

PRODUCT AND COST DIFFERENTIATION BY LARGE AUDIT FIRMS[#]

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Abstract

Do audit firms' offer "alternative and differentiated products" (GAO 2003, 18)? We develop a framework within which such issues can be investigated after controlling for confounding factors such as differences in audit firm sizes and changes in firm market shares. We find that large (Big Six) audit practices do in fact exhibit greater variability in market shares than would be case if audits were undifferentiated and homogeneous commodities. Prior literature suggests that (unobserved) audit attributes are likely to be differentially valued by clients with particular (observable) characteristics. Therefore, we use observed differences in the affiliations of audit firms to client industries to infer differences in the unobservable product attributes of audits conducted by large auditors. We also find significant associations between client industry characteristics and observable auditor attributes such as size and leverage (but not the extent of non-audit services). Our results fill a gap in the literature by providing empirical evidence on product/cost differentiation by large US audit firms and the nature and market-wide impact of such differentiation.

Keywords: Product Differentiation, Cost Differentiation, Auditor Industry Specialization, Audit Clienteles.

J.E.L.: L19, L84, M41.

1. INTRODUCTION

Are auditors producers of a homogeneous product using a homogeneous technology? Or does, instead, the value of an auditor's product vary across client industries, and the cost of providing an audit of equal desirability to a client differ across audit firms? In this paper we provide three strands of evidence rejecting the hypothesis that audits are a homogenous commodity produced by firms with identical cost structures. First, we find that audit firm client-industry market shares exhibit greater variability than one would expect under the assumption of auditor homogeneity. Second, we find that differences in audit firm client-industry market shares are systematic rather than random, and can in part be explained by observable client industry characteristics likely to reflect preferences for audit attributes and to influence audit costs. While we cannot completely disentangle the relative contribution of cost heterogeneity and product heterogeneity in determining audit firm client market share differences across client industries, our results provide evidence that both factors are present. Third, we find that the market shares of an auditor's practice in client-industries with particular characteristics depend systematically on auditor characteristics, such as leverage and the number of partners, i.e., they depend on aspects of auditor organizational structure.

There is a large body of empirical work on the industrial organization of audit markets starting with the pioneering study by Dopuch and Simunic (1980). The primary focus of this literature is whether client-industry attributes hypothesized to generate either product or cost differences between auditors explain the supply-side concentration of specific audit markets (usually defined in terms of 2-digit SIC codes). In other words, the question studied in the literature thus far has largely been of the form "Do markets differ?" or "Do markets that differ along attribute x differ in their concentration?" In this study, by contrast, we investigate questions of the form "Do auditors differ in the characteristics of the clients to whom they appeal the most (or least)?" and "Are the characteristics of auditor clienteles associated with the organizational characteristics of the audit firms?"

Equally importantly, our study identifies differences in the unobservable attributes of the products produced by different auditors. The gap in the literature that we hope to address is this: Most Industrial Organization literature on product differentiation starts by identifying key product characteristics and investigates the extent to which these product characteristics affect market shares. Thus, a study of product differentiation in the auto industry might investigate how the appeal

of various car attributes (e.g., luxury, spaciousness) differs across consumer groups (e.g., high income consumers, large families), or, equivalently, how the market share of cars of various attributes vary across well defined sub-markets with various characteristics.¹ This approach is difficult to implement in service industries, such as auditing, because key attributes of the products are not readily observable or measurable. Therefore, in this study, we adopt an indirect approach. First, we identify a list of unobservable audit attributes that are likely to appeal differentially to clients of various observable characteristics. Second, for each of these attributes, we identify the characteristics of clients who are likely to value it more highly. Third, we infer that an audit firm possesses a given attribute if its share among clients likely to particularly value that attribute is significantly larger than its overall economy-wide market share (or equivalently, if its normalized market share, i.e., client-segment share divided by economy-wide share, is significantly greater than 1). It directly follows that if auditors are undifferentiated producers, their client-industry market shares would not be too different (in a way we make precise below) from their economy-wide market shares.² As already discussed above, we find that actual shares are in fact too variable, and that they do in fact vary systematically in association with client and auditor characteristics in ways that suggest there are both product and cost differences among the large auditors.

What unobservable attributes (i.e. product or cost differences) might differentiate auditors in the eyes of their clients?³ While a definitive list would no doubt be quite extensive, in this study we focus on three principal sources of inter-firm product differentiation that are most likely to generate observable differences in our data. A key attribute that may influence client preferences for auditors is the degree of interpretive flexibility the auditor is willing to accommodate. On the audit product

¹ For example, if minivans are found to have relatively large market shares in suburban markets with large families, then this would be interpreted as evidence that spaciousness is an important car attribute, and one that large families value more than other families. Key papers in the literature on this class of estimation problems include Goldberg (1995), Berry et. al (1998), and Petrin (2002).

² Returning to our auto example, this would be equivalent to listing spaciousness as an important car attribute, postulating that large families value spaciousness more than other consumers, and inferring that a particular car (say, Dodge Caravan) is spacious by observing that its market share in markets with large families is higher than its economy-wide market share. Of course, in the case of cars, spaciousness is directly observed, eliminating the need for the type of indirect inference we employ in this paper.

³ In the rest of this paper, we refer to differences in the appeal of an audit firm's product to clients in different industries and in the cost structure of audit firms collectively as audit firm product and cost differentiation. Also see Simunic and Stein (1987) and Chan et al. (2002) for discussions of auditor differentiation.

side, auditors may differ in their interpretation of Generally Accepted Accounting Principles (GAAP) as applicable to a particular client industry and also in the set of audit procedures they conduct to produce an audit consistent with Generally Accepted Audit Standards (GAAS). In particular, auditors may differ on the degree of flexibility in the application of GAAP (see, e.g., Kinney 1986), with more flexible firms being more highly valued by clients with high proprietary costs of disclosure (Watts and Zimmerman 1978, Liberty and Zimmerman 1986, Kwon 1996) and by clients with a high proportion of thinly traded and intangible assets (Lev 2001, Ricchiute 1998, Revsine et al. 2001). Auditors may also differ in their product mix, with auditors offering a wider mix of services being more highly valued by clients in regulated or high growth industries (Simunic and Stein 1987). Finally, auditors can differ in the level of industry-specific knowledge, directly impacting their relative industry market shares, an effect that is likely to be more pronounced in industries with hard-to-value (thinly traded, intangible) assets (Craswell et al., 1995). On the cost side, firms' organization structure as well as investment in industry specific expertise may allow them to generate GAAS-compliant audits at varying cost. Moreover, firms may differ either in their audit and/or internal governance procedures in ways that allow some firms to better control client business risk than other firms, with firms that are better able to control client business risk being more attractive to clients in risky or litigious industries (by charging a lower risk premium). In sum, an auditor can have larger than expected share in an industry either due to product differentiation or due to cost differentiation.⁴

We devise tests to investigate whether the pattern of normalized audit firm market shares (actual market share scaled by the firm's expected (i.e., economy-wide) market share) is significantly more variable than what would be expected if auditor client assignments were purely random, i.e., if the assignments were to occur absent product and cost-differentiation. We find that actual shares do vary "excessively." Second, we identify patterns of association between normalized excess shares and client-industry characteristics and find that firms do differ significantly in the economic characteristics of the clients they audit. We then infer from the observed pattern of associations, likely differences in the attributes of the various auditors' products. Third, we investigate and

⁴ One might refer to audit firm choices the lead to differentiation on the product or cost side collectively as a market choice strategy. In this paper, we do not attribute attained outcomes to strategic intent, that is, we do not distinguish between outcomes that are part of a firm's grand plan and outcomes that have been attained through a sequence of independent decisions by firms and clients (see Mintzberg and Waters 1985).

document that the type differential appeal of auditors to clients of varying characteristics is to some extent associated with key organizational characteristics such as size (Simunic 1984), leverage (Cushing and Loebbecke 1986, Kinney 1986, Doogar and Easley 1998), but not with the auditor's product mix, i.e., the extent to which the auditor provides non-audit services (Simunic 1984, Beck et al. 1988, SEC 2000, DeFond et al. 2002, Frankel et al. 2002, Ashbaugh et al. 2003, Chung and Kallapur 2003).

Prior empirical literature (Dopuch and Simunic 1980, Eichenseher and Danos 1982) provides descriptive evidence on likely product and cost-differentiation by large auditors using somewhat different measures. In contrast to these studies, we formally demonstrate the over-dispersion of firms' normalized market shares relative to the benchmark of random client allocation. This part of our analysis, the results of which are not surprising given prior findings, also highlights the effect of normalization on the degree of measured practice concentration on client industries. Eichenseher and Danos (1981), Danos and Eichenseher (1982, 1986) and Hogan and Jeter's (1999) analysis of trends in auditor concentration and Kwon's (1996) analysis of the role of client industry competitiveness on audit market concentration are all related to our analysis of the influence of client industry characteristics on the strength of auditors' client-industry affiliations.⁵ Our investigation builds on this body of prior work by incorporating additional factors such as client industry business risk and asset valuation difficulty and relating client industry characteristics to unobserved audit attributes. Moreover, as we discuss at length below, our statistical framework allows us to consistently pool observations across audit firms and time periods. As far as we know, the question whether firm characteristics explain the affinity between clients in certain industries and particular audit firms, has never been investigated empirically in any form.

