The Large Audit Firm Fee Premium: A Case of Selectivity Bias?*

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Abstract

After controlling for client characteristics, existing studies report that large audit firms earn significantly higher fees than small audit firms. However, these studies treat auditor choice as exogenous. In contrast, this paper takes into account the fact that companies are not randomly assigned to audit firms. We find that the effects of auditor selection bias on audit fees are statistically significant. The results indicate that the premium earned by large audit firms is more than twice as large when selectivity is taken into account.

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ABSTRACT: After controlling for client characteristics, existing studies report that large audit firms earn significantly higher fees than small audit firms. However, these studies treat auditor choice as exogenous. In contrast, this paper takes into account the fact that companies are not randomly assigned to audit firms. We find that the effects of auditor selection bias on audit fees are statistically significant. The results indicate that the premium earned by large audit firms is more than twice as large when selectivity is taken into account.

1. Introduction

There have been several empirical studies of the determinants of audit fees, many of which include among the explanatory variables a dummy for audit firm size (Chan et al., 1993; Pong and Whittington, 1994; Craswell et al., 1995; Simunic and Stein, 1987; Beatty, 1989). As the coefficient on auditor size is significantly positive, these studies conclude that large audit firms are able to charge higher fees than small audit firms. In a competitive audit market, such fee differentials represent a return to higher quality.[1]

However, since companies are not randomly assigned to audit firms, it is invalid to treat the auditor size dummy as exogenous as has been customary in audit fee studies. Whilst we observe the fees that companies are charged after they have chosen their auditor, we do not observe the fees that they would have been charged, had they made the alternative choice. This self-selection may result in bias if a correction is not made. This paper examines audit fees within a two-stage selection model in order to correct for selection effects. In the first stage,

[1] In addition to audit fee studies, there is other evidence which supports the view that large auditors supply higher quality audits. For example, the stock market reacts more favourably when a company switches to a large auditor rather than to a small auditor (Nichols and Smith, 1983; Firth and Smith, 1992), large audit firms give more accurate signals of financial distress in their audit opinions (Lennox, 1999), companies with higher agency costs are more likely to hire large audit firms (Francis and Wilson, 1988; Johnson and Lys, 1990; DeFond, 1992; Firth and Smith, 1992), and companies involved in initial public offerings experience less under-pricing when they hire large audit firms (Balvers et al., 1988; Firth and Smith, 1992).

we model the initial auditor choice and in the second stage we evaluate the effects on fees of auditor size and selection bias. We find that the estimated large audit firm fee premium is more than twice as large when auditor selection is accounted for.

Both theory and empirical research suggest that it is appropriate to treat auditor choice as endogenous, as we do in this paper. Titman and Trueman (1986) and Datar et al. (1991) present signalling models in which it is more costly to hire accurate auditors than inaccurate auditors. They show that managers with favourable private information prefer more accurate auditors despite the higher cost. Empirical studies of auditor choice start from the premise that high agency costs increase the demand for audit accuracy and that large audit firms have more incentive to provide accurate audits. These studies confirm the view that companies with high agency costs are more likely to hire large auditors although the main determinant of auditor choice in these studies is company size (Francis and Wilson, 1988; Johnson and Lys, 1990; DeFond, 1992; Firth and Smith, 1992). The endogenous treatment of auditor choice in these papers contrasts with its exogenous treatment in extant audit fee research.

Section 2 describes the auditor selection and audit fee models employed in this paper and details the econometric methodology. Section 3 outlines the data and

Section 4 evaluates the impact on audit fees of audit firm size and selectivity bias.

