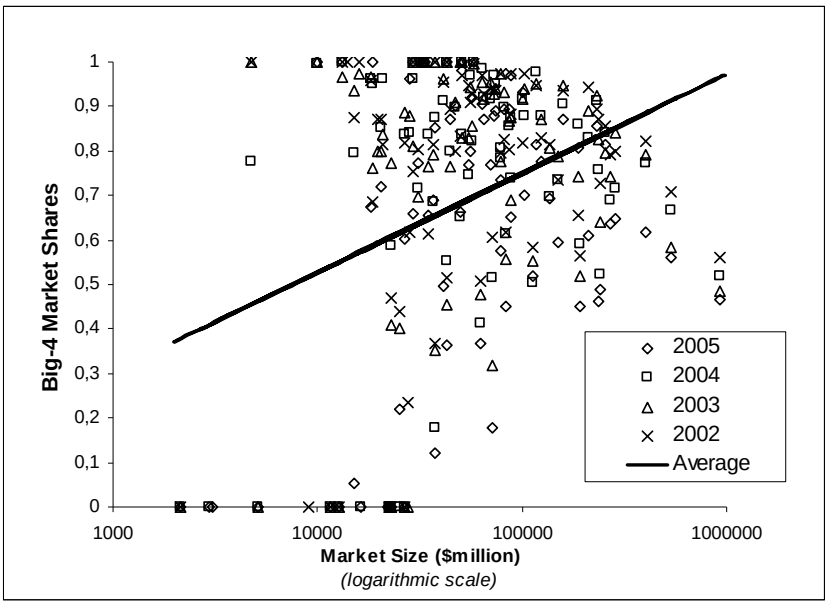
†, *, **, *** Significant at the 10%, 5%, 1% and 0.1% significance level respectively, using two-sided tests (one-sided if sign predicted).

[a] OLS t-statistics using HC3 standard errors.

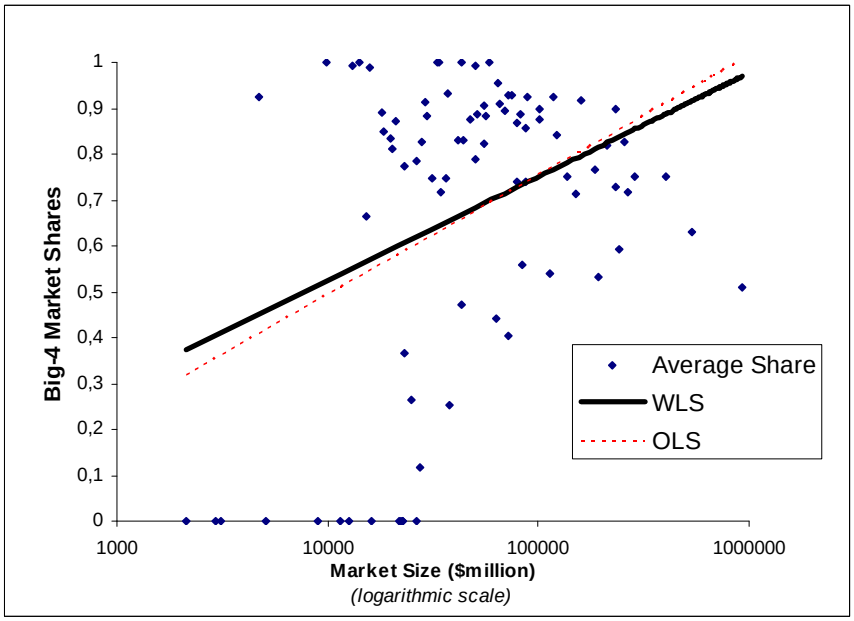
[b] Average Big-4 cumulative market shares are equal to the average of year-specific per market Big-4 cumulative market shares calculated from 2002 to 2005. Weights are equal to the number of years used in deriving the average cumulative market share for a given market.

The relation between market size and the cumulative market shares of the Big-4 auditors is illustrated in Figure 4.3. The positive correlation is clear and is consistent with the hypothesis that the value of Big-4 audits, relative to Non-Big-4 audits, is increasing in market size. Thus, the null hypothesis US-$H4_0$ is rejected.

Figure 4.2 Big-4 Cumulative Market Shares with Market Size
Panel A - individual years



Panel B - average Big-4 market shares



Robustness Tests and Discussion

As a robustness test, I control for the number of Big-4 and Non-Big-4 auditors operating in a given market.

$$B4SHARE_j = \eta_0 + \eta_1 LNGDP_j + \eta_2 LNB4_j + \eta_3 LNNB4_j + \varepsilon_j \qquad (4.13)$$

Where *LNB4* and *LNNB4* represent, respectively, the natural log of the number of Big-4 and Non-Big-4 auditors operating in a given market (for a given year). The objective is to control for supply constraints which can impact the cumulative market share of each auditor group. Of course, the decision to enter or exit a local market is itself linked to the market share an auditor can hope to secure. Hence, results from eq. (4.13) should be interpreted with caution as endogeneity may be a problem. On the other hand, *LNB4* and *LNNB4* may capture unobservable market characteristics correlated with market size which can affect audit firms' market positioning. I predict a positive coefficient on *LNB4* (i.e., $\eta_2 > 0$) and a negative coefficient on *LNNB4* (i.e., $\eta_3 < 0$).

I estimate eq. (4.13) separately for each year[123] and present the results Table 4.11. The number of observations (i.e., markets) is lower than for estimating eq. (4.3) since including *LNB4* and *LNNB4* requires that there be at least one auditor of each type operating in each market. The magnitude of the coefficient on *LNGDP* is only slightly lower than for eq. (4.3). The significance level is also generally the same, except for 2005 where the coefficient is only significant at the 10% level. As expected, coefficients on *LNB4* are significantly positive, while coefficients on *LNNB4* are significantly negative. A negative coefficient on *LNNB4* suggests that Non-Big-4 auditors are somewhat successful in competing against Big-4 auditors, possibly by occupying niche markets. Despite this, the Big-4 audit firms' cumulative market share is still increasing in market size, indicating that the value of their audits is increasing in market size.

[123] Estimating eq. (4.13) on average Big-4 cumulative market shares and the natural log of the average number of Big-4 and Non-Big-4 auditors is not adequate since market shares evolve more rapidly than auditor market entry/exit.

Table 4.11 Robustness Check: Regression of Cumulative Big-4 Market Shares on Market Size and Number of Auditors - eq. (4.13)

Parameters (predicted sign)	Regression Estimates (t-stats)[a]				
	Average (avg. t-stat)	2005	2004	2003	2002
Intercept	-0.143	-0.164	-0.059	-0.313	-0.035
(?)	(-0.39)	(-0.32)	(-0.19)	(-0.97)	(-0.1)
LNGDP	0.084	0.082	0.074	0.106	0.075
(+)	(2.58)	(1.66)†	(2.61)**	(3.89)***	(2.15)*
LNB4	0.175	0.187	0.194	0.160	0.159
(+)	(2.09)	(1.72)*	(1.8)*	(2.4)*	(2.43)**
LNNB4	-0.165	-0.182	-0.157	-0.183	-0.138
(-)	(-6.59)	(-4.99)***	(-6.13)***	(-8.97)***	(-6.26)***
R^2 *(avg. R^2)*	0.59	0.51	0.61	0.73	0.49
Observations	4	47	51	51	59

†, *, **, *** Significant at the 10%, 5%, 1% and 0.1% significance level respectively, using two-sided tests (one-sided if sign predicted).
[a] OLS t-statistics using HC3 standard errors.

Overall, results support US-H4$_1$. Of course, the test I propose for US-H4 offers only a crude estimation of the relation between market size and Big-4 audit value. This is why any conclusion regarding US-H4 should be interpreted in light of the results for specific tests on Big-4 audit quality (US-H5) and Big-4 audit fees (US-H6). This is done next.

4.6.3 Big-4 Audit Quality Analysis

Sample and Descriptive Statistics

Client-firms' financial statement information required to estimate eqs. (4.4) and (4.5) is obtained from *Compustat*. Observations with insufficient data are excluded. Furthermore, I exclude client-firms with two or more auditors identified for a given year (identified as "joint audits"). In total, 6,593 observations are excluded from the base sample of 12,158 observations retained initially (Table 4.1, Panel B), resulting in 5,565 valid audit engagements from 80 different U.S. local markets. The data requirement biases in favour of client-firms audited by Big-4 auditors; slightly more than 50% of observations are Big-

4 audits[124]. The excluded observations are spread in roughly equal proportions across market size categories, although 5 of the smallest markets are excluded from the audit quality sample as a result (Table 4.1, Panel A). As in the base sample, the number of observations per year is approximately constant and the proportion of Big-4 audits is constantly declining from 2002 to 2005 (Table 4.2).

Table 4.12 reports the descriptive statistics for the audit quality sample, where audit engagements are grouped by auditor type and market size category. The descriptive statistics indicate that client-firm characteristics and measures of abnormal accruals are mostly constant across all market size categories. This is also supported by the pair-wise correlations which are overall low between *LNGDP* and the dependent and other independent variables (Table 4.13). Indeed, the coefficients on these pair-wise correlations are all below 0.1, with the exception of *BIG4* which is still relatively low at -0.148.

[124] The fact that the sample is equally split between Big-4 and Non-Big-4 audits is an advantage because Non-Big-4 audits are included in the analysis to control for unobservable market characteristics. Also, Non-Big-4 audits excluded from the sample are likely less comparable to Big-4 audits than are Non-Big-4 audits not excluded.

Table 4.12 Mean (Median) Abnormal Accrual Sample Characteristics by Auditor Type and Market Size Category

	Big-4						Non-Big-4						Total Sample
	25b or less	25b – 50b	50b – 100b	100b – 300b	300b+ [a]	All Markets	25b or less	25b – 50b	50b – 100b	100b – 300b	300b+ [a]	All Markets	
Number of Observations	56	288	523	1594	551	**3012**	91	202	288	1101	871	**2553**	**5565**
% *ABACC* > 0	46%	59%	50%	51%	51%	**51%**	66%	53%	57%	54%	54%	**55%**	**53%**
ABACC $^{\pm}$	-0.014	0.026	0.002	-0.005	-0.002	**-0.001**	0.028	0.005	0.027	-0.005	-0.015	**-0.003**	**-0.002**
	(-0.013)	(0.015)	(0.001)	(0.001)	(0.005)	**(0.003)**	(0.059)	(0.018)	(0.019)	(0.015)	(0.014)	**(0.017)**	**(0.008)**
| *ABACC* |	0.080	0.101	0.099	0.129	0.117	**0.118**	0.381	0.307	0.246	0.268	0.280	**0.276**	**0.191**
	(0.042)	(0.055)	(0.053)	(0.072)	(0.064)	**(0.064)**	(0.242)	(0.137)	(0.1)	(0.124)	(0.143)	**(0.13)**	**(0.088)**
| *ABACC* $^{+}$|	0.071	0.108	0.101	0.122	0.113	**0.114**	0.311	0.291	0.239	0.244	0.245	**0.250**	**0.179**
	(0.041)	(0.057)	(0.053)	(0.075)	(0.061)	**(0.064)**	(0.178)	(0.128)	(0.104)	(0.131)	(0.129)	**(0.13)**	**(0.088)**
| *ABACC* $^{-}$|	0.087	0.090	0.098	0.137	0.122	**0.122**	0.518	0.325	0.256	0.296	0.319	**0.308**	**0.204**
	(0.042)	(0.048)	(0.053)	(0.07)	(0.068)	**(0.064)**	(0.376)	(0.147)	(0.096)	(0.119)	(0.152)	**(0.13)**	**(0.087)**
LNTA	4.24	4.33	4.57	4.38	4.41	**4.41**	1.40	2.04	2.34	2.32	2.38	**2.29**	**3.44**
	(4.48)	(4.45)	(4.89)	(4.56)	(4.47)	**(4.6)**	(1.15)	(2.11)	(2.36)	(2.42)	(2.46)	**(2.35)**	**(3.69)**
LEV	0.45	0.52	0.58	0.47	0.53	**0.50**	1.84	1.26	1.22	1.16	1.13	**1.18**	**0.82**
	(0.41)	(0.43)	(0.46)	(0.37)	(0.4)	**(0.4)**	(0.84)	(0.58)	(0.49)	(0.5)	(0.52)	**(0.52)**	**(0.44)**
lagLOSS (%)	0.48	0.47	0.43	0.55	0.53	**0.52**	0.74	0.62	0.54	0.63	0.65	**0.63**	**0.57**
ΔPPE	0.10	0.08	0.06	0.11	0.10	**0.09**	0.10	0.09	0.08	0.15	0.14	**0.13**	**0.11**
	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	**(0.06)**	(0.03)	(0.03)	(0.04)	(0.05)	(0.04)	**(0.04)**	**(0.05)**
GROWTH	0.17	0.13	0.13	0.30	0.22	**0.23**	0.27	0.48	0.30	0.37	0.31	**0.34**	**0.28**
	(0.08)	(0.07)	(0.06)	(0.08)	(0.07)	**(0.07)**	(0.03)	(0.04)	(0.06)	(0.07)	(0.07)	**(0.07)**	**(0.07)**
NBS	0.50	0.43	0.44	0.32	0.40	**0.37**	0.24	0.28	0.32	0.31	0.27	**0.29**	**0.34**
	(0)	(0)	(0)	(0)	(0)	**(0)**	(0)	(0)	(0)	(0)	(0)	**(0)**	**(0)**
σSALES	0.09	0.10	0.32	0.19	0.20	**0.21**	0.88	0.34	0.40	0.51	0.66	**0.55**	**0.36**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	**(0.03)**	(0.11)	(0.04)	(0.04)	(0.07)	(0.07)	**(0.07)**	**(0.04)**
σCFO	0.02	0.15	0.06	0.13	0.04	**0.10**	2.45	0.49	0.99	1.08	0.85	**0.99**	**0.51**
	(0.01)	(0)	(0)	(0.01)	(0.01)	**(0.01)**	(0.05)	(0.01)	(0.01)	(0.02)	(0.02)	**(0.02)**	**(0.01)**

[a] These three markets are: New York – Newark – Edison. NY-NJ-PA ($902.7b GDP and 18.6m population); Los Angeles – Long Beach – Santa Ana. CA ($538.4.2b GDP and 12.7m population) and Chicago – Naperville – Joliet. IL-IN-WI ($405.6b GDP and 9.3m population).