The rest of this paper proceeds as follows. Section 2 describes the analytical framework, the computation of normalized excess shares, and lays out the inferential framework. Section 3 describes the data, Section 4 sets out the regression model and results and Section 5 concludes.

⁵ Chan et al. (2002) study, which focuses on cost differentiation alone, is also related to our second research question.

2. INFERRING AUDITOR PRODUCT AND COST DIFFERENTIATION

2.1. Computing and Interpreting Normalized Excess Shares.

In order to investigate our research questions it is important to have a measure of auditor industry presence that accomplishes four things: first, it should appropriately scale for differences in the size of an auditor's practice; second, it should appropriately account for changes in the auditor's size over time; third, when used as the dependent variable in a regression, it should yield regression coefficients comparable across firms; and fourth, it should permit the researcher to pool observations for all firms in order to investigate the effects of firm characteristics. A measure that has these properties is the normalized excess share of an audit firm. The normalized excess share is computed as the difference between the firm's actual and expected shares for a given industry-year combination divided by the firm's expected share of that industry. A firm's expected share of an industry is simply the firm's market-wide share in that year.⁶

More formally, indexing industries by i , audit firms by j and time by t , let the size of the j^{th} auditor's total practice in industry i in year t be μ_{ijt} , and the expected size of the auditor's practice in that industry be $\hat{\mu}_{ijt}$, where $\hat{\mu}_{ijt}$ is simply the auditor's economy wide market share, μ_{jt} , times the size of industry i . We consider three measures of size for client industries and audit practices. These are (i) the number of clients, (ii) the sum of log client assets, or, (iii) the sum of client root sales.⁷ The firm's (normalized) excess share are defined as:

$$ExcessShare_{ijt} = \left(\frac{\mu_{ijt}}{\hat{\mu}_{ijt}} - 1 \right) \quad (1a)$$

or equivalently, by dividing both the numerator and the denominator by μ_{jt} , as

$$ExcessShare_{ijt} = \left(\frac{ActualMarketShare_{ijt}}{ExpectedMarketShare_{ijt}} - 1 \right) \quad (1b)$$

⁶ The subtraction of expected shares ensures that the mean of normalized excess shares is equal to zero for all auditors and facilitates its use as a dependent variable in a regression.

⁷ In principle, any index of client activity which would be a proxy for the amount of audit effort could be used to form a measure of industry and audit practice size.

The excess share computed in (1a) is the *proportion* by which a firm’s actual market share in an industry exceeds its expected market share if clients were allocated randomly to auditors proportionately to the size of the auditor’s overall practice.⁸ In other words, suppose there were no product or cost differences among audit firms. Then, one would expect auditors to be chosen randomly. In that case, the excess shares computed in (1a) would be pure noise, have a variance that can be calculated from the binomial distribution, and client industry and audit firm characteristics should play no significant role in explaining their pattern.⁹

On the other hand, if audit firms offer differentiated products and/or differ in their cost effectiveness in delivering (equivalent) audit services to particular types of clients, we would expect (i) greater variation of excess shares compared to the case of an undifferentiated supply side, (ii) a significant contribution by audit-relevant client industry characteristics towards explaining the pattern of excess shares and (iii) evidence that audit firm characteristics such as size, leverage and service mix are significantly associated with affinity between clients in particular industries and audit firms.

To investigate whether client and auditor characteristics can explain part of the variation in excess shares, we estimate models of the form

$$ExcessShare_{ijt} = \alpha + \beta X_{it} + \gamma Z_{jt} + \delta X_{it} Z_{jt} + \epsilon_{ijt} \quad (2)$$

where X_{it} is a vector of client industry characteristics, Z_{jt} is a vector of auditor characteristics (including, possibly, auditor indicator variables), and ϵ_{ijt} is a random variable of mean zero and is not correlated with X_{it} and Z_{jt} . When Z_{jt} is a full set of indicator variables, equation (2) yields a set of firm-by-firm regressions. While our dependent variable and research focus are quite different than the prior literature, some elements of our empirical implementation are similar to those in Hogan and Jeter (1999) in terms of our choice of explanatory variables. In fact, as we describe next, some of

⁸ Prior research (Yardley et al. 1992, Kwon 1996, Krishnan 2001) uses the ratio μ_{ijt} / μ_{jt} as an index of auditor industry specialization (see Gramling and Stone 2001 for a review). This specialization index does control for the overall size of an audit firm’s practice, but it does not adjust for industry scale, and therefore, it has a mean that varies across industries, making cross-industry comparisons difficult.

⁹ A detailed description of our testing methodology is in section 4.1.

the proxies for economies of scale, client industry competition, client industry risk etc. used in our study follow the definitions employed in prior research.

In what follows, we motivate our choice of regressors by explaining the role of particular industry and audit firm characteristics in influencing how clients value (or perceive) auditor attributes. Because not all firms can have positive excess shares in an industry, if some firms are relatively attractive to clients in an industry, other firms are likely to be less attractive.¹⁰ Therefore, we cannot assign a unique sign to any of the client industry characteristics in either the firm-by-firm regressions or in the overall auditor characteristics regression. What is critical to establishing product and cost differentiation across firms is the existence of systematic variation of client characteristics across auditors. Similarly, audit firm excess normalized shares in particular client industries can only help identify differences in underlying product and cost attributes across audit firms, not the level of any such attributes (throughout the paper, we will sometimes simply refer to attributes, rather than differences in attributes, for ease of exposition).

2.2. Client Industry Characteristics

First and most obviously, client industry technological characteristics may influence client preferences for auditors. We expect auditors to enjoy larger advantages in differentiating their product and/or to offer greater cost economies in industries in which the principal assets of the client are not tradeable or are thinly traded, i.e., in fixed-asset intensive industries and in industries with significant intangible assets (knowledge, or equivalently, human-capital intensive industries).¹¹ Conversely, advantages of the sort discussed above are likely to be smaller in industries in which the

¹⁰ In our empirical analysis we only examine the excess shares of the Big8/Big6/Big5 firms. Strictly speaking, all of these firms can have positive excess shares in an industry if fringe firms as a group have negative excess shares in the industry (and conversely if the fringe firms as a group have positive excess shares in an industry, all Big8/Big6/Big5 can have negative excess shares in that industry).

¹¹ Thin markets create difficulties for the auditor in estimating initial, carrying and terminal values of assets. For instance, Lev (2001, 3) notes: “... I trace the measurement and reporting problems of intangibles to the unique attributes of these assets: high risk, lack of full control over benefits and absence of markets.” Similar arguments relating to fixed-asset valuation in general and asset-impairment accounting in particular have been advanced in the auditing and financial statement analysis literature (Ricchiute 1998, 569-72; Revsine et al. 2001, 475-77).

principal assets are readily marketable or are commodities.¹² We use asset fixity (the ratio of non-current to total assets, *AFix*) as a measure of fixed-asset intensity and the natural log of Market to Book Value of Equity (*MtB*) as a measure of intangible intensity (Lev 2001, 8; Hall 2001).¹³ [In computing industry average MtB scores, we excluded all observations for which the ratio was negative since a negative MtB ratio makes no economic sense.] In sum, we infer that audit firms with higher than expected share in industries with high fixed asset intensity or intangible asset intensity are characterized by specialized fixed asset or intangible asset valuation expertise, respectively (see Table 1 for a complete mapping of client-industry characteristics to audit attributes).¹⁴

<Insert Table 1 about here>

Industry technological characteristics may also be a proxy for the value that clients attach to interpretative variation. A principal concern of the audit is to ensure that the client's financial statements provide reasonable values for the assets, liabilities and earnings of the client. However GAAP allows a considerable amount of latitude to managers in applying the standards (e.g., the choice of timing over the recognition of asset impairment or of revenues). Auditors' interpretation of what is permissible under GAAP may vary, allowing them to differentiate themselves to clients with different characteristics. This aspect of auditor differentiation may lead to differential appeal across industries for one of two reasons. First, and somewhat obviously, firms may differ in their interpretation of GAAP across different client industries. Second and somewhat less obviously, industry-specific excess shares may arise even when audit firms interpret GAAP identically for all their clients irrespective of client industry (but differ among themselves in the interpretation). Under this scenario a firm's share may vary systematically across client industries because clients'

¹² Examples of such industries might be retail trade, traditional manufacturing, transportation, and agriculture. However, each of these industries may also exemplify other influences such as regulation, litigation, or financial riskiness to different degrees.

¹³ U.S. generally accepted accounting principles (GAAP) do a poor job of measuring (valuing) intangibles since most R&D activity is expensed in the year in which the outlay occurs. Moreover neither the book value of R&D or patenting costs are good estimates of the value of self-generated intangible assets. Fama and French (1992), Lakonishok et al. (1994), Chan et al. (1995, 2001) use the Market-to-Book ratio as a proxy for the firm's growth expectations which is equivalent to imputing a premium attributable to unrecorded or intangible assets.