2. Model Specification

2.1. An overview

Previous studies examining the determinants of audit fees (AF_i) assume a model of the form

$$AF_i = \beta_0 + \beta_1' X_i + \beta_2' Z_i + \beta_3 AUD_i + u_i \tag{2.1}$$

Consistent with previous studies we define an audit firm as being large ($AUD_i = 1$) if it belongs to one of the Big Five and we define all other audit firms as small ($AUD_i = 0$).[2] In contrast to equation (2.1), the main finding of this paper is that it is invalid to treat the auditor size dummy as exogenous. In particular, $\widehat{\beta}_3$ underestimates the true size of the large audit firm fee premium. The remaining explanatory variables (X_i and Z_i) in equation (2.1) capture other client and

[2] The Big Five audit firms are KPMG, PricewaterhouseCoopers, Deloitte Touche, Arthur Andersen and Ernst and Young. In unreported results, we do not find that medium-sized audit firms charge higher fees than small local audit firms. An audit firm is categorised as medium-sized if it audits at least five listed companies but does not belong to the Big Five. The medium-sized audit firms in our sample are Baker Tilly, BDO Stoy Hayward, Binder Hamlyn, Grant Thornton, Pannell Kerr Forster, Robson Rhodes, Kidsons Impey, Hacker Young, Horwath Clarke Whitehill, Moore Stephens and Moores Rowland.

auditor characteristics that affect fees.

We follow the two-step approach outlined in Maddala (1983). We first estimate an auditor choice model and then use the estimation results to control for the effects of selection bias on audit fees. The auditor choice probit model is

$$AUD_i^* = \gamma_0 + \gamma_1' X_i + \gamma_2' Y_i + v_i \tag{2.2}$$

where

$$AUD_i = 1 \quad \text{if} \;\; AUD_i^* > 0$$

$$AUD_i = 0 \quad \text{otherwise.}$$

In comparing equations (2.1) and (2.2), note that the X_i variables affect both audit fees and the choice of audit firm. In contrast, the Z_i and Y_i variables affect only audit fees and auditor choice, respectively. To simplify notation, the auditor choice equation (2.2) is written as

$$AUD_i^* = \gamma_0 + \gamma_1' X_i + \gamma_2' Y_i + v_i \equiv \gamma' W_i + v_i \tag{2.3}$$

where $\gamma' = [\gamma_0 : \gamma_1' : \gamma_2']$ and $W_i = [1 : X_i : Y_i]$.

The audit fee models for large and small audit firms are

$$AF_{1i} = \beta_{10} + \beta'_{11} X_i + \beta'_{12} Z_i + u_{1i} \tag{2.4}$$

$$AF_{0i} = \beta_{00} + \beta'_{01} X_i + \beta'_{02} Z_i + u_{0i} \tag{2.5}$$

where AF_{1i} and AF_{0i} are the fees payable by company i to large or small audit firms, respectively. Recall that only one of AF_{1i} and AF_{0i} is observed for each company i, depending on whether the company chooses a large or a small auditor. Our selectivity corrections (discussed below) control for the fact that we do not observe the fees that companies would have paid if they had chosen audit firms of alternative size.

Note also that, unlike equation (2.1) (and most previous studies), equations (2.4) and (2.5) do not impose the restriction that the coefficients on the X_i and Z_i variables are the same for large and small audit firms (i.e. we do not impose the restriction that $\beta'_{11} = \beta'_{01}$and $\beta'_{12} = \beta'_{02}$).[3]

From equations (2.4) and (2.5), our estimate of the large audit firm fee premium is $\widehat{\beta}_{10} - \widehat{\beta}_{00}$. Under the hypothesis that large audit firms are able to charge

[3] An exception is Pong and Whittington (1994) who control for coefficient differences by including interaction terms between the auditor size dummy and the other explanatory variables (X_i and Z_i). However, Pong and Whittington (1994) do not control for auditor selection bias.

higher fees than small audit firms, the intercept in equation (2.4) is bigger than the intercept in equation (2.5) (i.e. $\widehat{\beta}_{10} > \widehat{\beta}_{00}$).