Table 4.13 Abnormal Accrual Sample Pearson Correlations Matrix (p-values)

Parameters	*LN GDP*	*AB-ACC* $^{\pm}$	*| AB-ACC |*	*| AB-ACC* $^{+}$*|*	*| AB-ACC* $^{-}$*|*	*BIG4*	*LNTA*	*LEV*	*lag LOSS*	*ΔPPE*	*GRO-WTH*	*NBS*	*σ SALES*
ABACC $^{\pm}$	-0.026												
	(0.058)												
| ABACC |	0.041	-0.189											
	(0.003)	(p<.001)											
| ABACC $^{+}$*|*	0.022	1.000	1.000										
	(0.245)	(p<.001)	(p<.001)										
| ABACC $^{-}$*|*	0.058	-1.000	1.000	0.000									
	(0.004)	(p<.001)	(p<.001)	(p<.001)									
BIG4	-0.148	0.005	-0.263	-0.261	-0.272								
	(p<.001)	(0.733)	(p<.001)	(p<.001)	(p<.001)								
LNTA	-0.048	-0.010	-0.435	-0.454	-0.431	**0.584**							
	(p<.001)	(0.473)	(p<.001)	(p<.001)	(p<.001)	(p<.001)							
LEV	0.006	-0.104	0.363	0.298	0.416	-0.229	-0.460						
	(0.684)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)						
lagLOSS	0.045	-0.064	0.262	0.227	0.296	-0.110	-0.342	0.192					
	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)					
ΔPPE	0.029	0.019	0.028	0.032	0.027	-0.040	0.085	-0.113	-0.034				
	(0.034)	(0.161)	(0.041)	(0.082)	(0.171)	(0.004)	(p<.001)	(p<.001)	(0.013)				
GROWTH	0.011	0.014	0.109	0.139	0.086	-0.042	-0.033	-0.003	0.117	0.255			
	(0.405)	(0.295)	(p<.001)	(p<.001)	(p<.001)	(0.002)	(0.014)	(0.8)	(p<.001)	(p<.001)			
NBS	-0.026	0.021	-0.105	-0.092	-0.118	0.069	0.178	-0.060	-0.130	-0.008	-0.032		
	(0.06)	(0.133)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.564)	(0.019)		
σSALES	0.043	0.008	0.157	0.154	0.169	-0.116	-0.211	0.238	0.064	0.000	-0.005	-0.027	
	(0.002)	(0.561)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.989)	(0.696)	(0.046)	
σCFO	0.001	0.032	0.211	0.254	0.177	-0.135	-0.218	0.254	0.103	0.077	0.122	-0.051	0.213
	(0.947)	(0.019)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)

There are, however, clear differences between client-firms audited by Big-4 auditors and those audited by Non-Big-4 auditors. As expected, Big-4 auditors audit larger and more complex client-firms (*LNTA* and *NBS*). Big-4 audit client-firms also face less financial distress and lower bankruptcy risk (*LEV* and *lagLOSS*). On the other hand, Non-Big-4 client-firms exhibit greater growth (*ΔPPE* and *GROWTH*) and have more volatile operations (*σSALES* and *σCFO*). At first glance, abnormal accruals also differ between Big-4 and Non-Big-4 audits. Relative absolute abnormal accruals (positive and negative) are smaller for client-firms audited by Big-4 auditors. The proportion of income increasing abnormal accruals is also lower for Big-4 audits. Overall, the preliminary evidence supports the notion that Big-4 auditors are more successful in limiting earnings management. However, it is important to note that abnormal accrual measures are for the most part significantly correlated with the proposed control variables (Table 4.13). Finally, pair-wise correlations among client-firm specific control variables are generally low and suggest that multicollinearity is not a serious problem (only *BIG4* and *LNTA* have pair-wise correlation above 0.5).

Results

Table 4.14 presents regression coefficient estimates for eq. (4.5), along with t-statistics in parentheses[125], using the full sample of client-firms, pooled over all years and markets. I turn first to the coefficient estimates on the engagement specific control variables presented in Section B. All coefficients for which the sign is predicted are of the expected sign, and often significant. As expected, larger client-firms report higher quality earnings as indicated by the smaller abnormal accruals (as % of total assets) of any sign and display more conservative accounting (i.e., column (1): negative coefficient with $ABACC^{\pm}$). Financial distress and lower bankruptcy risk is also significantly associated with greater absolute abnormal accruals, although the effect of income decreasing abnormal accruals dominates. The negative coefficient on *LEV* and *lagLOSS* with $ABACC^{\pm}$ may suggest that opportunistic earnings management to increase reported

[125] *t*-statistics are based on heteroskedasticity-consistent standard errors which are robust to within market correlation (i.e., clustered by market standard errors). Results are robust to using alternative clusters (i.e., client-firm, year, two-digit SIC and no clustering) and alternative estimation techniques (i.e., the jackknife method, the default in SAS is the Taylor series method).

Table 4.14 Results of Multiple Regression of Abnormal Accrual on its Determinants - eq. (4.5)

Parameters	Predicted sign	Regression Estimates (t-stats)[a] (1) $ABACC^{\pm}$	(2) $\lvert ABACC \rvert$	(3) $\lvert ABACC^{+} \rvert$	(4) $\lvert ABACC^{-} \rvert$
Section A: Test Variables					
BIG4	- / +	-0.0470	-0.0712	-0.0953	0.0343
		(-0.58)	(-0.82)	(-1.15)	(0.25)
LNGDP	?	-0.0099	0.0016	-0.0032	0.0104
		(-1.85†)	(0.26)	(-0.5)	(1.06)
BIG4* LNGDP	?	0.0057	0.0044	0.0074	-0.0047
		(0.89)	(0.63)	(1.09)	(-0.43)
Section B: Engagement Specific Control Variables					
LNTA	-	-0.0219	-0.0453	-0.0502	-0.0419
		(-4.57***)	(-13.87***)	(-11.18***)	(-10.02***)
LEV	? / +	-0.0361	0.0360	0.0181	0.0526
		(-4.97***)	(6.89***)	(3.9***)	(6.11***)
lagLOSS	? / +	-0.0511	0.0673	0.0353	0.0997
		(-6.31***)	(11.56***)	(5.38***)	(13.76***)
ΔPPE	? / +	0.0037	0.0336	0.0151	0.0560
		(0.22)	(2.44**)	(1.22)	(2.69**)
GROWTH	? / +	0.0041	0.0160	0.0214	0.0119
		(0.54)	(3.81***)	(3.98***)	(2.33*)
NBS	?	0.0171	-0.0107	0.0001	-0.0208
		(2.12*)	(-2.5*)	(0.01)	(-2.92**)
σSALES	? / +	0.0061	0.0062	0.0041	0.0094
		(0.72)	(1.58†)	(0.93)	(1.2)
σCFO	? / +	0.0052	0.0061	0.0098	0.0014
		(1.56)	(2.5**)	(2.73**)	(0.42)
Intercept	?	0.2282	0.2595	0.3413	0.1265
		(3.21**)	(3.31**)	(4.05***)	(0.98)
Section C: Net Effect of Market Size on *ABACC* for Big-4 audits					
$\alpha_2 + \alpha_3 = 0$	?	-0.0042	0.0060	0.0042	0.0057
		(-1.45)	(2.24*)	(1.06)	(1.59)
Number of observations		5565	5565	2946	2619
Adj. R^2		0.024	0.253	0.257	0.271

†, *, **, *** Significant at the 10%, 5%, 1% and 0.1% significance level respectively (one-tailed where signs are predicted, two-tailed otherwise).

[a] *t*-statistics based on heteroskedasticity-consistent standard errors which are robust to within market correlation (i.e., clustered by market standard errors).

earnings is not prevalent, but that operational shocks caused by financial difficulties are not fully captured in the accruals estimation model (eq. (4.4)). Measures of growth are positively correlated with the magnitude of unsigned abnormal accruals; although neither income decreasing nor income increasing abnormal accruals associated with client-firm

growth appear to dominate, as suggested by the insignificant *ΔPPE* and *GROWTH* coefficients when estimating with *ABACC* $^{\pm}$ (column (1)). Finally, the impact of operational volatility (*σSALES* and *σCFO*) on abnormal accruals appears limited.

Results for regression coefficient estimates on the variables of interest are presented in Section A of Table 4.14. First, although coefficient estimates on *BIG4* are all of the predicted sign, none is significantly different from 0 at conventional levels. In other words, based on the data, there does not appear to be a statistically significant difference between Big-4 and Non-Big-4 auditors' ability to restrict earnings management in small to medium sized, non-financial companies, as measured by abnormal accruals and when controlling for client-firm characteristics.

Second, coefficient estimates on *LNGDP* are also insignificantly different from 0 in every case, except when estimated using signed abnormal accruals (column (1)) which is significantly negative at the 10% significance level only. This is a high threshold of significance level given the large sample size and overall the evidence supports the conjecture that Non-Big-4 audit quality is mostly constant across local markets. Furthermore, the coefficients on *LNGDP* may simply be capturing unobservable market characteristics that affect abnormal accruals and that are correlated with market size. From the results, however, these characteristics do not seem to impact the general level of earnings quality, although accounting conservatism may be somewhat (weakly) increasing in market size (i.e., column (1): $\alpha_2 < 0$ with *ABACC* $^{\pm}$)[126].

Finally, coefficient estimates on *BIG4*LNGDP* are all, as expected, insignificantly different from 0. The evidence therefore supports (i.e., fails to reject) the null hypothesis US-H5$_0$ that Big-4 audit quality is constant in market size. On the one hand, if *LNGDP* captures unobservable market characteristics, insignificant coefficients on *BIG4*LNGDP* suggest that Big-4 audit quality is constant in market size, controlling for client-firm and unobservable market characteristics. On the other hand, if *LNGDP* mostly captures how

[126] The signs of the coefficient estimates on *LNGDP*, when estimated with | *ABACC* $^{+}$| and | *ABACC* $^{-}$|, are also consistent with this; although estimates are not significantly different from 0.

Non-Big-4 audit quality evolves in relation to market size, insignificant coefficients on *BIG4*LNGDP* suggest that Big-4 audit quality relative to Non-Big-4 audit quality remains constant in market size. In any case, the conclusion is unchanged and if the value of Big-4 audits relative to Non-Big-4 audits is increasing in market size, the evidence suggests that it is not the result of increasing Big-4 audit quality (relative to Non-Big-4 audits).

Robustness Tests and Discussion

As a robustness test, I perform a more restrictive analysis to evaluate whether Big-4 audit quality in general is constant in market size, regardless of the level of Non-Big-4 audit quality. Table 4.14, Section C shows the result of the following test: $\alpha_2 + \alpha_3 = 0$. Only when estimating eq. (4.5) jointly with all unsigned abnormal accruals (column (2)) is the sum of *LNGDP* + *BIG4*LNGDP* significantly above 0 (5% confidence level). This is, however, hardly sufficient to reject US-H5$_0$. First, it is often more appropriate to consider income increasing and income decreasing abnormal accruals separately. The former is mostly seen as evidence of opportunistic earnings management while the latter can be considered as evidence of conservative accounting. When analysing $|ABACC^{+}|$ and $|ABACC^{-}|$ separately, abnormal accruals for Big-4 audits do not change significantly with market size (columns (3) and (4)). In fact, the significant relationship reported in column (2) of Section C is most likely driven by income decreasing abnormal accruals[127] and would suggest that Big-4 audit quality is actually increasing in market size (i.e., more conservative). If anything, this reinforces the argument that the value of Big-4 audits is increasing in market size.

Finally, unreported results from alternative research designs yield identical conclusions. Specifically, I performed the same tests: (1) using a regular cross-sectional Jones model to estimate abnormal accruals (i.e., eq. (4.4) without *ΔAR*); (2) excluding *CFO* and *DCFO* from eq. (4.4) to estimate abnormal accruals; (3) using *ΔCFO* and *DΔCFO* as an alternative proxy proposed by Ball and Shivakumar [2006] to control for the effect of

[127] Notice that ($\alpha_2 + \alpha_3$) is negative in column (1) and slightly larger in column (4) than in column (3) (i.e., more "negative").

accounting conservatism in estimating abnormal accruals in eq. (4.4); and (4) using alternative computing methods for estimating standard errors (see footnote 125). Overall, results fail to reject US-H5$_0$.

4.6.4 Big-4 Audit Fee Analysis

Sample and Descriptive Statistics

As with the audit quality sample, client-firms' financial statement information required to estimate eq. (4.11) is obtained from *Compustat*. Observations with insufficient data are excluded. Again, I exclude observations identified as "joint audits" (see Section 4.6.3). I also exclude observations for which it is impossible to identify if an auditor change has occurred[128]. This results in the exclusion of 4,741 observations (and one market) from the base sample, the majority of which (81%) are Non-Big-4 audits (Table 4.1). Furthermore, to reliably estimate eq. (4.12), I exclude all observations from markets with fewer than five Big-4 and five Non-Big-4 audit engagements (over all years) that satisfy data requirements. This excludes 38 (mostly very small) markets with a total of 575 observations. The final sample consists of 6,842 observations from 46 different U.S. local markets, split equally between Big-4 and Non-Big-4 audits (Table 4.1). Once more, the number of observations per year is approximately constant and the proportion of Big-4 audits is constantly declining from 2002 to 2005 (Table 4.2).

Table 4.15 presents the descriptive statistics for the audit fee sample, where audit engagements are grouped by auditor type and market size category. Engagement specific control variables are generally constant across all market size categories (excluding the smallest market size category which contains very few observations). This is again supported by the pair-wise correlations reported in Table 4.16. Pair-wise correlations between *LNGDP* and engagement specific control variables are all below 0.1 (except *BIG4* which is still relatively low at -0.145). As expected, however, market specific control variables *CSTX* and *LNBIG4* are changing in market size. The correlation

[128] This is to accurately derive the *NEWAUD* control variable. Specifically, client-firms-year observations for which the first year of available auditor information in the *Audit Analytics* database falls between 2002 and 2005 are excluded.