¹⁴ In our framework, such expertise can reflect either cost advantages in producing an audit of given quality, or specialized knowledge that allows the firm to produce a better quality audit at a given price.

preferences for firms' interpretations varies systematically across industries.¹⁵ A second effect of distinctive client industry characteristics may be to allow auditors to develop standardized routines to reduce the costs of auditing clients in particular industries. In sum, both *AFix* and *MTB* may also secondary proxy for the extent of interpretive variation offered by different auditors.

Similarly, regulated industries (*REG*) call for a detailed knowledge of applicable regulations, leading to pronounced cost economies relative to unregulated industries. Since regulated industries often impose additional restrictions that can limit the amount of discretion allowed under GAAP, we believe that the primary impact of industry regulation would be to allow firms to differentiate themselves on the cost side (e.g., by reducing the cost of generating additional, industry-specific or mandated disclosures).¹⁶ This is consistent with prior studies which have interpreted higher auditor concentration in regulated industries as evidence that it only pays a few firms to invest the substantial resources necessary to master the industry-specific regulatory regime (Eichenseher and Danos 1981, Danos and Eichenseher 1982, 1986). We follow the classification used in Hogan and Jeter (1999) to identify regulated industries. In sum, we infer that audit firms with higher than expected market shares in regulated industries are audit firms that are cost effective in auditing regulated firms.

The degree of client industry competitiveness is also likely to influence the appeal of particular auditors. The competitive costs of standardized (and therefore comparable) disclosure may lead clients in highly rivalrous industries to prefer auditors who have a less standardized approach to interpreting GAAP as applicable to their industry. This effect may be partially dampened by the propensity of clients in oligopolistic industries to use different auditors (see Kwon 1996). We use the Herfindahl-Hirschman Index (*HHI*), as a measure of client industry rivalry because it is widely used in regulatory analyses (cf. GAO 2003, p. 18) and is also the most direct generalization of the client industry competitiveness measures used in prior literature (cf. Kwon 1996, Hogan and Jeter, 1999). In sum, we infer that audit firms with higher than expected market shares in concentrated

¹⁵ Thus, for instance, audit firms may apply different thresholds for classifying contingent liabilities under FAS 5. Even if an auditor were to use the same threshold for all industries, client preferences for the threshold may vary systematically across industries leading to systematic variation in firm market shares across industries.

¹⁶ However, to the extent that being in a regulated industry does not preclude the existence of some discretion under GAAP, it is also possible that audit firms could differentiate themselves by their positions on interpreting GAAP in regulated industries as well.

client industries are audit firms whose audits are characterized by less standardized disclosures (or, equivalently, by greater level of interpretative variability).

Auditors may differ in the procedures they use to manage risks posed by clients in industries with high risk of auditor litigation or with high average client financial riskiness and high levels of acquisition expenditures (two variables commonly associated with increased financial statement risk and auditor litigation). Auditors with better ability to sterilize risk may also develop reputations leading to larger excess shares in high risk industries. We measure client industry litigiousness (*LITIG*) by a set of industry dummies identified by recent studies (Palmrose 1986, Hogan and Jeter 1999). We use Altman's (1968) Bankruptcy (*Z*) Score and Acquisition Expenses (*ACQ*) as additional proxies for client financial riskiness. Since a number of the variables are financial ratios, their distributions are highly non-normal with very long tails. In the regression analyses reported below, we use logarithmic scaling of some of these variables. Further, since Altman's findings suggest that clients with *Z* scores above 3 are considered "safe" and thus possibly qualitatively different than clients with lower *Z* scores (Altman 1968; Penman 2001, 730), we use the fraction of clients with *Z* scores below 3 (*ClitZscr3*) as a measure of auditor business risk. In other words, the larger the fraction of clients with *Z* scores below 3, the more risky the industry. Since the *Z*-score is primarily used to assess the riskiness of manufacturing or industrial borrowers, we set *ClitZscr3* to zero for all industries with 2 digit SIC codes numbered 60 or higher. In sum, we infer that audit firms with higher than expected market shares in client industries characterized by high audit and client business risk are firms with audit procedures that better control (or sterilize) such risk.¹⁷

2.3. Audit Firm Characteristics

Each audit firm can choose to organize production in a unique way, be it in the degree of centralization or structure imposed on the audit (Cushing and Loebbecke 1986), the choice of labor mix (Doogar and Easley 1998), or the use of different audit approaches (Bell et al. 1997, Bell et al.

¹⁷ Despite our normalization, there might possibly be trends in the pattern of excess shares even after controlling for auditor and industry characteristics. Further, the excess shares may also depend on the number of firms despite our normalization for changes in audit firm size. We construct indicator variables for the periods 1980-1984, 1985-1988, 1989-1993, 1994-1997 and 1998, chosen to coincide with the dates at which the number of active auditors in the economy changes and to also yield roughly balanced windows around the 1989 Big Eight to Big Six mergers. As expected, the period indicators variables are uniformly not significant and thus are not included in the models reported in the text.

2002). Moreover, large audit firms differ in the extent to which they provide non-audit services. Differences in centralization, labor mix, audit approach and product mix can affect a firm's trade-off between exploiting economies of scale and its willingness to bear risk in audit markets. Therefore, these differences in internal firm structure might result in observable differences in firms' ability to appeal to clients in different industries on grounds of better fit of the firm's audit approach or on grounds of cost differentiation. We use firm-specific indicator variables and controls for the firm's size (*Partners*), the firm's organization structure (*Leverage*, i.e. staff-to-partner ratios), and product mix (*CnsShare*, i.e., proportion of non-audit fees) to test whether these firm attributes have a bearing on explaining variations in client affinity for auditors.¹⁸

High values of leverage can arise from one of two possible business approaches. First, a firm that applies a more standardized audit approach is likely to have a high staff to partner ratio (see Kinney 1986). Alternatively, high leverage can reflect high partner productivity, i.e., differences in human capital, with more highly leveraged firms being better able to exploit superior partner and manager expertise. A firm whose high leverage arises from applying a standardized approach is less likely to appeal to clients in highly rivalrous industries, i.e., industries with high competitive costs of disclosure (Palepu et al. 2000, Revsine et al. 2001). A firm whose high leverage arises from superior human capital is likely to have higher than expected shares in industries that require higher levels of valuation expertise. In sum, we expect a negative coefficient on the interaction between leverage and measures of client industry competitiveness and positive coefficients on the interaction between leverage and measures of fixed and intangible asset intensity.

We have no directional predictions for any of the other interactions (including those for *CnsShare*). However, if the concerns articulated in the auditor independence literature are valid, we would expect *CnsShare* to matter in some systematic fashion in terms of differentiating a firm's product or capabilities. In other words, if the appeal of jointly procuring audit and non-audit services from the same firm systematically varies across client industries, then we would expect *CnsShare* to be predictive of variations in normalized market shares.

¹⁸ Though in the long-run clientele composition and the staff-to-partner ratio is inter-related, in the short-run the resources (especially partners) under a firm's disposal are likely to drive the composition of its clientele (at the margin) rather than vice-versa (see Doogar and Easley, 1998). Therefore, endogeneity of leverage (in econometric terms) is not an issue.

3. DATA.

We now turn to the data sources of the variables described above. We obtain client-level financial data on total assets, sales, asset fixity, market to book ratios, acquisition expenditures, and Altman's Z-scores from Compustat. We classify industries as regulated or as litigious following Hogan and Jeter (1999). Finally, we obtain data on audit firm partner, staff and revenue mix from Public Accounting Report. Our sample consists of all client-year observations for which data on total assets and auditor identity is available in Compustat during the 1980-1998 period. Our audit firm characteristics consist of annual observations for the 1990-1998 period.

The values of client industry characteristics *AFix* and *MtB* are obtained by taking annual averages of the relevant financial characteristics at the two-digit SIC level. Thus, the asset fixity (*AFix*) of an industry for a given year is the average of the asset fixity of all clients in that two-digit SIC code during that year. The variable *ACQ* is defined as the ratio of the total value of acquisitions in a particular year and two-digit SIC code divided by that year's industry total assets. The variable *HHI* is defined as $HHI_{it} = \sum_{k \in K_{it}} (Sales_{kt} / Sales_{it})^2$ where k indexes clients, K_{it} is the set of clients in two-digit SIC code i and period t , $Sales_{kt}$ are the sales of client k during year t and $Sales_{it}$ are the sales of all clients in two-digit SIC code i and period t . The variable *CltZsr3* is the proportion of clients in an industry year combination with Z-scores smaller than 3. *CltZsr3* is set to zero for all SIC codes of 60 or higher. The variables *LITIG* and *REG* vary by industry but not by time. In other words, an industry is either regulated or not regulated, and litigious or not litigious for the entire sample period. The values of *LITIG* and *REG* are those reported in Table 2. Public Accounting Report's list of Top 100 accounting firms provides data on the number of audit firm partners, professional staff and firm revenues broken down into Accounting & Auditing, Tax and Management Consulting Service percentages. We use the percentage of MCS services (*CnsShare*) as the measure of non-audit services that may affect clients' affinity for particular auditors since the provision of tax-related services is traditionally considered to be so closely related to the provision of audit services themselves that it has never been the subject of serious regulatory concerns.¹⁹ Table 2 lists all the regressors used in the analysis.