We assume that the error terms u_{1i}, u_{0i} and v_i have a trivariate normal distribution, with mean vector zero and covariance matrix

$$\Omega = \begin{bmatrix} \sigma_1^2 & \sigma_{10} & \sigma_{1v} \\ \sigma_{10} & \sigma_0^2 & \sigma_{0v} \\ \sigma_{1v} & \sigma_{0v} & \sigma_v^2 \end{bmatrix}$$

To show why simple regressions may result in selectivity bias, we take conditional expectations of equations (2.4) and (2.5)

$$E[AF_{1i} \mid AUD_i = 1] = \beta_{10} + \beta_{11}' X_i + \beta_{12}' Z_i + E[u_{1i} \mid AUD_i = 1]$$

$$E[AF_{0i} \mid AUD_i = 0] = \beta_{00} + \beta_{01}' X_i + \beta_{02}' Z_i + E[u_{0i} \mid AUD_i = 0].$$

If auditor choice is systematically correlated with audit fees, the conditional means for audit fees and error terms are not equal to their unconditional means

$$E[AF_{1i} \mid AUD_i = 1] \neq E[AF_{1i}] \iff E[u_{1i} \mid AUD_i = 1] \neq E[u_{1i}] \equiv 0$$

$$E[AF_{0i} \mid AUD_i = 0] \neq E[AF_{0i}] \iff E[u_{0i} \mid AUD_i = 0] \neq E[u_{0i}] \equiv 0.$$

Estimating equations (2.4) and (2.5) without controlling for auditor selection results in a biased estimate of the large audit firm fee premium $(\widehat{\beta}_{10} - \widehat{\beta}_{00})$ if

$$E[((u_{1i} \mid AUD_i = 1) - (u_{0i} \mid AUD_i = 0))(\beta_{10} - \beta_{00})] \neq 0.$$

We control for the effects of selection bias in the second stage by estimating the following fee models for large and small audit firms

$$AF_{1i} = \beta_{10} + \beta_{11}' X_i + \beta_{12}' Z_i + \sigma_{1u} \lambda_{1i} + e_{1i} \tag{2.6}$$

$$AF_{0i} = \beta_{00} + \beta_{01}' X_i + \beta_{02}' Z_i + \sigma_{0u} \lambda_{0i} + e_{0i} \tag{2.7}$$

where

$$\sigma_{1u}\lambda_{1i} \equiv \sigma_{1u}\frac{\phi(\gamma' W_i)}{\Phi(\gamma' W_i)} = E[u_{1i} \mid AUD_i = 1]$$

$$\sigma_{0u}\lambda_{0i} \equiv \sigma_{0u}\frac{\phi(\gamma' W_i)}{1-\Phi(\gamma' W_i)} = E[u_{0i} \mid AUD_i = 0]$$

$$\sigma_{1u} \equiv \frac{\sigma_1^2 - \sigma_{10}}{\sigma_i}, \sigma_{0u} \equiv \frac{\sigma_0^2 - \sigma_{10}}{\sigma_i}, \text{and } \sigma_i^2 \equiv Var(u_{1i} - u_{0i}).$$

The functions ϕ and Φ are the standard normal probability density function and the cumulative distribution function, respectively. The key difference between equations (2.4)-(2.5) and equations (2.6)-(2.7) is that the latter include inverse Mills ratios (λ_{1i} and λ_{0i}) in order to control for selectivity bias.

In the first stage, the inverse Mills ratios are estimated using the results from equation (2.3) and in the second stage, they are included in equations (2.6) and (2.7). As a result, the conditional and unconditional expected error terms in equations (2.6) and (2.7) are equal to zero

$$E[e_{1i} \mid AUD_i = 1] = E[e_{1i}] = E[e_{0i} \mid AUD_i = 0] = E[e_{0i}] = 0.$$

The estimated large audit firm fee premium $(\widehat{\beta}_{10} - \widehat{\beta}_{00})$ in equations (2.6) and (2.7) is unbiased since

$$E[((e_{1i} \mid AUD_i = 1) - (e_{0i} \mid AUD_i = 0))(\beta_{10} - \beta_{00})] = 0.$$

2.2. The Explanatory Variables (X_i, Y_i and Z_i)

The explanatory variables (X_i, Y_i and Z_i) used in the auditor choice and audit fee models are defined in Table 1 and are discussed below.