Table 4.15 Mean (Median) Audit Fee Sample Characteristics by Auditor Type and Market Size Category

	Big-4						Non-Big-4						Total Sample
	25b or less	25b – 50b	50b – 100b	100b – 300b	300b+ [a]	All Markets	25b or less	25b – 50b	50b – 100b	100b – 300b	300b+ [a]	All Markets	
Number of Observations	**9**	**219**	**486**	**1958**	**703**	**3375**	**8**	**276**	**391**	**1530**	**1262**	**3467**	**6842**
Total Fees ($k)	151.6	264.0	426.1	378.9	400.7	**382.2**	39.5	77.4	87.9	112.4	125.8	**111.6**	**245.1**
	(172)	(172.3)	(207.5)	(253.1)	(250)	**(240)**	(43.2)	(42.8)	(57)	(59.7)	(81.3)	**(65)**	**(131)**
LNFEE	5.0	5.2	5.5	5.6	5.6	**5.5**	3.5	3.8	4.0	4.1	4.4	**4.2**	**4.9**
	(5.1)	(5.1)	(5.3)	(5.5)	(5.5)	**(5.5)**	(3.8)	(3.8)	(4)	(4.1)	(4.4)	**(4.2)**	**(4.9)**
LNTA	4.93	4.42	4.54	4.35	4.41	**4.40**	2.12	1.26	1.80	1.70	1.79	**1.71**	**3.04**
	(4.93)	(4.63)	(4.88)	(4.57)	(4.61)	**(4.63)**	(2.41)	(1.53)	(2.22)	(2.04)	(2.06)	**(2.04)**	**(3.41)**
INVREC	0.54	0.27	0.25	0.20	0.26	**0.23**	0.20	0.24	0.30	0.25	0.28	**0.27**	**0.25**
	(0.54)	(0.23)	(0.2)	(0.14)	(0.21)	**(0.16)**	(0.19)	(0.15)	(0.24)	(0.18)	(0.22)	**(0.19)**	**(0.18)**
LOSS (%)	0.89	0.35	0.42	0.53	0.50	**0.50**	0.50	0.67	0.58	0.67	0.70	**0.67**	**0.59**
ROA	-0.06	-0.03	-0.11	-0.18	-0.11	**-0.14**	-0.18	-10.41	-5.74	-16.73	-3.36	**-10.08**	**-5.18**
	(-0.05)	(0.02)	(0.02)	(-0.01)	(0)	**(0)**	(0.02)	(-0.16)	(-0.04)	(-0.14)	(-0.17)	**(-0.13)**	**(-0.04)**
LEV	0.69	0.53	0.56	0.49	0.56	**0.51**	0.54	38.44	6.38	9.26	9.90	**11.47**	**6.07**
	(0.69)	(0.46)	(0.45)	(0.37)	(0.4)	**(0.4)**	(0.24)	(0.79)	(0.51)	(0.57)	(0.6)	**(0.58)**	**(0.47)**
NBS	0.00	0.46	0.45	0.31	0.37	**0.35**	0.69	0.25	0.25	0.28	0.21	**0.25**	**0.30**
	(0)	(0)	(0)	(0)	(0)	**(0)**	(0.69)	(0)	(0)	(0)	(0)	**(0)**	**(0)**
NAS	0.28	0.31	0.26	0.23	0.25	**0.24**	0.27	0.14	0.19	0.18	0.16	**0.17**	**0.21**
	(0.21)	(0.19)	(0.23)	(0.18)	(0.21)	**(0.19)**	(0.22)	(0.1)	(0.14)	(0.13)	(0.12)	**(0.13)**	**(0.16)**
CONCERN (%)	0.33	0.09	0.08	0.08	0.07	**0.08**	0.13	0.55	0.34	0.41	0.42	**0.41**	**0.25**
NEWAUD (%)	0.00	0.05	0.07	0.05	0.05	**0.05**	0.13	0.14	0.16	0.17	0.17	**0.16**	**0.11**
BUSY (%)	0.11	0.60	0.72	0.75	0.72	**0.73**	0.13	0.70	0.69	0.65	0.64	**0.65**	**0.69**
CSTX	79.5	91.2	100.5	107.0	115.1	**106.6**	79.5	88.6	97.0	105.2	118.7	**107.8**	**107.2**
	(79.5)	(87.6)	(98.6)	(105.6)	(114.1)	**(105.6)**	(79.5)	(86.7)	(98.4)	(105.2)	(125.1)	**(105.2)**	**(105.6)**
LNBIG4	4.84	0.49	0.56	0.29	0.29	**0.35**				na			
	(6.91)	(0.41)	(0.29)	(0.29)	(0.29)	**(0.29)**							

[a] These three markets are: New York – Newark – Edison. NY-NJ-PA ($902.7b GDP and 18.6m population); Los Angeles – Long Beach – Santa Ana. CA ($538.4.2b GDP and 12.7m population) and Chicago – Naperville – Joliet. IL-IN-WI ($405.6b GDP and 9.3m population).

Table 4.16 Audit Fee Sample Pearson Correlations Matrix (p-values)

Variables	*LN GDP*	*LNFEE*	*BIG4*	*LNTA*	*INV-REC*	*LOSS*	*ROA*	*LEV*	*NBS*	*NAS*	*CON-CERN*	*NEW-AUD*	*BUSY*	*CSTX*
LNFEE	0.035													
	(0.004)													
BIG4	-0.145	**0.590**												
	(p<.001)	(p<.001)												
LNTA	-0.057	**0.762**	**0.582**											
	(p<.001)	(p<.001)	(p<.001)											
INVREC	0.052	0.013	-0.085	0.039										
	(p<.001)	(0.282)	(p<.001)	(0.001)										
LOSS	0.063	-0.226	-0.177	-0.376	-0.239									
	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)									
ROA	0.000	0.042	0.032	0.120	0.028	-0.032								
	(0.999)	(p<.001)	(0.008)	(p<.001)	(0.019)	(0.008)								
LEV	-0.006	-0.092	-0.058	-0.217	-0.046	0.046	-0.335							
	(0.611)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)							
NBS	-0.034	0.192	0.098	0.239	0.079	-0.158	0.018	-0.032						
	(0.005)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.135)	(0.008)						
NAS	-0.026	0.022	0.110	0.157	0.029	-0.075	0.020	-0.032	0.048					
	(0.033)	(0.07)	(p<.001)	(p<.001)	(0.018)	(p<.001)	(0.101)	(0.008)	(p<.001)					
CONCERN	0.034	-0.424	-0.382	**-0.608**	-0.066	0.369	-0.060	0.102	-0.147	-0.119				
	(0.004)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)				
NEWAUD	0.035	-0.132	-0.181	-0.108	0.031	0.048	0.001	0.017	-0.003	-0.035	0.100			
	(0.003)	(p<.001)	(p<.001)	(p<.001)	(0.009)	(p<.001)	(0.911)	(0.16)	(0.773)	(0.004)	(p<.001)			
BUSY	-0.006	0.127	0.077	0.062	-0.125	0.051	-0.011	0.019	-0.045	-0.031	0.008	-0.010		
	(0.605)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.383)	(0.116)	(p<.001)	(0.01)	(0.503)	(0.427)		
CSTX	**0.743**	0.092	-0.052	-0.013	0.019	0.073	-0.003	-0.014	-0.064	-0.021	-0.015	0.017	0.005	
	(p<.001)	(p<.001)	(p<.001)	(0.269)	(0.122)	(p<.001)	(0.794)	(0.242)	(p<.001)	(0.08)	(0.228)	(0.164)	(0.703)	
LNBIG4	-0.177	0.252	0.440	0.246	-0.020	-0.056	0.014	-0.026	0.044	0.051	-0.165	-0.085	-0.002	-0.125
	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.1)	(p<.001)	(0.245)	(0.034)	(p<.001)	(p<.001)	(p<.001)	(p<.001)	(0.891)	(p<.001)

between *CSTX* and *LNGDP* is especially high (0.743)[129]. Audit fees appear to increase somewhat in market size, most probably driven by *CSTX*.

Noteworthy are again the differences between client-firms audited by Big-4 auditors and those audited by Non-Big-4 auditors. As in the audit quality sample, the data confirms that Big-4 auditors audit larger and more complex client-firms (*LNTA* and *NBS*). They also audit relatively more profitable and less risky client-firms that report net losses less often (*LOSS*), have larger return-on-assets (*ROA*) and are less leveraged (*LEV*). Not surprisingly, Non-Big-4 auditors issue more going concern opinions on average than Big-4 auditors (*CONCERN*: 41% *vs.* 8%) as a result. Big-4 auditors also provide relatively more NAS-MAS to their clients (*NAS*) and audit more client-firms with December-January year-end (*BUSY*). *NEWAUD* for Non-Big-4 auditors is over three times higher than for Big-4 auditors. This coincides with the increase number of auditor switches by small and medium companies from a Big-4 audit firm to a smaller-tier auditor following the passage of SOX[130].

As expected, Big-4 audit fees are higher than Non-Big-4 audit fees. However, pair-wise correlations between engagement specific control variables and audit fees (*LNFEE*) are often significant, confirming that audit fees are driven by client-firm characteristics (Table 4.16). Finally, pair-wise correlations between control variables are generally low and suggest that multicollinearity is not a serious problem.

Results

I report in column (1) of Table 4.17 the OLS estimates of regression coefficients of eq. (4.11), along with t-statistics in parentheses[131], using the full sample of client-firms pooled over years and markets. In column (2) I present results from a median quantile

[129] The high correlation gives additional justification for using the "two stage" approach proposed in Section 4.5.4. Indeed, using this approach I can control for labour costs differences across markets with *CSTX* but avoid estimating eq. (4.11) with both *CSTX* and *LNGDP* as independent variables.
[130] Big-4 auditors also tend to have longer tenure.
[131] *t*-statistics are based on heteroskedasticity-consistent standard errors which are robust (i.e., clustered SE) to within client-firm correlation in column (1) and within market correlation in column (3); Median quantile (columns (2) and (4)) *t*-statistics are based on the bootstrap method which achieves some robustness to certain heteroscedasticity.

regression to alleviate the effects of outliers. Results in (1) and (2) are generally equivalent, which indicates that outliers are not driving the regression results. Columns (3) and (4) present results for robustness tests and are discussed later.

First, the coefficient on *CSTX* is significantly positive at the 0.1% level. This is consistent with the theory and confirms that audit fees are highly correlated to market specific audit labour costs. As predicted, the coefficient on *BIG4*CSTX* is also significantly positive, implying that Big-4 audit fees are increasing more rapidly in *CSTX* than for Non-Big-4 audit fees. This would happen if the proportion of engagement specific audit costs that varies with *CSTX* (i.e., "market variant" costs, such as auditor salary) relative to "market invariant" engagement specific audit costs (e.g., office stationary for example) is greater for Big-4 than for Non-Big-4 audit firms. In other words, a positive coefficient on *BIG4*CSTX* suggests that labour costs are proportionally more important for Big-4 auditors, which could be the result of a greater role played by specialised and experience staff and/or because more (standard) audit hours are performed (i.e., as stated in Section 4.5.4: greater *MIX* and/or *LABOUR*). This is an important result as it indicates key differences between Big-4 and Non-Big-4 audit production process.

Second, the coefficient on *BIG4*LNBIG4* is of the expected sign, but only significant (at the 5% level) for the median quantile regression (column (2)). Overall, the evidence only partially suggests that Big-4 audit firms are successful in extracting monopoly rents. In other words, competition among the Big-4 audit firms appears sufficient to limit abusive market power. This is formal proof supporting conclusions made by the GAO [2003b, 2008] that the high level of concentration in the auditing industry, dominated by the Big-4, does not seem to have had an adverse effect on audit fees thus far. The Big-4 audit fee premium, relative to Non-Big-4 auditors, appears in large part driven by difference in the audit production process and quality differential (i.e., vertically differentiated audits), rather than abusive market power by the Big-4 audit firms.

Table 4.17 Results of Multiple Regression of Audit Fees on its Determinants

Parameters	Predicted sign	Eq. (4.11) Regression Estimates (t-stats)[a] (1) Ord. Least Squares[a]	Eq. (4.11) Regression Estimates (t-stats)[a] (2) Median Quintile	Eq. (4.15) Regression Estimates (t-stats)[a] (3) Ord. Least Squares[a]	Eq. (4.15) Regression Estimates (t-stats)[a] (4) Median Quintile
Section A: Test and Market Specific Control Variables					
BIG4	+	*Market specific*	*Market specific*	1.5589 (5.61***)	1.5627 (7.39***)
CSTX	+	0.0245 (21.51***)	0.0250 (36.13***)	0.0023 (0.56)	0.0003 (0.19)
BIG4*CSTX	+	0.0102 (7.43***)	0.0106 (11.48***)	0.0071 (1.94*)	0.0102 (4.90***)
BIG4*LNBIG4	+	0.0210 (0.95)	0.0536 (1.72*)	0.0070 (0.40)	0.0126 (1.01)
LNGDP	?	*na*	*na*	0.1463 (3.37**)	0.1617 (9.09***)
BIG4* LNGDP	-	*na*	*na*	-0.0766 (-1.72*)	-0.1056 (-4.96***)
Section B: Engagement Specific Control Variables					
LNTA	+	0.2193 (15.86***)	0.2324 (17.87***)	0.2253 (16.33***)	0.2315 (14.60***)
INVREC	+	0.3178 (5.64***)	0.3033 (8.23***)	0.2974 (3.77***)	0.2967 (7.04***)
LOSS	+	0.0684 (3.22***)	0.0566 (3.66***)	0.0955 (5.15***)	0.0943 (4.70***)
ROA	-	-0.0001 (-2.27*)	-0.0001 (-0.33)	-0.0001 (-2.53**)	0.0000 (-0.13)
LEV	+	0.0003 (1.88*)	0.0003 (0.69)	0.0004 (2.53**)	0.0008 (1.85*)
NBS	+	0.1306 (6.20***)	0.1372 (8.70***)	0.1243 (6.43***)	0.1253 (7.36***)
NAS	?	-0.2732 (-2.59**)	-0.5173 (-7.47***)	-0.3010 (-2.97**)	-0.4865 (-6.40***)
CONCERN	+	0.1285 (4.53***)	0.1630 (6.91***)	0.1526 (5.29***)	0.1833 (7.19***)
NEWAUD	?	-0.0767 (-2.56*)	-0.1121 (-3.73***)	-0.0662 (-2.95**)	-0.0676 (-2.17*)
BUSY	+	0.1125 (4.70***)	0.1059 (6.05***)	0.1281 (5.69***)	0.1161 (6.41***)
IMR	?	-0.4698 (-8.82***)	-0.4675 (-10.17***)	-0.4877 (-9.49***)	-0.4924 (-9.28***)
Intercept	?	*Market specific*	*Market specific*	0.5103 (1.61)	0.5691 (3.65***)
Industry Dummies		YES	YES	YES	YES
Year Dummies		YES	YES	YES	YES
Number of observations		6842	6842	7417	7417

Table 4.17 (cont'd)

*, **, *** Significant at the 5%, 1% and 0.1% significance level respectively (one-tailed where signs are predicted, two-tailed otherwise).

[a] OLS *t*-statistics based on heteroskedasticity-consistent standard errors which are robust (i.e., clustered SE) to within client-firm correlation in (1) and within market correlation in (3); Median Quantile *t*-statistics obtained by resampling method (i.e., bootstrap).

Third, coefficient estimates on all engagement specific control variables are all highly significant (at the 5% level or less) and of the expected signs when predicted (Table 4.17, Section B). Specifically, audit fees have a statistically significant positive relation to client-firm size (*LNTA*); inherent (*INVREC*) and litigation risks (*LOSS* and *LEV*); and complexity (*NBS* and *CONCERN*). As expected, the coefficient on *BUSY* is also significantly positive. The coefficient on *ROA* is significantly negative, consistent with the idea that client-firms with weak returns are riskier. The coefficient on *NAS* is significantly negative which suggest the existence of synergies or economies of scope when auditors perform non-audit services and other management advisory services. The negative coefficient on *NEWAUD* suggests that auditors may be offering discounts (i.e., "low-balling") to attract new clients[132]. Results from the median quantile regression (column (2)) are equivalent, except for *ROA* and *LEV* which are of the predicted sign but not statistically significant at conventional levels.

Finally, I turn to the analysis of local market specific estimates of Big-4 audit fee premia. As detailed in Section 4.5.4, I obtain estimates for market specific Big-4 audit fee premia from estimating eq. (4.11) on the full sample with market specific intercepts, φ_{1j}, and Big-4 interaction terms, φ_{2j}. I estimate eq. (4.11) without a general intercept which results in 45 different local market estimates for φ_{1j} and φ_{2j}, out of the 46 markets included in the sample[133]. OLS estimates for φ_{2j} capture the average Big-4 audit fee premium for market

[132] Two other phenomena may also be occurring at the same time. First, new auditors may simply be "poor" at estimating audit fees for new clients such that they price "accidentally" below production costs on first engagements. These auditors would adjust their pricing in future years (note: auditors that price "accidentally" above production costs would tend not to be selected by prospective clients). Second, the majority of auditor switches in the sample are from Big-4 auditors to Non-Big-4 auditors. Because Non-Big-4 audit fees are lower, the *NEWAUD* variable may be capturing some of this fee differential.