¹⁹ However, as a conference reviewer pointed out, all auditor characteristics in the Public Accounting Report are measured with noise. Moreover, the leverage ratios are probably skewed by the different levels of Non-Audit Services across auditors (auditors with a higher proportion of NAS in their product mix are expected to have higher leverage).

<Insert Table 2 around here>

The dependent variable, $ExcessShare_{ijt}$ is computed for each Big 8/Big 6/Big 5 firm for each year using (i) client counts ($nDEV_{ijt}$), (ii) natural log of client total assets ($laDEV_{ijt}$) and (iii) square root of client total sales audited ($rsDEV_{ijt}$). We use the auditor client counts by industry to investigate whether auditors' market shares exhibit excess variation compared to the predictions of a simple binomial model of random auditor choice discussed in Section 4.1 below. All three measures of excess share are used in the regression analysis discussed in Sections 4.2 and 4.3. During our sample period there were three mergers among the erstwhile Big 8 firms and their successors: in 1989, DHS and TR merged to form DT and AY and EW merged to form EY reducing the number of large firms from eight to six. In 1997, PW and CL merged to form PwC, further reducing the set to five. Each firm is treated as a separate entity for the entire period of its existence in our sample period since audit firm attributes may have changed due to the merger.

Table 3 reports descriptive statistics for the variables of interest. Panel A shows that we have non-zero industry client counts ($nSIC2$) and industry total assets ($aSIC2$) for 1340 2-digit-SIC-year combinations. However there are some industry-year combinations for which client-industry sales ($sSIC2$) are zero. In what follows we report the results using either $nSIC2$ or $aSIC2$ and only note departures from the conclusions reached using $sSIC2$ where relevant. The mean value of client asset fixity ($AFix$) is .520 suggesting that the asset composition of the average industry is about evenly divided between current and non-current assets. The mean of the market to book ratio is less than one which explains the negative minimum and mean for $logMtB$. Similar explanations hold for $logHHI$ and $logACQ$ as well. Note that the maximum value of $logHHI$ is zero, implying that for at least one industry-year combination, one client accounts for the entire industry sales: this is the case where $nSIC2$ attains its minimum value of 1 (so that HHI is 1 for such industry-year observations).²⁰ The mean of $Clzscr3$ is 0.372 suggesting that a little more than a third of the clients in the average industry have Z scores smaller than 3, i.e. may be considered at least somewhat

²⁰ To investigate the effect of including (and therefore possibly unduly heavily weighting) such "small" industries, we repeat all our regression analyses using data only on "larger" industries (defined as industries with at least 760 client-level observations for the sample period, i.e., industries with on average about 40 client-level observations per year). The results of the large-industry-only analysis are qualitatively similar in all important respects to those reported in the paper.

financially risky. The means of *REG* and *LITIG* are about 0.28 and .10 respectively; about 28% of the observations in the sample come from regulated industries and 10% from litigious industries.

<Insert Table 3 around here>

We have data on Big 6 firms for eight years (1990-1997) and on Big 5 Firms for one year, leading to a total of 53 observations on audit firm partners, professional staff and share of consulting services. Panel B of Table 3 shows that on average Big Six firms had about 1500 partners per year and about 9.8 times as many professional staff members. Consulting services make up, on average, about 35% of firm revenues.²¹

Panel C of Table 3 reports key statistics for the distribution of the dependent variables. There is at least one auditor/client-industry/year combination in which an auditor has zero market share (and thus the minimum value of a normalized share is -1). Similarly, the large maximum values can be explained by noting that the value of the normalized share can be very large when one of the smaller Big Six auditors has a very large share.²² The mean normalized excess share is, as expected, close to zero²³ and, as we explain in the next section, the standard deviation of the normalized shares for the sample as a whole is considerably larger than would be expected under the random auditor choice hypothesis.

4. MODEL SPECIFICATIONS AND RESULTS.

4.1 *Is There Excess Variation In Firm Market Shares?*

Suppose that auditors are completely undifferentiated, both in terms of the cost of auditing clients and in terms of the willingness of clients to pay for audits. Then, client-auditor pairings would be completely random. As a consequence, the size of firm j 's clientele, μ_{ijt} , in period t and industry i would be a binomially distributed random variable with cumulative distribution $F_b(S_{it}, \mu_{ijt}, p_{jt})$

²¹ This was a period of considerable changes in the audit market, with the number of partners, the span of control, and the importance of consulting services in the produce mix increasing over time.

²² This is relatively more likely to arise when there are only a small number of clients in an industry.

²³ It does not have to be equal to zero because the average industry level market share for an auditor will not in general be equal to its economy-wide market share (unless all client industries are of the same size). In fact, an auditor with above average market shares in small industries and below average market shares in large industries will have a positive average normalized share.

where $F_b(\cdot)$ is the cdf of the binomial distribution,²⁴ S_{it} is the number of clients in industry i and year t , and p_{jt} is the probability that any client pairs off with auditor j in year t . We use as the value of p_{jt} the economy-wide share of auditor j , that is, we set $p_{jt} = \mu_{jt} / S_t$ where μ_{jt} is the size of auditor j measured in terms of number of the clients the auditor audits in year t and S_t is the size of (audited) economy in year t . It follows that auditor market shares would vary across markets, but their variation would be driven by this binomial process: we would not observe “too many” small shares or “too many” large shares, or equivalently firm shares that are relatively small would not be “too small” and firm shares that are relatively large would not be “too large.” If instead auditors were differentiated, then, following the discussion in the preceding sections, firm market shares would exhibit excess variation.

A conservative formal test for detecting statistically significant excess variation in audit firm market shares is as follows:²⁵ Compute the fraction of instances that $F_b(S_{it}, \mu_{ijt}, p_{jt})$ is smaller than 0.25 or greater than 0.75. If $F_b(\cdot)$ were an increasing and differentiable cdf, then this fraction would be expected to be 50% under the null hypothesis of random auditor choice. If auditor-client pairings are not random, frequency with which $F_b(S_{it}, \mu_{ijt}, p_{jt})$ is below 0.25 or above 0.75 (i.e., in the tails) will exceed 0.50. However, $F_b(\cdot)$ is a step function because the number of possible outcomes (number of times a firm is selected by a client) is a discrete random variable. Therefore, using $F_b(S_{it}, \mu_{ijt} - 1, p_{jt})$ instead of $F_b(S_{it}, \mu_{ijt}, p_{jt})$ when the value of $F_b(S_{it}, \mu_{ijt}, p_{jt})$ exceeds 0.75 yields a conservative test for excessive variation in market shares. In other words, we calculate the fraction of the time that $F_b(S_{it}, \mu_{ijt}, p_{jt})$ is less than 0.25 or $F_b(S_{it}, \mu_{ijt} - 1, p_{jt})$ exceeds 0.75.²⁶ Under the null of binomially distributed number of clients, the union of these events will be observed with probability strictly less than 0.5. If there is sufficiently strong over-dispersion, then probability of the union of these events will exceed 0.5. The conservativeness of the test is particularly strong for industries with a small number of clients. For this reason, we implement the test for industries with

²⁴ That is, $F_b(S_{it}, \mu_{ijt}, p_{jt})$ is the probability that firm j has μ_{ijt} or fewer clients in industry j in year t .

²⁵ As we explain in more detail in what follows, the test is conservative because it would fail to reject the null of no over-dispersion more often than its nominal size.

²⁶ Note that for small industries $F_b(S_{it}, \mu_{ijt}, p_{jt})$ may exceed 0.75 while $F_b(S_{it}, \mu_{ijt} - 1, p_{jt})$ may be less than 0.25. However, our implementation of the test, described in the following paragraph, omits all small industries, and thus precludes this phenomenon.

$S_{it} \geq 30$. There are 6059 industry-auditor-year combinations that satisfy this criterion. Of these, 3244, or 53.54%, have values of $F_b(S_{it}, \mu_{ijt}, p_{jt}) < 0.25$ or $F_b(S_{it}, \mu_{ijt} - 1, p_{jt}) > 0.75$. To test whether the fraction of these events exceeds 50% by a statistically significant amount, we calculate $F_b(6059, 3244, 0.5)$. Using the normal approximation to the binomial, we find that $F_b(6059, 3244, 0.5) = 1.000$.²⁷ Therefore, the null of binomially distributed clientele sizes is rejected at all conventional levels of significance.

A second test for excessive variation in firms' normalized shares can be derived as follows. Under the null hypothesis that within industries auditors are chosen at random with a probability $p_{jt} = \mu_{jt} / S_t$, the expected number of clients in an industry of size N_{it} is simply $\hat{\mu}_{ijt} = N_{it} p_{jt}$ with variance $\text{var}(\hat{\mu}_{ijt}) = N_{it} p_{jt} (1 - p_{jt})$. The realization of a normalized excess share of firm j in industry i in year t , $\mu_{ijt} / \hat{\mu}_{ijt} - 1$, then has, by construction, a mean of zero and a variance $\text{var}(\text{ExcessShare}_{ijt}) = (1 - p_{jt}) / (N_{it} p_{jt})$.²⁸ Therefore, the weighted excess share,

$$ES_{ijt}^w = \sqrt{\frac{N_{it} p_{jt}}{1 - p_{jt}}} \text{ExcessShare}_{ijt}$$

is distributed with mean zero and variance equal to 1.²⁹ The annual standard deviation of ES_{ijt}^w ranges from a low of 1.24 to a high of 1.53. A standard one-tailed chi-squared test for the sample variance rejects the null hypothesis that the sample standard deviation is equal to 1 at a p-value of

²⁷ Under the normal approximation, $(x - E[x]) / \sigma_x$ is approximately normally distributed when x is a binomially distributed variable.

²⁸ While the observed variance in the economy may be somewhat larger than this in the smaller client industries due to the indivisibility of audit clients, client lumpiness should not be a significant source of excess variation in larger industries.

²⁹ If weighted excess market shares are independently distributed across firms and industries, then the sample average of ES_{ijt}^w over all industry-firm combinations in year t will be normally distributed with variance equal to the inverse of number of the industry-firm combinations in t . This is a conservative estimate of the actual variance because excess market shares of firm j are generally negatively correlated across industries and excess shares of firms in industry i are generally negatively correlated across firms. This estimate is conservative because it assumes that firm clienteles in any year are realizations from an *i.i.d.* binomial processes. A negative covariance between the normalized shares across industries for a particular firm and across firms for a particular industry would result in lower dispersion of ES_{ijt}^w .

less than 0.0001 for all years.³⁰ One concern about the chi-squared test may be that ES_{ijt}^w is not normally distributed. However, ES_{ijt}^w for industries with a large number of clients will be approximately normal since the binomial distribution, re-scaled so as to be of constant variance as the number of trials goes to infinity, converges to the normal distribution. Therefore, we repeat the tests for industries with more than 30/40/100/200 clients. For all of these thresholds the null of the sample standard deviation being equal to 1 is rejected at a p-value of less than 0.0001 for all years.

Descriptively, the results of both sets of tests on the variance of normalized excess shares are consistent with, though not implied by, the prior findings in the literature and in a recent GAO study that audit firms' market shares in a large number of industries suggest that "certain firms dominate particular industries or groups" (GAO, 2003:10).

4.2 Firm-by-Firm Regression Analysis: Inferring Auditor Attributes.

The tests reported above and the excess shares shown in Table 4 strongly suggest that large audit firm market shares do exhibit excess variation compared to what would be expected under the null of no product or cost heterogeneity. However, given our sample size, one might reject the null of no heterogeneity even if auditors are, in fact, perfectly homogeneous: affinity of a firm to particular industries may arise due to purely historical or idiosyncratic factors. For example, a former partner or manager of an audit firm may work for a client in an industry, thus creating a network of clients in that industry even in the absence of any substantive differences in costs or the audit product.³¹ Further, and equally important, demonstrating the existence of differentiation using the non-parametric tests we employed above does not characterize the nature of differentiation. In other words, demonstrating the existence of differentiation does not shed light on the economic determinants of differentiation, i.e., in what ways do audit firms differ with regard to product and cost structures.

Our regression analysis in this sub-section addresses both issues by investigating whether the pattern of excess shares can be explained by economic factors. If economic factors do in fact help

³⁰ See Hogg and Craig (1978) and Johnston (1984). Aggregating the values of ES_{ijt}^w would not yield a valid test because there is likely to be strong positive correlation across years, thus biasing the standard deviation of the mean of ES_{ijt}^w upwards.

³¹ See, for example, the discussion of employee affiliation with audit firms in Lennox (2003).

explain a firm's excess shares, then these shares are not likely to arise from completely random auditor affinity to particular industries (i.e., factors that are unrelated to an auditor's cost structure or audit philosophy). Further, by estimating the relationship between a firm's excess shares and economic factors we are able to characterize the firm's capabilities and attractiveness to clients in various industries.

To investigate the issues outlined above, we estimate for each audit firm, j , the following base model

$$\begin{aligned} ExcessShare_{ijt} = & \gamma_j + \theta_{1,j} CltFix_{it} + \theta_{2,j} REG_i + \theta_{3,j} \log(MtB_{it}) + \theta_{4,j} \log(HHI)_{it} \\ & + \theta_{5,j} LITIG_i + \theta_{6,j} CltZscr3 + \theta_{7,j} \log(Acq_{it}) + \epsilon_{ijt} \end{aligned} \quad (3)$$

where i indexes client industries, j indexes audit firms, t indexes time and ϵ_{ijt} is a disturbance term of mean zero and uncorrelated with any of the regressors.³² This set of regressions is equivalent to estimating equation (2) without an intercept and using a comprehensive list of auditor indicator variables for the vector of auditor characteristics Z_{jt} . The vector formed by the intercepts γ_j of equation (3) is equal to the vector γ of equation (2) and the vector formed by the slopes θ_{kj} of equation (3) is equal to $\beta + \delta Z_{jt}$.

This model is estimated for each audit firm in our sample. For firms created by merger, each of the constituent firms was treated as a separate firm from the merged entity. Thus the regression for each firm represents the analysis of normalized shares of that firm only for the period during which the firm was in existence as an independent entity during our period of study. Table 4 reports the results of this analysis using excess shares based on natural-log-of-assets-audited. [The results using the excess shares based on client count are both quantitatively and qualitatively similar. The results

³² We also estimated a model using the natural log of Average Employee Compensation as a measure of human capital intensity instead of the measure of intangible intensity $\log MtB$. We also further estimated an expanded model that included several client financial characteristics identified in prior research as important client business risk measures (Lev and Thiagarajan 1993, Brealey et al. 1999, Choi et al. 2002). Smaller client size, lower liquidity, solvency, profitability, and low asset turnover are commonly identified sources of risk in the literature. We chose Relative Client Sales (Individual Client Sales/Average Economy-Wide Client Sales) as a client size measure, Current Ratio and Cash Flow/Total Liabilities as liquidity/solvency measures, Return on Total Assets as a profitability measure, and Asset Turnover defined as Sales/Total Assets as an activity measure. Overall, the addition of these measures did not affect any of the conclusions mentioned in the text. Finally, we estimated variants of the model that include period dummies as described in Section 2. The period dummies are uniformly not statistically significant. Thus, as expected, after controlling for the growth in the overall large firm audit shares, there appears to be no significant change in the pattern of industry dominance by these large firms.

using root-of-client-sales weighted excess shares are generally weaker but directionally consistent with those reported in Table 4.]

<Insert Table 4 around here>

Table 4 provides overwhelming evidence in support of the hypothesis that audit firms' normalized shares are not the result of random factors alone. Each column of Table 4 reports, in the last row, the F-statistic for the joint test of significance of the client industry attribute measures listed in column 1 of Table 4.³³ All firms except PW and PwC show statistically significant explanatory power for the client industry attributes. The analysis reported in Table 4 treats each firm-industry-year market share as an independent observation, thereby ignoring the panel nature of the data and thus the year-to-year serial correlation among audit firms' market shares. Therefore, the usual OLS standard errors and even the White heteroskedasticity-consistent standard errors would understate the true standard errors (and overstate statistical significance). For this reason, we compute standard errors using appropriate-for-panel-data bootstrap methods.³⁴ For our sample, statistical significance at the 1% level using White's standard errors is comparable to significance at 5% using bootstrap standard errors. We report in all tables bootstrap standard errors though similar conclusions would have been reached had we used White's standard errors and considered 1% to be the relevant threshold for statistical significance. However, F-tests are at this point calculated using White's covariance matrix because bootstrap-generated F-tests are rather cumbersome to construct.³⁵

³³ Reported t-statistics and F-tests are based on White's (1980) heteroskedasticity consistent covariance matrix, since the discussion in the preceding section implies that variance of the residual varies across observations systematically on the basis of auditor and industry size, and possibly other variables.

³⁴ The standard bootstrap would involve sampling with replacement individual observations, that is, sampling firm-client industry-year combinations. To preserve the time series structure of the data, we sampled with replacement three-year long histories of firm-client industry combinations. The length of the segment reflects the degree of serial correlation. Loosely speaking, three year long segments reflect the assumption that three observations in our sample contain as much information as one observation in the absence of any serial correlation. In a univariate time series model with AR1 errors, this would correspond to a value of ρ of approximately 0.8. The number of data replications is 1,000. See Horowitz (2001) for more discussion of implementing the bootstrap in panel data with serial dependence.