[133] One market, $j = 46$, is optimally "forced" as the general intercept where $\varphi_{1j=46} = \varphi_{2j=46} = 0$. This market is Washington – Arlington – Alexandria, DC-VA-MD-WV ($285.2b GDP and 5.1m population) which is the 4th largest MSA in the United States. A "low" Big-4 audit fee premium (i.e., $\varphi_{2j} = 0$) in this large market

j. In other words, φ_{2j} represent the average difference in Big-4 audit fees relative to Non-Big-4 audit fees in market *j*, controlling for client-firm characteristics, (labour) costs differences and unobservable market characteristics (captured by φ_{1j}). The interpretation for φ_{2j} obtained from a median quantile regression (Table 4.17, column (2)) is similar. Those estimates are, however, robust to outliers and are analogous to the market specific "median" difference in Big-4 audit fees relative to Non-Big-4 audit fees (i.e., median Big-4 audit fee premium). I use both series of estimates to test US-H6. Table 4.18 presents summary statistics for the different sets of estimates for φ_{1j} and φ_{2j}, grouped by market size category[134].

Section A of Table 4.18 shows that the number of observations per market is, on average, well above the minimum imposed of five Big-4 and five Non-Big-4 observations per market. In fact, the number of observations per market is likely sufficient to properly estimate φ_{1j} and φ_{2j}. Nonetheless, smaller markets clearly have fewer observations from which φ_{1j} and φ_{2j} can be estimated. Consequently, the use of WLS to estimate eq. (4.12), where weights equal the number of Big-4 audits per market, is justified to address the resulting heteroskedasticity.

Briefly investigating Section B of Table 4.18, the Big-4 audit fee premium is positive on average, whatever the method used to estimate eq. (4.11). The market specific Big-4 premium, averaged across all markets ($20b GDP and above), is equal to 0.312 for $\hat{\varphi}_{2j}^{OLS}$ and 0.213 for $\hat{\varphi}_{2j}^{MQ}$. The median is lower, although still above 0. Moreover, no market specific Big-4 fee premium estimate is significantly negative, while 36% of $\hat{\varphi}_{2j}^{OLS}$ are significantly positive at the 5% confidence level (17% of $\hat{\varphi}_{2j}^{MQ}$ are significantly positive at the 5% confidence level). As expected, the Big-4 audit fee premium is decreasing in

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is entirely consistent with the theory. Estimates of φ_{1j} and φ_{2j} for other markets represent the proportional difference between audit fees in those markets and the base audit market of Washington DC.

[134] To simplify, I identify market specific Big-4 audit fee premium estimates obtained from the OLS regression of eq. (4.11) as $\hat{\varphi}_{2j}^{OLS}$, and those obtained from the median quantile regression of eq. (4.11) as $\hat{\varphi}_{2j}^{MQ}$; φ_{2j} with no superscript refers to both set of estimates.

market size. Indeed, average $\hat{\varphi}_{2j}^{OLS}$ and $\hat{\varphi}_{2j}^{MQ}$ for the 15 smallest markets is equal to 0.386 and 0.319 respectively, with 40% and 30% of estimates greater to zero at the 5% level. For the largest 15 markets, the average drops to 0.218 for $\hat{\varphi}_{2j}^{OLS}$ and 0.110 for $\hat{\varphi}_{2j}^{MQ}$, with only 27% and 2% of estimates significantly greater to zero at the 5% level. Median estimates for φ_{2j} are also decreasing from small markets to larger ones. This serves as preliminary evidence in support of US-H6$_1$.

As a formal test for US-H6, I estimate eq. (4.12) and present the results in Table 4.19. To address heteroskedasticity problems, I estimate eq. (4.12) using WLS and OLS, where OLS standard errors are heteroskedasticity-consistent standard errors more suitable for small samples (HC3, see footnote 122). Columns (1) and (2) of Table 4.19 present, respectively, WLS and OLS regression estimates for eq. (4.12) on $\hat{\varphi}_{2j}^{OLS}$. Columns (2) and (4) of Table 4.19 present the same results, but for $\hat{\varphi}_{2j}^{MQ}$. In all cases, results are equivalent, although slightly more significant with market specific Big-4 audit fee premia estimated using the quantile regression technique (i.e., $\hat{\varphi}_{2j}^{MQ}$).

Results reported in Table 4.19 are all significant and of the expected sign. First, the intercept is significantly positive, confirming the existence of a "general" Big-4 audit fee premium and is consistent with findings reported in Table 4.18. Notice that this Big-4 audit fee premium exists despite controlling for Big-4 audit firm market power and variable costs differences (i.e., *BIG4*LNBIG4* and *BIG4*CSTX* in eq. (4.11)). Hence, this must indicate that Big-4 audits are indeed perceived as higher quality than Non-Big-4 audits. Second, the coefficient on *LNGDP* is significantly negative. This indicates that the Big-4 audit fee premium is, as expected, decreasing in market size and supports US-H6$_1$ (i.e., US-H6$_0$ is rejected).

Table 4.18 Market Specific Big-4 Premia and Intercepts from eq. (4.11) – φ_{2j} and φ_{1j} - Statistics per Market Size Group

	Market Size Group (GDP $b)			All Markets
	Lower third ($20b to $63b)	**Middle third ($64b to $120b)**	**Top third ($121b plus)**	
Section A: Regression details				
Number of Markets	15	15	15	45
Mean (median) number of valid observations per market				
Big-4 audit engagements	22 (21)	53 (37)	155 (137)	73 (38)
Non-Big-4 audit engagements	26 (13)	40 (21)	192 (89)	75 (23)
Section B: Market specific Big-4 premia				
from OLS regression: $\hat{\varphi}_{2j}^{OLS}$				
Mean	0.386	0.332	0.218	0.312
Median	0.337	0.327	0.190	0.264
% p-value < 5%, [+, –]	[40%, 0%]	[40%, 0%]	[27%, 0%]	[36%, 0%]
from median quantile regression: $\hat{\varphi}_{2j}^{MQ}$				
Mean	0.319	0.210	0.110	0.213
Median	0.255	0.237	0.045	0.168
% p-value < 5%, [+, –]	[33%, 0%]	[10%, 0%]	[2%, 0%]	[17%, 0%]
Section C: Market specific intercepts				
from OLS regression: $\hat{\varphi}_{1j}^{OLS}$				
Mean	0.055	0.002	0.116	0.058
Median	0.072	0.131	0.140	0.089
% p-value < 5%, [+, –]	[13%, 13%]	[13%, 20%]	[33%, 13%]	[20%, 16%]
from median quantile regression: $\hat{\varphi}_{1j}^{MQ}$				
Mean	0.057	0.057	0.156	0.090
Median	0.036	0.125	0.147	0.118
% p-value < 5%, [+, –]	[20%, 13%]	[33%, 13%]	[47%, 13%]	[33%, 13%]

Table 4.19 Results of Regression of Market Specific Big-4 Premium (φ_{2j}) on Market Size - eq. (4.12)

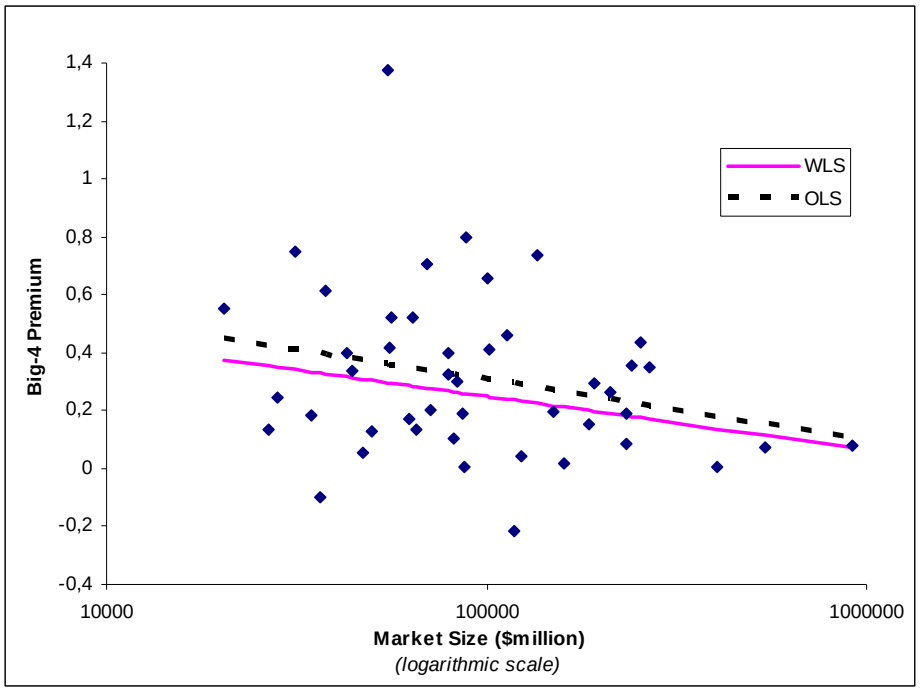
Parameters (predicted sign)	**Regression Estimates on Market Specific Big-4 Premium from OLS estimation of eq. (4.11) :** $\hat{\varphi}_{2j}^{OLS}$ (t-stats)		**Regression Estimates on Market Specific Big-4 Premium from Median quantile estimation of eq. (4.11) :** $\hat{\varphi}_{2j}^{MQ}$ (t-stats)	
	(1) WLS	**(2) OLS[a]**	**(3) WLS**	**(4) OLS[a]**
Intercept (+)	1.166 (2.39*)	1.340 (2.81**)	1.228 (3.05**)	1.339 (3.04**)
LNGDP (-)	-0.080 (-1.99*)	-0.090 (-2.26*)	-0.092 (-2.77**)	-0.098 (-2.68**)
Adj. R^2	0.084	0.068	0.151	0.100
Number of markets	45	45	45	45

*, ** Significant at the 5% and 1% significance level respectively (one-tailed where signs are predicted, two-tailed otherwise).
[a] OLS t-statistics using HC3 standard errors.

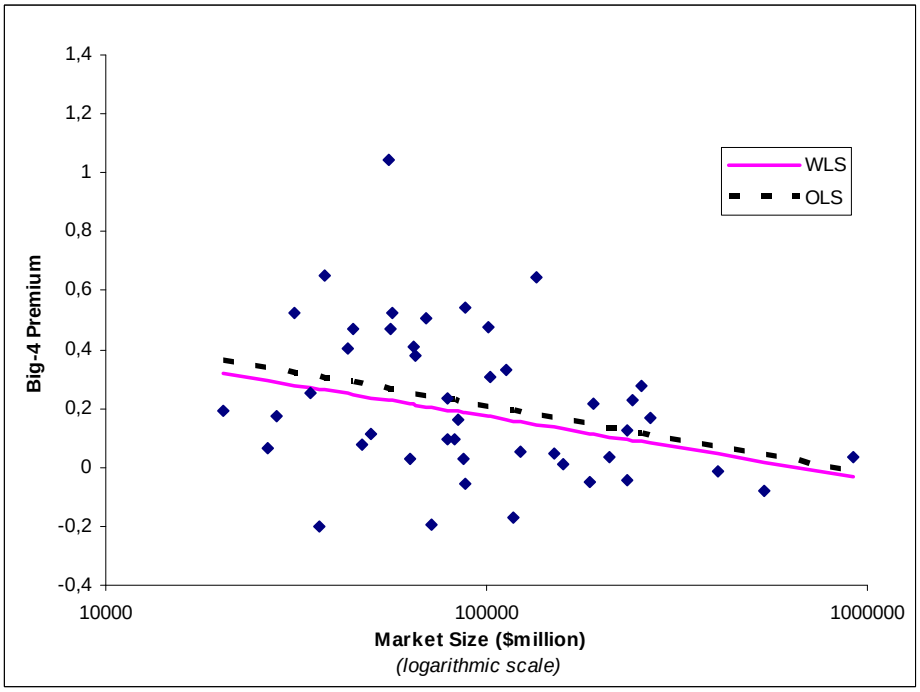
The negative relation between Big-4 audit fee premium and market size is illustrated in Figure 4.3. Specific point estimates for φ_{2j} obtained from the OLS regression of eq. (4.11) are presented in Panel A (i.e., $\hat{\varphi}_{2j}^{OLS}$) while those obtained from the median quantile regression of eq. (4.11) are presented in Panel B (i.e., $\hat{\varphi}_{2j}^{MQ}$). Regression lines for eq. (4.12), estimated using WLS and OLS, are also drawn. There is greater variation in point estimates in the smaller markets. Nonetheless, the downwards trend in Big-4 audit fee premium as market size grows is clear from the regression lines.

Figure 4.3 Big-4 Fee Premium with Market Size

Panel A - "Average" Big-4 Fee Premium $\hat{\varphi}_{2j}^{OLS}$



Panel B - "Median" Big-4 Fee Premium $\hat{\varphi}_{2j}^{MQ}$



Robustness Tests and Discussion

The negative relation between Big-4 audit fee premium and market size could potentially result from "excessive" market power exercised by Big-4 audit firms in smaller markets that is not sufficiently controlled for in eq. (4.11). In other words, price competition between Big-4 audit firms may be more intense in larger markets, which would drive down Big-4 audit fees. This would bias in favour of US-H6$_1$ if the number of Big-4 audit firms N_{B4} operating in a given market underestimates Big-4 market power (i.e., *BIG4*LNBIG4* in eq. (4.11)). For example, market specific conditions (e.g., first mover advantage) could grant a Big-4 audit firm substantial market power over other Big-4 and Non-Big-4 auditors. This would be considered as an unobservable market characteristic and would load on estimates of φ_{2j}. To control for this I estimate the following model:

$$\varphi_{2j} = \varsigma_0 + \varsigma_1 LNGDP_j + \varsigma_2 (\overline{HHI_j^{B4}} - \overline{THHI_j^{B4}}) + \varepsilon_j \qquad (4.14)$$

Where $\overline{HHI_j^{B4}}$ is the market specific Hirschman-Herfindahl Index (HHI) calculated on Big-4 audit firms' market share only (see footnote 121), averaged over 2001 to 2005; and $\overline{THHI_j^{B4}}$ is the "theoretical" HHI if all Big-4 audit firms operating in market *j* have equal market shares and is equal to 1 over the number of Big-4 audit firms operating in market *j* (in a given year *t*): 1 / $N_{B4j,t}$, averaged over 2001 to 2005. The first term is a measure of the average concentration within the Big-4 market segment, for a given market *j*. The closer $\overline{HHI_j^{B4}}$ is to 1, the more concentrated and "unequally" balanced are market shares among Big-4 auditors. In other words, one (or possibly two) Big-4 auditor dominates the local market and can potentially extract additional monopoly rents (i.e., fee premium).