³⁵ In Table 4, there are $7 \times 11 = 77$ parameters corresponding to industry characteristics. Of these 24 are significant at the 1% level using White (1980) heteroskedasticity consistent standard errors. Of these 24, 21 remain significant at the 5% level when standard errors are calculated by bootstrapping 3-year-long observation sequences. Since this corresponds to 26% of the estimated parameters (compared to 5% one would expect in a test of size 0.05 under the null of no systematic relationship if parameter estimates are not correlated), our finding of a systematic relationship between industry characteristics and firm excess shares does not depend on the method of calculating standard errors.

Since the normalized shares were constructed to be comparable across firms, differences between firms' approaches can be read off the rows of Table 4. A positive coefficient in Table 4 indicates that the firm has above average appeal to clients in industries with high values of that particular characteristic (relative to its economy-wide appeal). Row 1 of Table 4 shows that *ClfFix* (which is a measure of fixed asset intensity and thus a likely source of differentiation, either by allowing audit firms to tailor their approaches to client industry needs or by allowing firms to exploit cost economies), does in fact explain a significant amount of the variation in normalized shares for AA, KP, EY, and PWC. AA, KP and PWC are the only firms for which *ClfFix* plays a positive role: these three firms seem to find attractive (or are found to be more attractive by) clients in fixed-asset industries. Clients in industries with high *logMtB* (growth prospects or, equivalently, high intangible assets) and KP and EW appear significantly less likely to affiliate than do the other large auditors. Given that the coefficient of *logHHI* is negative for DHS, we cannot interpret the negative coefficients of *ClfFix* and *logMtB* for that firm as necessarily reflecting lower expertise in asset valuation.³⁶ In sum, clients with high proportions of fixed or intangible assets, i.e. clients with high need for industry-specific valuation expertise, appear to find AA, and to some extent KP and PWC, more attractive than clients in other industries.³⁷ By contrast, such clients appear to find EW, EY and (possibly) DHS less attractive than do clients in other industries.

Client industry competitiveness as measured by *logHHI* appears to matter only for AA, DHS and DT. In each case, these firms either tend to avoid or are less attractive to clients in industries characterized by greater inter-client competition relative to clients in other industries. Clients in regulated industries (*REG*) appear to either prefer or find more cost-effective, EW, EY and DHS while they tend to avoid TR.

Finally, we turn to the three risk measures, *LITIG*, *ClfZscr3* and *logACQ*. DT is the only firm that appears to avoid or be avoided by clients in litigious industries while AA, EY, DHS and CL seem to be significantly more likely to be affiliated with clients in industries with higher client

³⁶ All three negative signs could have been driven by DHS offering lower interpretative variation and thus being less attractive to clients in asset intensive industries and to highly concentrated industries. In all the other firm regressions, *logHHI* is either not statistically significant, or is opposite sign to the asset intensity measures (when the latter are significant).

³⁷ The positive affinity of KP for industries with high asset fixity appears to be stronger than the tendency to have lower market shares in industries with high Market-to-Book ratio.

financial distress risk. The risk posed by client acquisition activity is significant only for DHS (with a negative sign). In sum, the risk measures suggest that AA, EY, and CL are either particularly attractive to or cost-effective in auditing risky clients (relative to auditing other clients), while DT appears to be unattractive or not cost-effective (the results for the other firms appear to be inconclusive). Table 5 summarizes the firm-by-firm product attribute inferences derived from Table 4.

<Insert Table5 about here>

4.3 Pooled Regression Analysis

In this subsection we investigate whether the systematic affinity between audit firms and client industries can be linked to observable attributes of firm size, organization and product mix. In other words, we now ask, can differences in client preferences and audit firm cost structures across industries be linked to observable audit firm characteristics? Our regression models in this subsection are designed to address this question.

Table 6 reports the analysis of audit firm characteristics by estimating model (2) in which the vector X_{it} is as described in equation (3) and the vector Z_{jt} consists of the firm's staff-to-partner ratio (*Leverage*), the number of partners (*Partners*), and the percentage of revenue obtained from consulting activities (*CnsShare*). Since we only have annual data on audit firm characteristics for the period 1990-1998, these regressions are based on observations for those years only. Because the correlation between *CnsShare* and *Leverage* is approximately 0.86, the two variables may not be statistically significant when jointly used in the regression even though in principle one or both of them can help explain audit-firm/client-industry affinity. To investigate this possibility we report three models in Table 6: The first model contains interaction terms for both leverage and consulting while the other two omit, respectively, consulting and leverage. All three models include interactions for audit firm size (number of partners) and use log-assets-weighted measure of excess shares.³⁸

<Insert Table 6 about here>

³⁸ Results using excess shares based on the number of clients are similar to those reported in Table 6.

The model with both leverage and consulting effects shows that consulting and its interactions are not jointly statistically significant (F-test Consulting = 1.32) while leverage and its interactions are jointly marginally significant (F-test Leverage = 2.21). However, when only either leverage or consulting effects are included, they are each strongly statistically significant. When comparing the model with only leverage effects to the model with only consulting effects, we observe that leverage effects are statistically more important than consulting in explaining the pattern of normalized excess shares. This, coupled with the results of the first model, suggests that leverage does indeed explain client preferences for auditors or auditor capabilities. The results for consulting, on the other hand, are consistent either with consulting merely proxying for leverage or exhibiting insufficient independent variation to allow the measurement of its effect. In other words, we do not find any evidence that consulting systematically affects clients' affinity for auditors across industries.³⁹ Finally, audit firm size also appears to influence auditor attractiveness to clients with specific economic characteristics.⁴⁰ The pattern of interaction results broadly supports our conjectured directional influences: all the interaction terms are either directionally consistent with those hypothesized in Section 2 or are not significant.

Overall, Table 6 provides evidence that the internal structure of the firm affects client preferences for auditors. The results for both size and consulting are relatively weak and it appears that consulting provides no additional explanatory power beyond that provided by leverage alone. This latter finding is not consistent with non-audit services generating additional market share for auditors as would be expected under the audit-as-loss-leader hypothesis.⁴¹

³⁹ It is interesting to compare our findings with those of the auditor independence literature. While Ashbaugh et al. (2003), Chung and Kallapur (2003), and DeFond et al. (2002) find that non-audit services do not influence audit quality, Frankel et al. (2002) find a positive association between non-audit services and earnings management indicators. Our results suggest that to the extent that the mix of non-audit services captures the likelihood that auditors are chosen for their tolerance for earnings management (or equivalently, willingness to compromise audit quality), it does not appear that the appeal of any of the major audit firms to their clients varies systematically across different sectors of the economy (i.e., across client industries).

⁴⁰ Recall, however, that as we mentioned above, auditor characteristics are measured with error which likely attenuates the statistical significance of these variables.

⁴¹ If non-audit services did matter, their effect would likely not be uniform across industries, and thus, some of the interactions with industry characteristics would have been statistically significant.

4.4. Sensitivity Analysis with Respect to Industry Classification

Fama and French (1997) propose an alternative industry grouping based on the aggregation of 4-digit SIC codes. One of the main features of this aggregation is that SIC codes with a relatively small of clients are aggregated to more inclusive groupings.⁴² Since the Fama-French classification has attracted substantial interest, particularly in the Finance literature, we investigated the robustness of our results to using this classification instead of the more commonly used SIC classification.⁴³ Table 7 presents the firm-by-firm regression results (i.e., the counterpart to Table 4). Since the values of both the normalized excess shares and the measures of client industry characteristics differ across the two classification systems, the coefficients of the two tables are not directly comparable. Therefore, we focus our discussion only on parameter significance. A few key observations are in order. First, 12 (out of 77 parameters, excluding the constants) are significant at the 5% level in both Tables 4 and 7 and all are of concordant signs (i.e., they have the same sign in both tables). Second, nine parameters that are significant in Table 4 are no longer significant in Table 7 (seven of these are of the same sign in both tables, three of which are significant at the 10% level in both tables). Third, there are 16 parameters that are statistically significant in Table 7 but not in Table 4 (12 of them are of the same sign in both tables). Finally, the Fama-French analysis has fewer observations. This is due to the consolidation of smaller sectors, which probably also contributes to a higher R-squared.⁴⁴ The pooled regression results (i.e., the counterpart to Table 6) are very similar to those using the SIC classification (in terms of significance), and are omitted for the sake of brevity.

<Insert Table 7 about here>

Thus, none of the results reported in Tables 4 and 6 are contradicted by the results using the Fama-French classification, though the Fama-French based analysis fails to confirm the importance of some client industry characteristics in explaining the market shares of some of the auditors. To

⁴² Even at the two digit level that we use in this paper, the ratio of standard deviation of the number of firms in a sector to the expected number of firms in that sector is much higher for the SIC classification than in the Fama-French classification (1.35 versus 0.92).

⁴³ The Fama-French classification has also been used by researchers in the accounting literature. See, in particular, Bhojraj et al. (2003) who find in a comparison of alternative industry definitions that the SIC and Fama-French classification systems “differ little from each other in most (capital market research) applications.”

⁴⁴ The aggregation of smaller sectors in the Fama-French classification greatly reduces the differences in the variance of the dependent variable across sectors, which in turn increases the proportion of the variation of normalized excess shares explained by industry characteristics.

the extent one believes that the Fama-French classification is the relevant definition of audit markets, one might adopt a conservative approach in interpreting the results, and in particular focus on only the results discussed in section 4.2 that are corroborated by the results in Table 7 at the 10% level or lower. Under this conservative reading of the results, one could no longer reliably consider either Ernst and Whinney or Ernst and Young to be focused on regulated industries. Similarly, one would not be able to reliably assign any product attributes for PricewaterhouseCoopers. Finally, one would no longer be confident in asserting that Deloitte Haskins and Shells may have had superior ability to compensate for client business risk or that Deloitte and Touche tends to appeal less to clients with high proprietary costs of disclosure.

5. CONCLUDING REMARKS.

This paper examines whether audit firms exhibit systematic differences in their practice profiles. In particular, the paper investigates whether differences in firm clienteles can be quantified in terms of client industry characteristics or whether they are completely random. We find substantial “excess” variability in audit firms’ industry market shares and also that this variability can be explained by client industry characteristics. Measures of asset fixity, industry competitiveness, regulatory environment, and client industry riskiness are all important in predicting auditor-client affiliations. We interpret the pattern of auditor/client-industry affiliations as providing information about the attributes of the audits provided by different firms. We also find that among readily observable audit firm characteristics, the most important one in explaining the pattern of excess shares is the firm’s leverage, or staff-to-partner ratio. Interestingly, contrary to concerns that audits may have been offered as loss-leaders to increase client purchases of non-audit services, the extent of consulting activity does not appear to significantly explain the pattern of excess shares.

In sum, our analysis goes beyond a purely descriptive understanding of audit firm clienteles by providing empirical evidence that economic factors hypothesized in prior literature as important determinants of audit firm clienteles do in fact matter. Moreover, we base our analysis on a portfolio based approach. This approach consists of normalizing within-firm excess shares and has several appealing features. First, it correctly captures the fact that for the questions investigated in this paper, the relevant criterion is not market share but share relative to firm size. Second, it correctly adjusts for changes in audit firm size over time. Third, it correctly scales regression coefficients to make

them comparable across firms (in the firm-by-firm regressions). Finally, it allows us to pool observations from all firms to investigate the extent to which firm characteristics affect practice profiles. Jointly, the last two features allow us to correctly assess the quantitative impact of industry and auditor characteristics in explaining audit firm product and cost differentiation. Thus, our analysis not only yields new results but also uses a novel (and appropriate) methodology to obtain them.

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Table 1

Hypothesized relationships between (unobservable) audit product attributes and observable client and auditor characteristics.

Audit (Product) Attributes	Client characteristics associated with auditor attribute.
Fixed Asset Valuation Expertise	High client-industry fixed asset Intensity (<i>CltFix</i>)
Intangible Asset Valuation Expertise	Low client-industry Book-to-Market ratio (<i>BtM</i>)
Interpretive Flexibility	High client-industry fixed asset intensity (<i>CltFix</i>) Low client-industry Book-to-Market ratio (<i>BtM</i>) High client-industry competition (<i>HHI</i>)
Regulatory Expertise	High level of client-industry regulation (<i>REG</i>)
Risk Sterilization (Tolerance)	High client-industry litigiousness (<i>LITIG</i>) Large fraction of low z-scores in client-industry (<i>ZSCORE3</i>) High client industry acquisition expenses (<i>Acq</i>)
Audit (Product) Attributes	Associated auditor organizational characteristics
Fixed Asset Valuation Expertise	High Leverage
Intangible Asset Valuation Expertise	High Leverage
Interpretive Flexibility	Low Leverage
Regulatory Expertise	High Leverage (?)
Risk Sterilization (Tolerance)	Auditor Size (?)

Table 2
List of Regressors.^(a)

Auditor related variables.

Leverage	Staff per partner ^b
Partners	Number of partners ^b
%MCS	Fraction of firm-wide revenues earned from Management Consulting Services ^b
AFix	Non-current to Total Assets [1 - {Current Assets (14) ÷ Total Assets (6)}].
logMtB	Natural log of market to book ratio [Market Value of Equity (24*25) / Book Value of Equity (6-181)].
logHHI	Natural log of the client industry Herfindahl index.
REG	1 for 2-digit SIC codes 10, 12, 13, 14, 20, 29, 40, 41, 42, 44, 45, 46, 48, 49, 60, 61, 62, 63, 64, and 67, and 0 otherwise ^c
LITIG	1 for 2-digit SIC codes 28, 35, 36, 38, 60, 67, 73, and 0 otherwise ^c
logACQ	Natural log of (Industry total acquisition expenditures (129) / Industry total assets (6)).
ClzZScore3	Fraction of clients in the industry (2-digit SIC or Fama-French) with Altman Z-scores below 3. The value of Altman's z-score [1.2*(CA(14)-CL(5))/TA(6) + 1.4*(RE(36)/TA(6)) + 0.6*(MVEQ(24)*(25)/TL(181) + 0.998(Sales(12)/TA(6))].

Notes: All numbers within parentheses are annual *Compustat* item numbers. (a) All segment level variables are client averages by industry (2-digit SIC or Fama-French) and year. Interactions with and auditor characteristics are not listed as separate variables. (b) data obtained from Public Accounting Report. (c) As reported in Hogan and Jeter (1999).

Table 3

Variable Distributions

This table reports values of independent variables used in the analysis at the individual client level. The total sample consists of all clients for which financial information for some subset of variables listed in Table 2 was available in the 1999 *Compustat* Database.

Panel A. Client Industry Characteristics

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
nSIC2	1340	103.597	135.779	1	1205
sSIC2	1340	95144.670	175373.200	0	1361432
aSIC2	1340	135251.100	321170.800	0.567	4194248
CltFIX	1340	0.520	0.169	0.104	0.965
logMtB	1320	-0.483	0.686	-2.079	4.585
logHHI	1337	-2.106	0.908	-4.555	0
logACQ	1235	-4.649	1.487	-13.237	-0.290
CltZscr3	1337	0.372	0.302	0	1
REG	1340	0.284	0.451	0	1
LITIG	1340	0.099	0.299	0	1

Panel B. Auditor Characteristics

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
Partners	53	1501.679	371.626	869	2677
Leverage	53	9.793	3.210	6.688	20.211
CnsShare	53	35.057	13.511	14	70

Panel C. Dependent variable distributions

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
nDEV	9228	-0.002	0.772	-1	11.422
laDEV	9228	-0.008	0.771	-1	11.454
rsDEV	9208	-0.026	0.896	-1	9.500

Table 4

Influence of client sector characteristics on 2-digit SIC code excess (log-asset) weights in large (Big Five and predecessor) audit firm practices 1980-1998. The dependent variable is normalized excess shares computed as in equation (7) and the regression model is as specified in equation (10).

	AA		KP		AY		EW		EY	
	Coeff	BSE ^a	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE
ClfFIX	0.498*	0.151	0.732*	0.222	0.168	0.441	-0.811	0.418	-1.124*	0.194
logMtB	-0.025	0.026	-0.085*	0.038	0.074	0.056	-0.172*	0.056	0.005	0.031
logHHI	-0.098*	0.037	0.049	0.044	-0.018	0.07	0.001	0.065	-0.001	0.052
REG	-0.006	0.056	0.09	0.075	-0.144	0.131	0.248*	0.116	0.202*	0.07
LITIG	0.042	0.049	0.067	0.066	0.158	0.095	0.043	0.079	0.06	0.08
ClfZscr3	0.21*	0.093	-0.117	0.129	0.137	0.209	0.028	0.188	0.219*	0.104
logACQ	0.006	0.015	-0.021	0.019	-0.026	0.024	0.037	0.024	0.026	0.019
Constant	-0.576*	0.13	-0.331	0.169	-0.292	0.239	0.474*	0.233	0.52*	0.217
N	1233		1233		568		568		665	
R ²	0.092		0.062		0.02		0.069		0.13	
F	16.87 [§]		11.34 [§]		3.73 [§]		4.54 [§]		19.22 [§]	

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	DHS		TR		DT		CL		PW		PWC	
	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE
ClfFIX	-0.614*	0.25	-0.702	0.393	-0.287	0.237	-0.248	0.186	0.13	0.268	0.72*	0.346
logMtB	-0.106*	0.05	-0.06	0.055	-0.08	0.043	0.084	0.052	-0.051	0.05	0.13	0.131
logHHI	-0.186*	0.056	0.113	0.063	-0.102*	0.049	0.07	0.058	-0.037	0.056	-0.014	0.082
REG	0.42*	0.108	-0.332*	0.108	-0.13	0.073	0.034	0.082	0.04	0.084	-0.186	0.136
LITIG	-0.173	0.096	-0.177	0.096	-0.282*	0.083	0	0.071	-0.01	0.082	0.192	0.125
ClfZscr3	0.392*	0.176	-0.089	0.182	-0.061	0.121	0.463*	0.148	0.165	0.155	0.299	0.205
logACQ	-0.05*	0.022	0.009	0.023	0.027	0.022	-0.039	0.02	0.028	0.023	-0.125	0.066
Constant	-0.654*	0.206	0.847*	0.259	0.129	0.237	-0.079	0.189	-0.073	0.194	-0.987*	0.404
N	568		568		665		1166		1166		67	
R ²	0.223		0.125		0.096		0.039		0.015		0.215	
F	23.6 [§]		14.96 [§]		12.53 [§]		5.68 [§]		1.91		1.68	

^a BSE = bootstrap standard errors.