The second term, however, is what the HHI^{B4} should be if all Big-4 entrants were of equal size. The ESC model proposed predicts a symmetric equilibrium with identical Big-4 auditors. In fact, the control variable *BIG4*LNBIG4* included in eq. (4.11) assumes symmetry between Big-4 audit firms. Hence, the difference between the two terms, $\overline{HHI_j^{B4}} - \overline{THHI_j^{B4}}$, is a measure of market power not captured by the control variable

*BIG4*LNBIG4* included in eq. (4.11) (i.e., "residual" market power). I make no predictions for the sign of the coefficient on $(\overline{HHI_j^{B4}} - \overline{THHI_j^{B4}})$. On the one hand, "residual" market power can allow dominant Big-4 audit firms to price above others which would result in a positive coefficient[135]. On the other hand, dominant Big-4 audit firms may hold larger market share because they price their services more competitively (e.g., costs advantages) which would result in a negative coefficient.

All other variables in eq. (4.14) are as defined previously. I estimate eq. (4.14) again using WLS and OLS separately on both sets of estimates $\hat{\varphi}_{2j}^{OLS}$ and $\hat{\varphi}_{2j}^{MQ}$. In all instances, the coefficient on $(\overline{HHI_j^{B4}} - \overline{THHI_j^{B4}})$ is insignificantly different from 0 and untabulated results on other coefficient estimates are almost identical to those obtained from eq. (4.12). Consequently, the conclusion on US-H6 remains unchanged. This result is very significant as it confirms once more that Big-4 audit fee premium is not the result of abusive market power by Big-4 auditors.

I also investigate the relation between market size and market specific intercepts estimated from eq. (4.11). Summary statistics for $\hat{\varphi}_{1j}^{OLS}$ and $\hat{\varphi}_{1j}^{MQ}$ are presented in Section C of Table 4.18 (see above). The evidence generally suggests that market specific estimates are close to 0, although possibly increasing slightly in market size. I perform a regression of these estimates on *LNGDP*, as in eq. (4.12). In untabulated results, the coefficient on *LNGDP* is insignificantly different from 0. Overall, these results suggest that *CSTX* used as a control variable in eq. (4.11) properly captures input cost differences between markets that are correlated with market size. The remaining differences, captured by market specific intercepts, are generally uncorrelated with market size, implying that unobservable market characteristics cannot be fully accounted for with a market size proxy. This validates the conjecture that Non-Big-4 investments in audit technology are constant in market size (no significant correlation between φ_{1j} and

[135] Because these dominant Big-4 audit firms "control" a larger share of total market Big-4 audit fees, the market specific Big-4 audit fee premium will reflect mostly these audit firms' pricing strategy.

LNGDP), and consequently, justifies using Non-Big-4 audits as a control group for unobservable market specific characteristics.

As a robustness test, I also evaluate the relation between market size and Big-4 audit fee premium directly in the general audit fee regression model. More formally, I extend eq. (4.11) to include *LNGDP* along with a general Big-4 interaction term, *BIG4*LNGDP*, but excluding market specific intercepts and Big-4 interaction terms. This is presented in eq. (4.15):

$$\begin{aligned} LNFEE_{itj} = \quad & \alpha_0 + \alpha_1 BIG4_{itj} + \beta_1 CSTX_j \\ & + \beta_2 (BIG4_{itj} * CSTX_j) + \beta_3 (BIG4_{itj} * LNBIG4_{tj}) \\ & + \beta_4 LNGDP_j + \beta_5 (BIG4_{itj} * LNGDP_j) \\ & + \phi_1 LNTA_{itj} + \phi_2 INVREC_{itj} + \phi_3 LOSS_{itj} + \phi_4 ROA_{itj} \\ & + \phi_5 LEV_{itj} + \phi_6 NBS_{itj} + \phi_7 NAS_{itj} + \phi_8 CONCERN_{itj} \\ & + \phi_9 NEWAUD_{itj} + \phi_{10} BUSY_{itj} + \phi_{11} IMR_{itj} \\ & + (fixed\ effects) + \varepsilon_{itj} \end{aligned} \qquad (4.15)$$

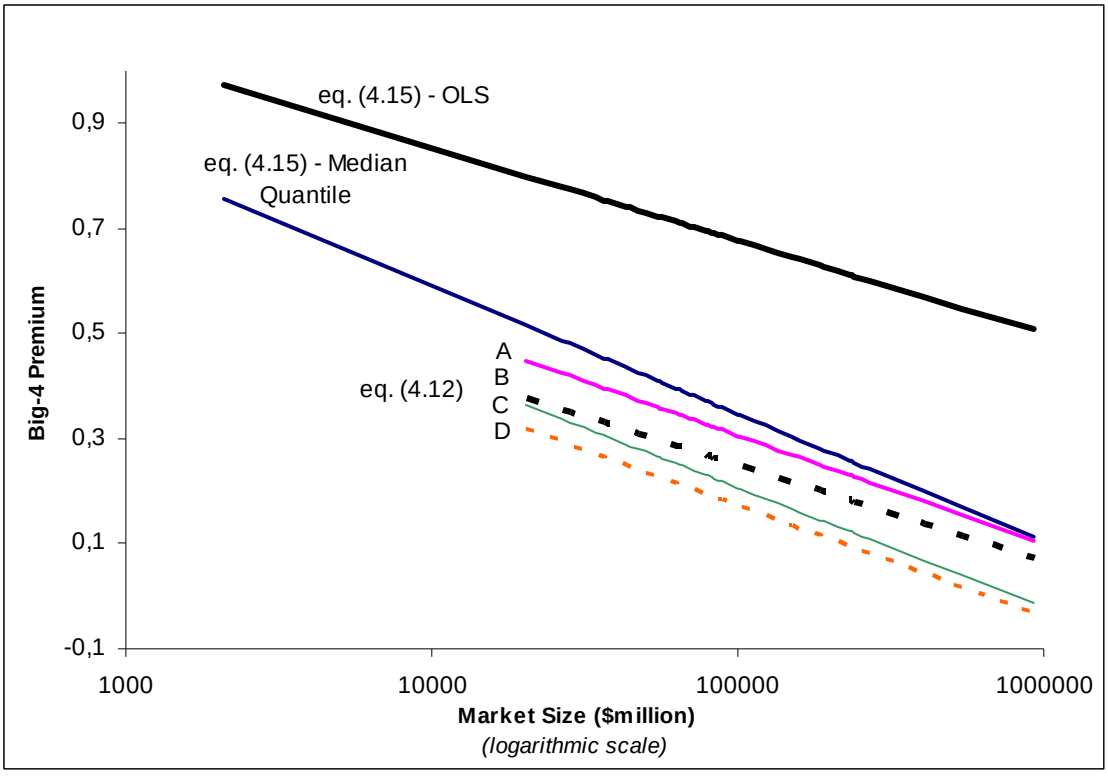
Where all variables are as defined previously. An alternative test for US-H6 is to evaluate whether or not the coefficient on *BIG4*LNGDP* is significantly negative (i.e., $\beta_5 < 0$). *LNGDP* is then included as a control for unobservable market characteristics. However, as stated above, these may not be correlated with market size and I therefore make no prediction for the sign of the coefficient on *LNGDP* (i.e., $\beta_4 = ?$). The main advantage of using eq. (4.15), besides its simplicity, resides in the possibility to use all the available data without imposing a minimum number of observations in each market to reliably estimate market specific intercepts and Big-4 audit fee premia. This potentially increases the power of the analysis. On the other hand, because *LNGDP* and *CSTX* (as well as *BIG4*LNGDP* and *BIG4*CSTX*) are highly correlated (see Table 4.16), coefficients for these variables are estimated much less precisely (i.e., multicollinearity). Also, unobservable market characteristics are not explicitly included in eq. (4.15). Overall, this can significantly reduce the reliability and power of the analysis.

I estimate eq. (4.15) on the full sample using OLS and median quantile regression and report the respective results in columns (3) and (4) of Table 4.17 (see above). Notice that the sample size is increased by 575 observations to 7,417. Results on engagement specific control variables are equivalent to those for eq. (4.11) (i.e., columns (1) and (2)). As expected, the coefficient on *BIG4* is significantly positive. And, consistent with US-H6, Big-4 audit fee premium is decreasing in market size as evident from the significantly negative coefficient on *BIG4*LNGDP*. Results on *BIG4*CSTX* and *BIG4*LNBIG4* are also consistent with result reported earlier in columns (1) and (2). Overall, results from eq. (4.15) are equivalent from those obtained using the "two-stage" approach, with one notable exception. Indeed, the coefficient on *CSTX* is insignificantly different from 0 while the coefficient on *LNGDP* is significantly positive. Because these two variables are highly correlated, *LNGDP* captures the full effect of costs differences across markets. Yet, the conclusion regarding US-H6 remains unchanged.

Interestingly, the change in Big-4 audit fee premium with market size is very similar regardless of the estimation technique used. Moreover, the reduction in Big-4 audit fee premium is economic significant. I illustrate in Figure 4.4 the negative relation between Big-4 fee premium and market size estimated from eqs. (4.12) and (4.15). Lines are drawn from the smallest to the largest market included in the samples; that is, from Logan, UT-ID ($2.1b GDP) to New York – Newark – Edison, NY-NJ-PA ($920.7b GDP) for eq. (4.15), and Greenville, SC ($20.3b GDP) to New York for eq. (4.12). And although the line from the OLS estimation of eq. (4.15) stands above all other lines, their slopes are all very similar.

Figure 4.4 Estimated Big-4 Fee Premium with Market Size

- Line A is the OLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{OLS}$.
- Line B is the WLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{OLS}$.
- Line C is the OLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{MQ}$.
- Line D is the WLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{MQ}$.



To understand better how Big-4 audit fee premium evolves with market size, I present in Table 4.20 estimates of Big-4 premia for 8 "representative" markets (including the smallest and largest markets included in the sample). Panel A presents Big-4 audit fee premium "point estimates" for each market, determined from the coefficients obtained from the different estimations of eqs. (4.12) and (4.15). These represent an approximate measure of the Big-4 audit fee premium; that is, the approximate percentage difference between Big-4 audit fees relative to Non-Big-4 audit fees, all else equal. From this approximation, it is possible to observe that the Big-4 audit fee premium between Greenville, SC and New York drops by a significant amount of about 30 to 40 percentage points. However, the approximation error becomes greater as the change in *LNGDP* becomes larger (Wooldridge [2003, p. 88]. To address this, I apply a common simple

correction and present in Panel B the "corrected" estimated Big-4 premium per market (i.e., the exponential of the "point estimate", minus 1). In any case, the conclusion is the same: (1) the reduction in percentage points of the Big-4 audit fee premium as market size increases is economically significant; and (2) the drop in percentage points is approximately equal regardless of the estimation technique used. In Panel B, this drop ranges from 38 to 56 percentage points.

Finally, unreported results for eq. (4.12) are also robust to alternative estimation techniques. To limit the influence of outliers, I estimate eq. (4.12) (for both sets of estimates φ_{2j}): (1) using median quantile regression; and (2) using OLS and WLS after deleting φ_2 estimate for San Antonio, TX ($55.2b GDP) as it significantly deviates from other estimates with $\varphi_2^{OLS} = 1.374$ and $\varphi_2^{MQ} = 1.045$. I also estimate all WLS regressions using the inverse of the variance (i.e., $1/\text{var}(\hat{\varphi}_{2j})$) as weights. I all cases, results are equivalent to the ones reported earlier. Overall, the evidence strongly supports US-H6$_1$.

Table 4.20 Estimated Big-4 Audit Fee Premium for Representative Markets – Illustrative Example

Market	GDP ($b)	Estimation from eq. (4.12): $\hat{\omega}_0 + \hat{\omega}_1 * LNGDP_j$				Estimation from eq. (4.15): $\hat{\alpha}_1 + \hat{\beta}_5 * LNGDP_j$	
		(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Point Estimate							
GREENVILLE, SC	**20.3**	0.45	0.38	0.36	0.32	0.80	0.52
TULSA, OK	**31.2**	0.41	0.34	0.32	0.28	0.77	0.47
SALT LAKE CITY, UT	**43.1**	0.38	0.32	0.29	0.25	0.74	0.44
LAS VEGAS-PARADISE, NV	**62.7**	0.35	0.29	0.25	0.22	0.71	0.40
PITTSBURGH, PA	**88.2**	0.32	0.26	0.22	0.18	0.69	0.36
ATLANTA-SANDY SPRINGS-MARIETTA, GA	**211.2**	0.24	0.19	0.13	0.10	0.62	0.27
LOS ANGELES-LONG BEACH-SANTA ANA, CA	**538.4**	0.15	0.11	0.04	0.02	0.55	0.17
NEW YORK-NEWARK-EDISON, NY-NJ-PA	**920.7**	0.11	0.07	(0.01)	(0.03)	0.51	0.11
Difference: Greenville - New York		**0.34**	**0.30**	**0.38**	**0.35**	**0.29**	**0.40**
Panel B: Corrected Estimated Big-4 Premium (exp[POINT ESTIMATE] – 1)							
GREENVILLE, SC	**20.3**	57%	46%	44%	38%	122%	67%
TULSA, OK	**31.2**	51%	41%	38%	32%	115%	60%
SALT LAKE CITY, UT	**43.1**	46%	37%	34%	28%	110%	55%
LAS VEGAS-PARADISE, NV	**62.7**	42%	33%	29%	24%	104%	49%
PITTSBURGH, PA	**88.2**	37%	30%	24%	20%	99%	43%
ATLANTA-SANDY SPRINGS-MARIETTA, GA	**211.2**	27%	21%	14%	11%	86%	31%
LOS ANGELES-LONG BEACH-SANTA ANA, CA	**538.4**	17%	12%	4%	2%	73%	18%
NEW YORK-NEWARK-EDISON, NY-NJ-PA	**920.7**	11%	7%	-1%	-3%	66%	12%
Difference: Greenville - New York		**45%**	**38%**	**45%**	**41%**	**56%**	**56%**

Columns (1) is the OLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{OLS}$; column (2) is the WLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{OLS}$; column (3) is the OLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{MQ}$; column (4) is the WLS estimation of eq. (4.12) on $\hat{\varphi}_{2j}^{MQ}$; column (5) is the OLS estimation of eq. (4.15); and column (6) is the estimation of eq. (4.15) using median quantile regression.

4.7 Conclusion and Discussion

The most significant contribution of this study is to evaluate audit firm competition in the U.S. using well established techniques used in the industrial organisations literature in combination with techniques developed in the auditing literature. Indeed, audit firm competition and its impact on market structure, audit quality and audit fees is difficult to understand. Only by performing a thorough analysis of the structure of the audit industry jointly with tests of audit quality and audit fees is it possible to paint a more complete picture of the complex dynamics of the industry.

The results also have important policy implications. Taken together, the results are consistent with the ESC framework and suggest that the U.S. audit industry is competitive, despite the high level of concentration. In fact, Big-4 audit firms' domination of the industry has not adversely impacted audit quality and audit fees. Surveying client-firms, auditors, academics and other market participants, the GAO reached similar conclusions in its most recent study of the industry (GAO [2008]). This study, however, offers more formal evidence on these issues.

Interestingly, the ESC model predicts that recent market share gains by Non-Big-4 auditors in the small to medium sized public company market segment may only be temporary. Indeed, concentration in this segment of the audit market has decreased since 2002, but this seems mostly driven by a temporary market shock created by the passage of SOX. Following SOX, audit fees generally increased, forcing some client-firms seeking cheaper alternatives to switch to a Non-Big-4 auditor. At the same time, the additional work load prompted Big-4 auditors to drop smaller, less profitable audit clients to focus on their larger clients. Yet, as market participants have adapted, Big-4 auditors are likely to resume more active competition with Non-Big-4 auditors in order to reclaim lost market shares, especially in current harsh economic times. In fact, this view is echoed in a recent article stating that Big-4 audit firms are aggressively attempting to lure back clients they lost to the Non-Big-4 audit firms by discounting rates by as much as 20% to 25% and increasing marketing efforts (Cole [2008]). This is entirely consistent

with the ESC framework. Based on this model, the higher-quality Big-4 auditors naturally dominate the audit industry and the level of market concentration in the small to medium company market segment is, consequently, likely to return to higher pre-SOX "equilibrium" levels. This is an interesting future research question in itself. Finally, the severity of the current economic crisis can also provide a natural setting for investigating further how Big-4 and Non-Big-4 audit firms differ in their investment strategies.

5 NATIONAL AUDIT MARKETS: AN EXPLORATORY STUDY

In this section, I describe how differences in national audit market characteristics, namely market size and institutional and regulatory environments can affect the structure of the auditing industry and the level of audit quality and audit fees, particularly differences between Big-4 and Non-Big-4 auditors. I build on the ESC framework to develop testable empirical predictions, although a formal test of these hypotheses is left to future research. I conclude this section by presenting preliminary evidence supporting these hypotheses based on results reported in published works.

5.1 Motivation and Literature Review

A cross-country setting provides a natural experiment to explore the impact of institutional and regulatory factors on the auditing industry. This is the main contribution of this study as it provides the strongest setting to test *Observations 5* and *6* presented in Section 3.5; i.e., the relation between the relative market demand for high-quality Big-4 audits (θ), industry structure and the difference between Big-4 and Non-Big-4 audits (fees and quality). But because national markets vary greatly in size as well, this study is helpful for re-validating *Observations 1'* through *4* which were the focus of Section 4.

5.1.1 The Impact of Institutional and Regulatory Factors on the Structure and Dynamics of the Auditing Industry

As noted in Section 2, government and regulatory agencies, professional accounting bodies, business associations and private interest groups have recently expressed concerns over the current level of market concentration and the potential adverse impact this may have on audit quality and fees[136]. As a result, institutional and regulatory changes have been, or are being, considered in order to facilitate entry into the industry

[136] These concerns are greatest for the public company audit market segment in general and the audit market for large multinational public companies in particular. A limitation on the number of capable audit suppliers is a major concern for these companies (i.e., restricted auditor choice), even if a highly concentrated market need not imply higher audit fees and/or lower quality audits.

or, at the very least, prevent the exit (or "fall") of an important industry player (i.e., Big-4). These efforts are aimed to insure a sustainable and competitive audit market by, among other things, preventing (or limiting) further concentration of the industry (e.g., GAO [2008] and London Economics [2006]). For example, the European Union (E.U.) recently assessed the impact a series of modifications to its member states' civil liability regimes would have on statutory audits (London Economics [2006] and EC-DG [2008]). The final report recommends that a directive be issued encouraging member states to introduce limitations to their liability regimes, although the precise mechanisms by which this would be achieved are left to the member states' discretion (e.g., some form of liability caps, proportionate liability, contractual limits on liability, etc.).

Likewise, auditor liability reform is also being considered (or suggested) in the United States. Indeed, the stringent auditor liability regime of the U.S. and the threat of crippling liability are often seen as significant deterrents limiting entry and/or the growth of smaller audit firms into the public company audit market segment (e.g., GAO [2008])[137]. Moreover, the probability of a Big-4 auditor disappearing following catastrophic litigation is nontrivial; which would raise further the level of concentration (e.g., The American Assembly [2005], Talley [2006], U.S. Chamber of Commerce [2007] and AICPA [2008]). Not surprisingly, there have been calls to reform the U.S. auditor litigation regime and limit in some way the burden imposed on auditors (e.g., Sustaining New York's and the U.S.' Global Financial Services Leadership [2007], U.S. Chamber of Commerce [2007] and AICPA [2008]).

Other institutional factors are also seen as having a potential impact on the structure of the auditing industry. For example, restrictions on audit firm ownership rules (and related regulations) may limit audit firms' access to (financial) capital, especially smaller firms, and thus hamper growth and entry into the industry (e.g., Office of Fair Trading [2004], Oxera Consulting [2007] and GAO [2008]). Essentially, ownership restrictions create an exogenous barrier to entry. In this respect, potential changes to ownership rules have

[137] In the same vein, prohibitive liability insurance (or simply the inability to purchase appropriate insurance) also limits growth and/or entry into the industry.

been considered in Europe (Oxera Consulting [2007]) and lobbied for in the U.S. (U.S. Chamber of Commerce [2007]).

Although significant liability costs and ownership restrictions may be considered as exogenous barriers to entry, their true impact on market structure is unclear. First, in a study on audit firm ownership rules in the E.U., Oxera Consulting [2007] found no evidence that the level of market concentration is related to differences in ownership rules or general ownership structures adopted across member states. The study concludes that changes to audit firm ownership rules in the E.U. would have only a limited effect on market configuration. Similarly, GAO [2008] concludes that such measures in the U.S. would also have minimal impact and recommend no (immediate) direct intervention in the audit market by U.S. authorities to address the concentration issue.

Second, a study commissioned by the E.U. reports evidence that the audit market (for public companies) in E.U. countries where an auditor liability cap is in effect have a slightly less concentrated market configuration than in counties with no such cap (London Economics [2006]). However, the concentration measures used are based on the number of audit engagements (rather than actual fees) and the results are sensitive to the market definition (i.e., number of public companies included in the calculation). The study also cautions against any generalisation of the results as the sample of E.U. member states with liability caps is too small to draw strong inferences and the authors acknowledge that many other factors affect market structure[138]. Overall, the evidence from the study only suggests a weak link between market structure and audit firm ownership rules.

Third, in assessing the implications for competition of a cap on auditor liability, a report by the Office of Fair Trading (U.K.) concluded that "(…) unlimited liability is, at most, a minor entry barrier in comparison to other impediments to entry (…)" (Office of Fair

[138] Survey results presented in section 32.3 of the London Economics 2006 study also suggest that audit firm client acceptance decisions, with respect to the perceived riskiness of a potential client, are not significantly different between audit firms operating in countries with liability caps from those operating in countries with no caps.

Trading [2004, p. 10]) and argues that allowing liability caps would be "competitively neutral overall". In fact, other barriers to entry viewed by the OFT as more significant (i.e., reputation, global networks and economies of scale) have been argued previously in Section 3 to have evolved, to a significant degree, endogenously (i.e., through audit firm conduct). Doubts about the usefulness of auditor litigation reform to limit (or lower) industry concentration have also been expressed by U.S. authorities. Indeed, the Advisory Committee on the Auditing Profession, appointed by the U.S. Treasury Secretary, failed "(…) to reach a consensus as to whether limits on auditor liability would be beneficial or harmful to the capital markets and to investors or, for that matter, whether such limits are necessary to sustain the auditing profession" (ACAP [2008, p. VII:23]).

Clearly, more research is needed to better understand the complex links which (may) exist between institutional and regulatory characteristics and the structure of the auditing industry. More important is the need to also consider demand-side characteristics when investigating this relation. Indeed, the fundamental point of this thesis has been to demonstrate the importance of demand-side characteristics in influencing auditor conduct; essentially, how market size and the "local" demand for audit quality influences auditors' investment decisions. Yet, the current debate has essentially taken a "supply-side" approach by focusing on how exogenous market characteristics, such as auditor liability regime and ownership rules, impact auditors' cost functions and consequently their conduct (e.g., entry/exit decisions, client acceptance, audit quality and fees, etc.). Hence, investigating the relation between market structure, audit product attributes and local market institutional and regulatory characteristics (to the extent these affect the relative demand for audit quality) from the perspective of the ESC framework improves our understanding of these complex and misunderstood interactions and contributes to the debate.

At first glance, while most national audit markets generally appear to be concentrated (e.g., Walker and Johnson [1996] and Narasimhan and Chung [1998]) and dominated by the Big-4 audit firms, there are some differences across markets. Building on the intuition of the ESC framework, the primary objective of this study is to determine if these

differences in market structure are significant and whether they can be, at least partially, explained by variations in market characteristics. This is essentially an empirical test of *Observations 2*, *3* and *6* presented in Section 3.

To date, the literature on audit market structure is mostly country specific and descriptive in nature. In fact, with the exception of perhaps London Economics [2006] and Oxera Consulting [2007], I know of no study that formally compares general market configurations across multiple countries on the bases of key macroeconomic characteristics, such as market size and legal regime. As well, these two studies only cover the E.U. and fail to simultaneously account for the potential effect of market size on market structure. Moreover, in both cases, the particular analyses comparing market structure to specific institutional characteristics were secondary to the main objective of the study and were not driven by an underling theory.

Finally, I am aware of only one study that actually compares Big-4 market dominance across countries on the bases of institutional characteristics (i.e., investor protection and legal origin). Francis *et al.* [2003] find that Big-4 (Big-5 in their study) cumulative market share (as measured by the square root of total assets audited) is greater in countries with stronger investor protection. Nonetheless, the study I propose adds to the literature in several ways. For one, Francis *et al.* [2003] use Big-4 market shares as a proxy for the level of audit quality per country and thus can only provide an indirect explanation for this finding. Specifically, their hypothesis states that "countries with strong investor protection have higher quality accounting and higher quality auditing than countries with weak investor protection" Francis *et al.* [2003, Hypothesis 1]. Although the logic behind their hypothesis is well supported by the international governance literature, it need not imply, in its present formulation, that cumulative Big-4 market shares be positively correlated with investor protection[139]. By building on the industrial economic literature, however, I make an explicit claim about the link between Big-4

[139] For example, higher audit quality could involve both Big-4 and Non-Big-4 audits as a result of stricter (exogenous) regulations and audit oversight which may be correlated with investor protection. Of course, the authors implicitly assume that higher audit quality is predominantly delivered by Big-4 auditors.

market dominance and institutional factors (*Observation 6*)[140]. Furthermore, their study neither investigates other aspects of the general market structure nor considers the possible impact of market size (*Observations 2* and *3*).

In fairness, Francis *et al.* [2003] is more a study on audit quality and corporate governance (i.e., the link between institutional characteristics and audit quality) than a study on the structure of the auditing industry. As a proxy for audit quality, the auditors, however, retained a measure that appeals more to the study of audit market configuration. The ESC framework has the advantage of explicitly illustrating the link between market structure and audit quality, thus painting a more complete picture. Hence, it may be more appropriate to revisit the authors' hypothesis by investigating simultaneously market configurations and attributes of the audit product, namely audit quality and fees, across countries. This latter point is explained next.

5.1.2 Cross-country differences in audit quality and fees

It is only natural to extend on the market structure analysis and investigate cross-county differences in audit quality and fees. This study therefore contributes to the growing literature on international governance, and specifically on the role auditors play (e.g., Francis *et al.* [2003], Fan and Wong [2005] and Choi and Wong [2007]).

There are several analytical studies illustrating the connection between audit quality and/or audit fees and specific aspects of the audit environment (e.g., auditor liability, regulatory environment, etc.)[141]. While a full review of this literature is beyond the scope

[140] While Francis *et al.* [2003] argue that the relative demand for Big-4 audits is higher in countries with stronger investor protection, it is not obvious in their setting that the cumulative market share of Big-4 auditors would itself necessarily be higher.

[141] Analytical studies include Newman *et al.* [2005] who show that, among other things, markets with relatively greater auditor penalties for audit failure have higher audit fees. However, the relation between the audit product and audit environment is not always clear-cut. For example, Nelson *et al.* [1988] show that increased damaged awards do not always lead to increased auditor effort under some liability regimes. Likewise, Narayanan [1994] shows that contrary to popular wisdom, proportionate liability regimes may actually lead to higher audit quality in comparison to audits performed under a "joint and several" liability regime. Other attributes, such as auditing standards, have been shown analytically to affect auditor conduct (Dye [1993] and Schwartz [1998]). See Watkins *et al.* [2004] and London Economics [2006, Annex 6] for reviews.

of this thesis, empirical evidence also generally confirms that both audit fees and audit quality are affected by institutional characteristics (e.g., Taylor and Simon [1999] and Francis [2004], see Section 2.2 for an earlier discussion). However, all these previous studies (both analytical and archival) derive their hypotheses and explanations from the standard reputation and "deep-pocket" hypotheses, and thus from a "supply-side" perspective. Moreover, many empirical studies are country-specific which limits direct comparison of the results. Finally, specific differences between Big-4 and Non-Big-4 audits across countries are seldom studied and generally not well understood (e.g., Choi *et al.* [2008a] and Francis and Wang [2008]). More work is needed in this area as authors document conflicting results and explanations often vary.

One recent example is Choi *et al.* [2008a] and Francis and Wang [2008]. The first authors conjecture and document a negative relation between Big-4 audit fee premium and the strictness of a country's legal regime. Choi *et al.* [2008a] argue that as the strictness of legal regimes increases, both Big-4 and Non-Big 4 audit firms increase effort, and thus fees. However, under the assumption that Big-4 auditors face higher potential litigation costs for any engagement (i.e., "deeper pockets"), their analytical model shows that Non-Big-4 auditors will actually increase their effort relatively more than Big-4 auditors as the strictness of legal regimes increases. In effect, this reduces the fee gap between the two sets of firms (i.e., lower Big-4 audit fee premium), but also implies that the spread between Big-4 and Non-Big-4 audit quality decreases (i.e., decreasing Big-4 audit quality relative to Non-Big-4 auditors).

On the other hand, Francis and Wang [2008] argue that Big-4 audit quality is increasing, relative to Non-Big-4 audit quality, with the degree of investor protection, an attribute strongly (positively) correlated with the measure of legal regime strictness used in Choi *et al.* [2008a]. Francis and Wang [2008] analyse measures of earnings quality (i.e., earnings conservatism) and document results consistent with their hypotheses. Hence, both studies present very different hypotheses and report seemingly conflicting results. While both groups of authors acknowledge the work of the other, they generally offer no explanation to reconcile the results and conclude that more research is needed to address

this issue, which is echoed in a discussion paper by Magnan [2008]. Interestingly, the ESC model I propose offers an explanation that is consistent with observations in both studies. Therefore, the ESC framework can provide valuable insight into an issue that remains largely unresolved.

5.2 Hypotheses

The hypotheses are derived directly from the observations presented in Section 3. Since predictions are conditional on θ (*Observations 5* and *6*), it is important to determine in which way observable country-specific characteristics affect this parameter. That is, how institutional and regulatory factors impact the relative market demand for high-quality Big-4 audits. This is discussed in detail in Section 5.2.1 below before formally presenting the hypotheses.