* indicates significance at a p-value of 0.05.

[§] indicates that the joint F-test (using White heteroskedasticity-corrected standard errors) for client characteristics is significant at a p-value of 0.05.

Table 5

Audit attributes of the audits produced by different auditors during the period 1980-1998 based on regressions of auditor (normalized) excess market shares on client-industry (2-digit SIC) attributes.

Auditor	Product Attributes^{a,b}
Arthur Andersen	Superior fixed asset valuation expertise Lower interpretive variation Superior ability to sterilize risk
KPMG	Superior fixed asset valuation expertise Lower intangible asset valuation expertise
Arthur Young	No differentiation relative to market-average
Ernst & Whinney	Lower intangible asset valuation expertise Superior regulatory expertise (?)
Ernst & Young	Lower fixed asset valuation expertise Superior regulatory expertise (?) Superior ability to sterilize risk
Deloitte, Haskins and Sells	Lower fixed asset valuation expertise (?) Lower intangible asset valuation expertise (*) Lower interpretive variation Superior regulatory expertise Moderately higher ability to sterilize risk
Touche Ross	Lower regulatory expertise
Deloitte & Touche	Lower interpretive variation (?) Lower ability to sterilize risk
Coopers & Lybrand	Superior ability to sterilize risk
Price Waterhouse	No differentiation relative to market-average
PricewaterhouseCoopers	Superior fixed asset valuation expertise (?)

^a “superior” or “lower” are defined relative to the market average. Firms are adjudged to have superior or lower ability relative to the market-average at the 5% level of significance.

^b ? = Not significant even at the 10% level in the Fama-French industry regressions. * = potential confound due to the firm offering lower interpretive variation.

Table 6

Effects of audit firm characteristics on 2 digit SIC excess (log-asset) weights in large (Big Five and predecessor) audit firm practices 1980-1998. The dependent variable is laDEV or log-assets-weighted normalized excess shares computed as in equation (7) and the regression model is as specified in equation (8) and explained in more detail in Section 5.3.

	Model 1		Model 2		Model 3	
	Coeff	BSE ^a	Coeff	BSE	Coeff	BSE
Constant	0.682	0.453	0.842	0.456	0.537	0.438
<i>CltFIX</i>	0.331	0.572	0.436	0.57	0.894	0.535
<i>logMtB</i>	-0.105	0.141	-0.078	0.136	-0.065	0.127
<i>logHHI</i>	0.39*	0.126	0.437*	0.134	0.4*	0.131
<i>REG</i>	0.024	0.201	-0.002	0.206	-0.048	0.19
<i>LITIG</i>	0.046	0.189	0.034	0.187	0.057	0.176
<i>CltZscr3</i>	0.363	0.325	0.393	0.335	0.531	0.325
<i>logACQ</i>	-0.032	0.066	-0.008	0.063	0.011	0.058
<i>Leverage</i>	-0.029	0.057	-0.077*	0.026		
<i>CnsShare</i>	-0.013	0.015			-0.019*	0.007
<i>Partners^b</i>	0.175	0.248	0.077	0.249	0.234	0.254
<i>FIXL</i>	0.123*	0.06	0.086*	0.029		
<i>logMtBL</i>	0.006	0.014	-0.001	0.005		
<i>logHHIL</i>	0.003	0.013	-0.013*	0.007		
<i>REGL</i>	-0.016	0.019	-0.005	0.011		
<i>LITIGL</i>	0.004	0.021	0.007	0.009		
<i>BnkrptL</i>	0.036	0.032	0.023	0.016		
<i>logACQL</i>	0.009	0.006	0.003	0.003		
<i>FIXC</i>	-0.01	0.015			0.017*	0.008
<i>logMtBC</i>	-0.002	0.004			-0.001	0.001
<i>logHHIC</i>	-0.005	0.003			-0.004*	0.002
<i>REGC</i>	0.003	0.005			0	0.003
<i>LITIGC</i>	0.001	0.005			0.002	0.002
<i>BnkrptC</i>	-0.004	0.009			0.004	0.004
<i>logACQC</i>	-0.002	0.002			0	0.001
<i>FIXP</i>	-0.628*	0.298	-0.701*	0.29	-0.833*	0.294
<i>logMtBP</i>	0.027	0.103	0.05	0.101	0.055	0.101
<i>logHHIP</i>	0.056	0.077	0.042	0.072	0.043	0.072
<i>REGP</i>	-0.091	0.065	-0.125	0.07	-0.096	0.069
<i>LITIGP</i>	-0.044	0.096	-0.037	0.098	-0.049	0.098
<i>BnkrptP</i>	-0.247	0.175	-0.27	0.174	-0.303	0.176
<i>logACQP</i>	0.011	0.037	-0.001	0.033	-0.002	0.034
Adjusted R ²	0.06		0.07		0.07	
N	3334		3334		3334	
F Leverage	2.21 [§]		10.21 [§]			
F Consulting	1.32				7.3 [§]	
F Partners	4.37 [§]		3.24 [§]		3.8 [§]	

^a BSE = bootstrap standard errors.

^b *Partners* is the number of partners in thousands.

* indicates significance at a p-value of 0.05.

[§] indicates that the joint F-test (using White heteroskedasticity-corrected standard errors) for interactions between client characteristics and *Leverage*, *CnsShare* or *Partners* is significant at a p-value of 0.05.

Table 7

Influence of client sector characteristics on Fama-French 48 industry excess (log-asset) weights in large (Big Five and predecessor) audit firm practices 1980-1998. The dependent variable is normalized excess shares computed as in equation (7) and the regression model is as specified in equation (10).

	AA		KP		AY		EW		EY	
	Coeff	BSE ^a	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE
CltFIX	0.333	0.18	0.458*	0.181	-0.978*	0.336	-1.258*	0.316	-0.707*	0.226
logMtb	-0.021	0.034	-0.104*	0.042	0.099	0.063	-0.097	0.058	-0.05	0.041
logHHI	-0.133*	0.05	-0.025	0.039	0.161	0.094	0.053	0.058	0.093*	0.047
REG	0.009	0.066	0.384*	0.074	-0.278*	0.133	0.042	0.092	-0.049	0.07
LITIG	0.035	0.054	0.34*	0.062	-0.169	0.118	-0.17	0.1	-0.07	0.07
CltZscr3	0.32*	0.102	-0.108	0.109	0.446*	0.197	0.185	0.147	0.249*	0.119
logACQ	-0.019	0.019	0.047*	0.021	-0.04	0.03	0.003	0.025	-0.007	0.02
Constant	-0.8*	0.204	-0.293	0.153	0.686*	0.277	0.744*	0.251	0.504*	0.207
N	896		896		421		421		475	
R ²	0.127		0.182		0.141		0.13		0.158	
F	11.64 [§]		25.47 [§]		9.41 [§]		10.57 [§]		9.67 [§]	

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	DHS		TR		DT		CL		PW		PWC	
	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE	Coeff	BSE
CltFIX	-0.113	0.343	-0.922*	0.327	-0.261	0.229	0.021	0.204	-0.127	0.274	0.22	0.468
logMtb	-0.115*	0.058	0.052	0.047	-0.147*	0.035	0.144*	0.065	-0.164*	0.048	0.251	0.132
logHHI	-0.209*	0.067	-0.124*	0.052	-0.002	0.047	0.086	0.069	-0.01	0.045	-0.069	0.072
REG	0.232	0.129	-0.21*	0.096	-0.022	0.072	0.011	0.093	0.119	0.114	-0.179	0.196
LITIG	0.127	0.094	-0.204*	0.093	-0.147*	0.067	-0.07	0.093	0.043	0.071	0.079	0.14
CltZscr3	-0.049	0.177	-0.124	0.157	-0.032	0.108	0.297*	0.141	-0.213	0.132	0.293	0.225
logACQ	-0.083*	0.025	0.005	0.02	0.011	0.02	-0.067*	0.029	0.036	0.026	-0.199*	0.093
Constant	-0.968*	0.261	0.286	0.205	0.219	0.214	-0.139	0.205	0.247	0.198	-1.107*	0.448
N	421		421		475		848		848		48	
R ²	0.169		0.199		0.096		0.047		0.037		0.415	
F	10.52 [§]		9.83 [§]		9.65 [§]		3.82 [§]		4.82 [§]		2.87	

^a BSE = bootstrap standard errors.

* indicates significance at a p-value of 0.05.

[§] indicates that the joint F-test (using White heteroskedasticity-corrected standard errors) for client characteristics is significant at a p-value of 0.05.