5.2.1 Institutional and Regulatory Environments and the Demand for Big-4 Audits

In real audit markets with heterogeneous client-firms, the value, net of audit fees, derived from high-quality Big-4 audits will likely differ across client-firms as the level of information asymmetry between insiders and outsiders likely varies. Moreover, agency costs associated with information asymmetry along with firm outsiders' ability to monitor and protect their investments are affected by local institutional and regulatory characteristics, such as the strength of outside investor protection[142]. Consequently, individual client-firm demand for Big-4 audits will be a function of both client-firm and country specific characteristics. The objective here is to extrapolate from individual client-firms' demand for Big-4 audits and estimate aggregate (i.e., country specific market) demand for such audits.

As was argued in Section 3.5, instances where there is little information asymmetry between management and stakeholders, or where agency conflicts in general are

[142] Investor protection is broadly defined and intended to capture a wide range of institutional factors such as disclosure requirements, liability standards and anti-director rights (La Porta *et al.* [2006]). For this study, I limit country specific institutional and regulatory characteristics to the level of investor protection.

mitigated through alternative mechanisms other than external auditing, the demand for higher audit quality may be limited. For example, the benefit to client-firm value (e.g., lower cost of capital, limited expropriation of assets, etc.), net of audit fees, may be less important for companies with highly concentrated ownership and insider-dominated corporate governance structures. Essentially, these alternative governance mechanisms substitute for the demand of high-quality Big-4 audits. And because countries with weaker investor protection generally have more concentrated ownership and insider-dominated corporate governance structures (Shleifer and Vishny [1997], La Porta *et al.* [1999] and Shleifer and Wolfenzon [2002]), one could expect, *ceteris paribus*, that the aggregate demand for Big-4 audits is higher in countries with stronger investor protection (Francis *et al.* [2003]).

Moreover, in certain legal environments, company insiders may have greater incentive and ability to successful expropriate shareholder wealth (e.g., Shleifer and Vishny [1997]). For example, Leuz *et al.* [2003] report lower earnings quality (i.e., greater earnings management) in countries with weaker investor protection regimes. They argue that in such countries, company insiders have greater ability to acquire private control benefits and thus have greater incentive to manage earnings in order to mask true firm performance. Consequently, it is equally likely that insiders will seek to appoint a lower quality (Non-Big-4) auditor to successfully conceal true firm performance and, on average, the demand for high-quality Big-4 auditors should be lower[143].

[143] Notice as well that countries with stronger investor protection generally have more developed and better performing financial markets (La Porta *et al.* [1997, 1998] and Shleifer and Wolfenzon [2002]). Also, these markets generally have rules that limit the influence firm insiders have on the auditor selection process (e.g., independent audit committees). In such environments, firm insiders will generally behave more in accordance with corporate outsiders' incentives because of the discipline imposed by better functioning financial markets. Hence, even if insiders, such as company managers, were successful in proposing the appointment of a lower quality Non-Big-4 auditor, they would likely suffer the full burden of the reduction in firm value which results from the negative signal. That is, the capital market will more accurately react and outside investors will take concrete actions that impose real costs on insiders (i.e., "price protection"). This includes a reduction in the value of insiders' portfolio of company shares and options, lower bonus pay, employment termination and even direct legal action, etc. On the other hand, in countries with weak investor protection, insiders will potentially get away with selecting a lower quality Non-Big-4 auditor without suffering the full burden of the cost. Here, either outside investors are slow (or unable) to react appropriately (i.e., ineffective capital market), they are limited in the legal actions they can take against insiders and/or auditors (i.e., weak investor protection), or they are simply unable to distinguish and detect opportunistic insider behaviour (i.e., non-transparent disclosure rules). Even if the selection of a lesser quality auditor is self revealing, insiders may be able to extract greater net personal wealth in a weak legal

The choice of a Big-4 auditor is also positively correlated with client-firm size (e.g., GAO [2003b], Oxera Consulting [2006] and Choi and Wong [2007]). One reason is that smaller auditors often have insufficient capacity to audit large companies (GAO [2003b] and Oxera Consulting [2006]). In the same vein, client-firms may have limited budgets allocated to external auditing which in turn can limit their ability to hire a Big-4 auditor. Finally, larger client-firms may simply value Big-4 audits more (see Sections 3.5 and 4.3.2 for a more detailed discussion). Again, as evidence suggests that firms are larger in countries with stronger investor protection (Shleifer and Wolfenzon [2002]) and more efficient judicial systems (Rajan *et al.* [2001]), the aggregate demand for Big-4 audits is expected to by higher in countries with stronger investor protection[144].

Taken together, the arguments presented above suggest that overall, *ceteris paribus*, the aggregate demand for Big-4 audits is higher in countries with stronger investor protection[145]. Formally:

Observation 7

θ is increasing in the strength of investor protection.

Importantly, however, this prediction need not be in contradiction with recent results reported by Choi and Wong [2007]. Indeed, they find evidence that Big-4 auditors play a more important governance role in countries with weaker investor protection (i.e., high-quality Big-4 audits substitute for weaker country-level investor protection mechanisms)[146]. Yet, their focus is on *individual client-firm* demand for Big-4 audits (i.e., micro level) while this study focuses on *total market* demand for Big-4 audits (i.e., macro level) as an important determinant of auditor conduct. In fact, their "aggregate" results show a positive relation between Big-4 auditor choice and the strength of a

environment. Overall, this reinforces the idea that the demand for Big-4 audits would be lower in weaker investor protection regimes.

[144] For this reason, the relevant national audit markets need to include client-firms of all sizes, as the size distribution of client-firms is an important determinant of the relative demand for Big-4 audits within a country. This is in contrast to the U.S. study where it was preferable to exclude large public companies from the sample (see Section 4.3.2).

[145] Controlling for simultaneity and other factors affecting the demand for Big-4 audits is especially difficult here. This is discussed in greater detail in Section 5.2.4 below.

[146] Fan and Wong [2005] also demonstrate that Big-4 auditors play an important governance role in countries with generally weak investor protection (i.e., East Asia).

country's investor protection regime (Choi and Wong [2007, Tables 1 and 3], I return to this in Section 5.3) [147].

5.2.2 Market Structure

Detailed hypotheses referring to the market structure of the auditing industry are derived directly from *Observations 2*, *3* and *6* presented in Section 3, along with *Observation 7* presented above. Controlling for differences in investor protection, the general predictions about market structure in relation to market size should hold. As in the U.S. study (Section 4), the first hypothesis states the non-convergence result of auditor concentration (formulated in alternative form):

> Int-H1$_1$: The minimum level of auditor concentration does <u>not</u> converge to 0 as market size becomes very large ($S \rightarrow \infty$): $C1 > 0$.

Here, markets are defined nationally[148] (i.e., countries) and size refers, as in the U.S. study, to the size of the local economy measured by national GDP. Int-H1 is simply a reformulation of *Observation 2*.

As for the form of the market size-structure relationship, this depends on cost parameters σ, a and γ which are difficult to observe. Unlike the U.S. audit market, it is much more difficult to offer a prediction for this relation (US-H2) in an international setting. As such, it is an empirical issue whether or not the size-structure relationship is monotonic or not and I present only a general hypothesis (*Observation 3*):

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[147] Also, a recent finding by Francis and Wang [2008], at first glance, appears to contradict the notion that high audit quality acts as a substitute for weaker investor protection. Indeed, they find that earnings quality is increasing in the strength of a county's investor protection regime, but only for client-firms with Big-4 auditors. This can be interpreted as audit quality and investor protection working as complementary governance mechanisms, not substitutes. If this is true, it is unclear what additional value client-firms facing high agency costs in countries with weak investor protection would derive from supposedly higher Big-4 audit quality. Hence, why these client-firms are more inclined to demand Big-4 audits remains unclear.

[148] This is consistent with the international governance literature. Countries can be though of independent audit markets and institutional and regulatory environments are generally constant within a country. Although there are often state, provincial or territorial level regulations in place within counties, these are assumed to induce only limited variations in auditor and client-firm conduct. Furthermore, many countries are often too small that auditors only operate in one or a few locations. Hence, partitioning national markets would lower the power of the analysis (even for the U.S., as this would complicate comparisons across countries). The objective here is to evaluate cross-country differences.

Int-H2: The relation between market size and auditor concentration, as measured by the market share of the leading audit firm, is possibly non-monotonic.

Int-H1 and Int-H2, however, make no formal claim about the market dominance of Big-4 auditors across different national markets. Yet, as demonstrated in Section 3.5, because the value of Big-4 audits (either higher audit quality and/or lower audit fees) is increasing in investor protection (*Observations 5* and *7*), the cumulative market share of the Big-4 auditors should also be increasing in investor protection. Formally, this is stated in the following hypothesis (formulated in alternative form):

Int-H3$_1$: The combined market share of the Big-4 auditors is increasing in the strength of investor protection.

Int-H3 is a reformulation of *Observation 6b* and results directly from *Observations 5* and *7*. This is an important contribution of this study. With respect to market size, it is also expected that Big-4 audit firms will grow and dominate more often national audit markets as the size of those markets increases. The idea is that Big-4 auditors will invest more in audit technology as market size increases, while the size of Non-Big-4 auditors should generally remain the same on average, as it is the number of Non-Big-4 entrants that increases with market size. Essentially, I adapt US-H3 from Section 4.4.1 to an international setting (formulated in alternative form):

Int-H4a$_1$: Big-4 auditor size is increasing in market size (i.e., greater market shares per national partnerships);
Int-H4b$_1$: Big-4 auditors lead more often in larger national markets (i.e., greater market shares).

From the above hypotheses, it is clear that both market size and the strength of investor protection impact the structure of the auditing industry, and most importantly, the size and market dominance of Big-4 auditors.

5.2.3 Audit Product

The size and market dominance of Big-4 audit firms are found to increase with both market size and the strength of investor protection because these auditors' capital investment strategies differ from that of Non-Big-4 auditors. Essentially, as more investment opportunities become available (i.e., larger markets and/or greater demand for Big-4 audits), Big-4 auditors invest more in audit technology and the relative value of their audits increases accordingly. With this in mind, the following two hypotheses can be formulated (in alternative form):

Int-H5$_1$: The value of Big-4 audits relative to Non-Big-4 audits is increasing in market size.

Int-H6$_1$: The value of Big-4 audits relative to Non-Big-4 audits is increasing in the strength of investor protection.

Int-H5 is simply a reformulation of *Observation 4* while Int-H6 results from *Observations 5* and *7* (see Section 3.5). Since audit value is defined as the ratio of audit quality to price, the more relevant research question is how specifically Big-4 audit quality and fee premium, relative to Non-Big-4 auditors, evolve with market size and the level of investor protection[149].

How Big-4 audit firms are structured has significant implications for how capital investments are undertaken and thus how Big-4 audit fees and audit quality evolves. Big-4 audit firms are organised as international networks of independent and legally distinct national member firms[150]. These member firms are set up as national legal entities, most often as limited liability partnerships. Member firms are linked though a central international entity which performs a coordinating role but provides no services to

[149] While the level of audit quality and audit fees for both Big-4 and Non-Big-4 auditors may vary across countries for a variety of reasons, the focus here is on how the difference between Big-4 relative to Non-Big-4 audits evolves across national markets.

[150] In most jurisdiction, locally operating audit firms are required to be owned and governed by a majority of (if not exclusively) locally licensed professionals (Oxera Consulting [2007] and ACAP [2008]). There is also a benefit of creating separate national legal entities as this "shields" international member firms from legal actions against one member in a specific country. Francis and Wang [2008, footnote 3] point out that the PCAOB (U.S.) requires separate registration for each Big-4 national partnership involved with SEC registrant and argue that this is consistent with the "country-specific" view of Big-4 audit firms.

clients[151]. This central body acts mostly to promote the audit firm's international brand; identify, develop and coordinate global business strategies; and facilitate and coordinate interactions and knowledge sharing between member firms. By entering into a global membership, member firms commit to a code of conduct and set quality standard in exchange for the right to use the firm's brand name. Other privileges associated with membership include an access to local experts in other countries, shared knowledge and expertise, common auditing methodology, etc. In fact, this standardisation is valued by audit clients (especially large multinational firms or firms with international investors) as it lowers uncertainty about the quality of the audit services purchased.

In recent years, global Big-4 networks have become increasingly integrated and have thus been able to gain additional economies of scale (ACAP [2008]). However, national member firms remain legally independent and the international entity has no legal responsibility with respect to the actions of its members. The network governance structure is such that national partnerships develop and follow in large their own (local) business strategies, adapted to their local market[152]. Hence, although these member firms contribute to the development and growth of the global network, they nonetheless operate at a national level.

Moreover, national members of Big-4 networks play different leadership roles within their respective network. For example, initial technological innovations to enhance audit quality and improve the efficiency of the audit process are usually spearheaded by the largest member firms, such as the U.S. and U.K. partnerships. And while there is a strong incentive to share these innovations across the network as all members share a common international brand name, the member firm initialising such investments are likely the main beneficiary. That is, member firms investing earlier in a technology will generally make a more effective and efficient use of it (e.g., better knowledge, integration, etc.).

[151] PricewaterhouseCoopers International Limited (a U.K. membership-based company); Ernst & Young Global Limited (a U.K. company limited by guarantee); Deloitte Touche Tohmatsu (a Swiss Verein) and KPMG International (a Swiss cooperative). Source: audit firms' websites.

[152] Evidence of this comes from country specific merger agreements between Andersen and other Big-4 firms following the Enron scandal. For example, Ernst & Young Australia "merged" with the Australian arm of Andersen while Deloitte Canada "merged" with Andersen Canada. Of course, once a partnership becomes a member of an international audit network, it agrees to respect the membership agreement.

Consequently, not all members of a Big-4 network will use audit technology in the same way and this is likely to lead to differences in both audit quality and audit fees between member firms of any given international Big-4 network.

It is an empirical question whether investments are designed to enhance audit quality or improve production efficiency; yet it is reasonable to assume that both types of investments occur at the national level. Hence, because the level of investment in audit technology is increasing with both market size and the strength of investor protection, I present the following hypotheses (in alternative form):

Int-H7a$_1$: Big-4 audit quality, relative to Non-Big-4 audits, is increasing in market size.
Int-H7b$_1$: Big-4 audit fees, relative to Non-Big-4 audits, are decreasing in market size.

Int-H8a$_1$: Big-4 audit quality, relative to Non-Big-4 audits, is increasing in the strength of investor protection.
Int-H8b$_1$: Big-4 audit fees, relative to Non-Big-4 audits, are decreasing in the strength of investor protection.

Of course, the strength of each result depends on the importance of quality enhancing audit technology investments relative to process innovating investments. Also, differences in Big-4 audit quality may be difficult to observe for several reasons. First, audit quality is empirically difficult to measure and techniques are imperfect at best. Second, the incentive for Big-4 audit networks to maintain a uniform brand-image and quality level across their network is strong. On this last point, the integration of Big-4 international networks may have recently reached a point at which differences in audit quality between member firms may become trivial[153]. Examples of this push for further integration by the Big-4 networks are reported in the Advisory Committee on the Auditing Profession's final report:

> Compelled by the increasing globalization of the capital markets and the disconnect between independent autonomous member firms and seamless provision of services, some auditing firms are moving to

[153] International regulatory changes such as the passage to IFRS and ISA may also accentuate this.

> adopt an even more structurally integrated network. For instance, in 2007 KPMG integrated its practices in the United Kingdom, Germany, and Switzerland into a single entity, a U.K. registered LP. (…) In addition, in April 2008 Ernst & Young announced its intention to consolidate practices in eighty-seven countries in Europe, the Middle East, India, and Africa into one unit led by one management team and a single profit-sharing scheme. (…) In August 2008, PricewaterhouseCoopers announced its intention to reorganize its practices into three regions: China, United Kingdom, and United States. (ACAP [2008, p. V:16])

These efforts are all very recent and may significantly alter, in the near future, the dynamics of the auditing industry worldwide. Investigating the impact of this structural change in Big-4 audit networks is in itself interesting, although I leave this to future research. Nonetheless, cross-country differences in Big-4 audit fee premium are likely to persist and are easier to identify. Indeed, many investment decisions to improve production efficiency are taken strictly at a national (and city) level based on local market conditions, and these do not compromise the brand value of the network (for example, organising specific client-firm industry training for staff, the extent of use of centralised administrative support units such as IT and HR departments, etc.).

As in the U.S. study, these hypotheses suggest that high concentration, and specifically Big-4 market dominance, does not necessarily impair Big-4 audit quality and/or raise audit fees. This is in line with recent statements by international audit firms (Global Public Policy Symposium [2006]) as well as findings by several government sponsored studies (GAO [2003b, 2003a, 2008], Oxera Consulting [2006] and London Economics [2006]) that the audit market is overall competitive. Again, however, excessively high concentration poses a real problem regarding auditor choice and could eventually lead to a reduction in audit quality and an increase in audit fees. Overall, it is an empirical issue whether or not auditor concentration in national markets has reached that point.

5.2.4 Simultaneous Demand and Supply Side Effects and Other Methodological Issues

The effects of market size and investor protection on the structure of the auditing industry, Big-4 audit quality and audit fee premium are assumed to hold when all other institutional, regulatory and other environmental factors are held constant. Careful thought must therefore be given to the design of empirical tests in order to properly distinguish from alternative explanations. This is especially difficult in a multi-country setting and is beyond the scope of this thesis. Here I present some of the issues that would need to be addressed, yet leave to future research to establish how this should be done.

First, the two test variables (market size and investor protection) are likely significantly positively correlated with one another, making it difficult to distinguish between the two. King and Levine [1993] and Levine and Zervos [1998] report that financial market development is positively associated with economic growth. Given the importance of legal environment on the development of financial markets (La Porta *et al.* [1997], La Porta *et al.* [1998] and Shleifer and Wolfenzon [2002]), it is expected that legal attributes, such as investor protection, therefore are correlated with economic growth. Indeed, Levine [1998] finds that economic growth is stronger in countries where creditor rights are emphasised and contracts rigorously enforced.

Second, as argued previously, audit quality and audit fees are directly affected by country-specific regulations governing the auditing profession in general[154] (e.g., accounting and auditing standards, oversight of the auditing profession, country and state level professional bodies, professional designation and training requirements, auditor liability regime in general, etc.). The extent of regulation and supervision of the auditing profession is likely positively correlated with investor protection[155]. The challenge, again,

[154] Regulation and supervision of the auditing profession is viewed here as having a direct impact on auditors' production cost function (i.e., "supply-side" effect).

[155] In fact, some indexes used to measure "investor protection" are actually constructed, in part, from measures of liability standards for auditors. For example, La Porta *et al.* [2006]'s "investor protection index" is itself constructed from other indices, among which a "liability standard index", itself constructed from several measures for liability including "liability standard for accountants".

is to distinguish between "supply-side" and "demand-side" drivers of audit quality and fees[156].

Third, the supply of Big-4 audits in weak investor protection regimes may itself be limited, which would impact mostly the degree of Big-4 market dominance and Big-4 audit fees. One possibility is that Big-4 auditors' client selection processes differ across legal regimes. In a way, strong investor protection can help auditors maintain their reputation for quality. Wary of opportunistic earnings management and eager to maintain their reputation, Big-4 auditors may be more selective in weak legal environments where earnings management is more prevalent (Leuz *et al.* [2003]). That is, they can restrict their service to only the (few) "least risky" audit clients[157]. This creates a selection bias which can affect observed audit quality and fees, but also directly impact the presence of Big-4 auditors in a given market. Another possibility is that Big-4 auditor expansion into newly emerging markets is still recent and limited. In this context, it may be difficult to infer much from observed market structure and audit fees as markets may significantly be out of equilibrium.

5.3 Preliminary Evidence

As preliminary evidence in support of the hypotheses presented above, I briefly discuss results presented in recently published studies. Importantly, while these results support some of the hypotheses I develop, it does not diminish the relevancy of this study and any future formal test of its predictions. In large, the questions this study raise remain open for the following reasons: (1) most of the studies presented addressed different research questions and, as such, the results I review were often interpreted in a different context and/or mostly of secondary importance to their respective study's main research

[156] In the same vein, earnings quality, often used to measure audit quality, is known to be a function of investor protection (e.g., Leuz *et al.* [2003]. This creates concerns about measuring accurately the impact of investor protection on audit quality (not just earnings quality).

[157] Of course, the reverse could be true whereby Big-4 auditors may be wiling to take on riskier clients as their legal costs in weak investor protection regimes are lower. At first glance, however, survey evidence does not suggest that, at least in the E.U., the client selection process is significantly linked to the legal environment (London Economics [2006, Section 32.3] (see footnote 136). Overall, it is unclear what impact, if any, this would have on results and deserves some consideration when designing empirical tests.

questions, (2) none of the studies considered the effects of market size, and (3) the studies employ different methodologies and samples and so are not directly comparable. Essentially, this review is intended as only a first step in validating the application of the ESC framework to the auditing industry.

Studies on the structure of the auditing industry are not directly comparable because they are often country specific and/or define market shares differently. However, the general consensus is that market concentration has been increasing and is currently fairly high in most countries investigated (e.g., Walker and Johnson [1996], Narasimhan and Chung [1998], Oxera Consulting [2006], London Economics [2006] and GAO [2003b, 2008]). Because the countries studied vary greatly in size, ranging from small economies like Hungary to the large economies of the U.K. and the U.S., this offers preliminary evidence supporting the non-convergence result of Int-H1.

Francis *et al.* [2003] formally test the relation between country-specific Big-4 aggregate market shares and investor protection. As discusses earlier, for a sample of 31 countries, they find that Big-4 cumulative market share is increasing with the degree of investor protection[158]. Their result is also consistent with descriptive statistics reported by Choi and Wong [2007, Table 1]. Partitioning their sample of 39 countries into "weak" and "strong" legal environments[159], they find that the average Big-4 (Big-5 in their study) market share is equal to 80.18% in strong legal countries, compared to 61.83% in weak legal countries. They also analyse whether the likelihood of individual client-firms hiring a Big-4 auditor increases with the strength of legal environment (controlling for client-firm characteristics and other macro-economic attributes) and find that the demand for Big-4 audits is increasing in investor protection Choi and Wong [2007, Table 3][160]. Overall, these results are in line with Int-H3.

[158] Their main test uses La Porta *et al.* [1998]'s "anti-director rights" index to measure investor protection.
[159] Their main proxy for legal environment, ENF_PRO, is equal to 50% multiplied by La Porta *et al.* [1997]'s "Rule of Law" index, plus La Porta *et al.* [1997]'s "Anti-director" index.
[160] Fargher *et al.* [2001] present results somewhat related to those reported by Choi and Wong [2007]. In an auditor choice model, they find a significantly positive relation between the likelihood of hiring a Big-4 auditor and the degree of financial disclosure (i.e., CIFAR index of international disclosure). Financial disclosure is a component of investor protection in La Porta *et al.* [2006].

With respect to the impact of legal environment on the quality and pricing of Big-4 audits relative to Non-Big-4 audits, I only know of two studies which perform a formal cross-country analysis. As discussed earlier, Francis and Wang [2008] report that Big-4 audit quality is increasing, relative to Non-Big-4 audit quality, in the degree of investor protection, while Choi *et al.* [2008a] find that Big-4 audit fee premium is decreasing in the strictness of a country's legal regime. These results are consistent with Int-H8a and Int-H8b respectively, and Int-H6 when interpreted together.

Finally, there exist many other studies presenting country-specific results concerning market structure, audit quality, audit fees, and Big-4 and Non-Big-4 audit differences. Of course, a full review of this literature is beyond the scope of this thesis. However, a formal structured review, from the perspective of the ESC framework, could yield additional insights prior to commencing a complete empirical analysis.

6 CONCLUSION

In this thesis, I propose a model of audit firm competition based on Sutton [1991]'s ESC model which builds on key features of the demand for audit services and where both audit quality and auditor size are endogenous. I therefore revisit the notion of audit quality and investigate how it is related to auditor size and the structure of the auditing industry. Specifically, I show that Big-4 audit firms compete mostly on audit value (i.e., quality and price) through capital investments in audit technology, the level of which is increasing in both market size and investor protection. Big-4 audit firms are larger and control more market shares than Non-Big-4 auditors as a result of these investments, since the superior audit technology permits them to offer higher audit quality at a relatively lower price than Non-Big-4 auditors can.

Consistent with my predictions, empirical results for the U.S. local audit market confirm that the audit industry is characterised as a natural oligopoly dominated by the Big-4 audit firms. I find that the minimum level of auditor concentration (as measured by the market shares of the top n auditors) does not converge to 0 as market size becomes very large. Moreover, auditor concentration in relation to market size is non-monotonic. The empirical evidence also supports the conjecture that Big-4 audit value is increasing in market size. I argue and find that Big-4 audit value is increasing in market size as a result of additional investments in process innovating audit technology and more important economies of scale in larger markets. Specifically, I report that with respect to market size: (1) cumulative Big-4 market share is increasing; (2) Big-4 audit quality, as measured by the level of abnormal accruals, is constant; and (3) the Big-4 audit fee premium, relative to Non-Big-4 auditors, is decreasing.

I also relate market structure, Big-4 audit quality and fee premium to the strength of a country's investor protection regime. As such, I derive a set of hypotheses to be tested in a cross-country setting. The challenges of designing an international study which would properly test these hypotheses are beyond the scope of this thesis and I leave this to future research. However, a review of the literature suggests that the hypotheses derived from

the ESC framework are generally consistent with the evidence previously documented. Yet, much insight into the audit industry can be gained from formally investigating simultaneously the impact of market size and investor protection on market structure, Big-4 audit quality and fee premium. This is especially pertinent given internationally expressed concerns over the current level of market concentration and the potential adverse impact this may have on audit quality and fees.

Taken together, my results imply that the audit industry is overall competitive. In fact, the level of Big-4 audit quality and fees across markets exhibit patterns consistent with innovations in audit quality and audit production (i.e., product and process innovations). More specifically, Big-4 audit firms invest in audit technology to compete for audit clients and as the level of such investments increases, this translates into increasing audit quality and decreasing audit fees, relative to Non-Big-4 auditors. Hence, the Big-4 auditors' incentive to innovate and improve (or at least maintain) the quality of their audits and limit the fees they charge does not seem to be diminished by their dominant market position. Rather, my thesis demonstrates that this dominant market power is, at least in part, the direct result of such innovations. This view directly challenges the classical structure-conduct-performance paradigm that guided earlier criticism over auditor concentration (e.g., Subcommittee on Reports [1977]).

In that sense, my thesis has direct policy implications as it provides key insights into the auditing industry, how audit firms compete and how the industry evolves. Mine is the only study (of which I am aware of) to theoretically explore the link between the structure of the auditing industry, audit quality and audit fees. As such, I provide support for the lack of evidence in recent reports to suggest that the high level of auditor concentration (i.e., Big-4 market dominance) has, thus far, impaired audit quality and/or lead to an abnormal increase in audit fees (e.g., GAO [2003b, 2003a, 2008], Oxera Consulting [2006] and London Economics [2006]). Hence, while recent concerns about high auditor concentration are warranted, they may be overstated.

This study also contributes to the audit quality literature by proposing an alternative explanation for the auditor-size-audit-quality relation. I argue that existing hypotheses (i.e., "reputation", "deep-pocket" and "brand-name" hypotheses) may not be strong enough in themselves to explain fully documented phenomena, such as the Big-4/Non-Big-4 dichotomy. The theory I propose relies on simpler assumptions which are supported by the academic and professional auditing literature. Moreover, my results confirm the importance of market characteristics, such as market size and investor protection regimes, in determining differences between Big-4 and Non-Big-4 audit quality and fees, and more importantly, how these differences evolve across markets.

In addition, the empirical research design I propose in the U.S. study (Section 4.5.4) makes a significant contribution to the auditing literature. Indeed, the audit fee model improves on the standard model used in the literature by explicitly including a precise proxy of audit firm labour cost and an interaction term to allow for differences between Big-4 and Non-Big-4 audit production processes. The inclusion of a proxy for Big-4 audit firm market power is also an important addition. Furthermore, the introduction of a "two stage" approach to investigate the relation between market specific Big-4 audit fee premia and a test variable offers a more powerful research design. All these adjustments to the audit fee model are well motivated by the theory developed from the ESC framework. Compared to the standard methodology used, the empirical model I develop is better suited for investigating and understanding differences between Big-4 and Non-Big-4 audit firms and the sources of the Big-4 audit fee premium. This is especially true when the research question involves comparing audits across different markets.

It is important to stress that while the evidence suggests the highly concentrated structure of the auditing industry does not appear to have adversely impacted audit quality and fees; the question of auditor choice remains problematic (e.g., GAO [2003b, 2003a, 2008], Office of Fair Trading [2004], The American Assembly [2005], Oxera Consulting [2006], London Economics [2006] and ACAP [2008]). That is, to which degree do certain companies have a real choice in selecting their external auditors? Indeed, the number of audit firms capable of auditing large multinational public companies is often

limited to the Big-4 auditors. While the issue of auditor choice has not been addressed explicitly in this thesis, the findings nonetheless contribute to the debate. The main finding that the auditing industry is naturally concentrated confirms that "increasing" auditor choice is difficult, if not impossible.

In concluding, it is worth noting that constraints on auditor choice are only further accentuated by recent auditor independence rules prohibiting (or restricting) external auditors from providing certain non-audit services (e.g., SOX). While these rules are designed to improve real and perceived auditor independence, and thus audit quality (real and perceived), they also have the undesirable effect of artificially restricting auditor choice. In turn, this may alter the (equilibrium) dynamics of the industry by creating a more "captive" audit clientele, which can potentially have a negative long term impact on audit quality and fees. Hence, in designing public policy measures to enhance audit quality, it is crucial to weigh the pros and cons of extensive auditor independence rules. The real question then becomes: how can audit quality be effectively promoted? This is a complex issue beyond the scope of this thesis. Yet, as this thesis has demonstrated, long term improvements in audit quality - through audit firm driven innovations and greater auditor competence (i.e., audit technology) - along with other benefits such as lower audit fees, can be achieved from healthy competition. As recent regulatory reforms have focused predominantly on auditor independence rather than the basic issues of auditor competence (Humphrey *et al.* [2006]), it may be desirable to ease some of the more constraining auditor independence rules to alleviate the auditor choice problem some companies face. In turn, this would help stimulate competition and thus product and process innovations. Ultimately, audit quality would remain constant or possibly increase. Of course, this is an empirical question which requires future research.

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