[Insert Table 1 here]

2.2.1. Variables (X_i) included in both the Auditor Choice and Audit Fee Models

Consistent with previous studies, we hypothesize that auditee size, complexity and risk affect both fees and the choice of audit firm (e.g., Pong and Whittington, 1994). There are a number of different measures of size that may be used. Previous studies use either assets (e.g., Craswell et al., 1995) or sales turnover (e.g., Chan et al., 1993) or both (Pong and Whittington, 1994). We use both assets (ASS_i) and sales (SA_i), as each represents a different dimension of size (Pong and Whittington, 1994). Fees likely reflect both turnover and assets as audit work involves the examination of both transactions during the year (reported in the profit and loss account and cash flow statement) and year-end balances (reported in the balance sheet). We expect to find that large companies hire large audit firms more often than small audit firms and that large companies pay higher fees.

A more complex or more risky auditee requires more audit work. Risk and complexity are in some ways closely linked, as a more complex auditee will *ceteris paribus* pose more risk than a less complex auditee, although risk may also arise from other quarters.[4] Again, there are several different dimensions of complexity and risk that may be measured. One measure of complexity is the number of different areas of business that the auditee is involved in. This is captured in our model by the number of different main SIC (Standard Industry Classification) codes (SIC_i). The existence of subsidiary companies will increase complexity as consolidated accounts must be audited. Hence, we include among our explanatory variables the number of subsidiary companies located in the UK (DS_i) and overseas (OS_i). We expect to find that more complex companies are more likely to hire large audit firms and are more likely to pay higher fees.

Gearing (G_i) is included as a risk measure, as companies often fail through cash flow problems or suffer restrictive bond covenants. Profitability is another measure of auditee risk. As in previous studies, we define a loss dummy ($LOSS_i$) equal to

[4] One example would be the integrity of management.

one if the company made a loss in the past three years. We hypothesize that these risk variables are positively associated with audit fees. On the other hand, the hypothesized relationship between auditor choice and client risk is ambiguous. More risky companies may prefer to hire large audit firms in order to reduce agency costs (Francis and Wilson, 1988; DeFond, 1992). On the other hand, large audit firms may be reluctant to accept high-risk clients because of the potential damage to their reputations or because of the threat of litigation (Krishnan and Krishnan, 1997).

We also include a dummy ($BUSY_i$) for the so-called 'busy period' of accounting firms, namely year-ends which fall between 1 December and 31 March inclusive.

2.2.2. Variables (Y_i) included in the Auditor Choice Model only

In order to identify the effects of selectivity bias (as captured by the $\sigma_{1u}\lambda_{1i}$ and $\sigma_{0u}\lambda_{0i}$ terms), it is important to include some variables in the auditor choice model, but to exclude them from the audit fee models. The Y_i variables which fulfill this role are defined in Table 1.

We hypothesize that the proportion of directors who are non-executives (NX_i) is positively associated with audit firm size for at least two reasons. Firstly, non-executives may have a stronger preference for high quality (large) audit firms compared to executive directors, as they partly fulfill a monitoring role. Secondly, companies which have a high demand for monitoring may be more likely to appoint non-executive directors and may be more likely to hire large audit firms.

We also hypothesize that auditor choice depends on directors' personal affiliations with audit firms. We expect to find that companies hire large (small) audit firms more often when directors disclose that they previously worked for large (small) auditors. Our affiliation variables equal one if the company discloses an affiliation with a large (LAF_i) or small (SAF_i) audit firm, respectively. The affiliation variables (LAF_i and SAF_i) are equal to zero if there is no such disclosure. Corporate affiliations with audit firms are discussed in more detail in Section (3.1).

2.2.3. Variable (Z_i) included in the Audit Fee Models only

We include an audit office location variable in the audit fee models but exclude it from the auditor choice model. The location variable (LON_i) equals one if the audit office is located in London and zero otherwise. We expect to find that London offices have higher costs and therefore charge higher audit fees compared to audit offices located outside of London.

3. Data

3.1. Data sources

Our study is based upon an initial cross-sectional sample of 1543 listed UK companies which file annual results for the period 1997-98. The PricewaterhouseCoopers Corporate Register (PCR) is used to identify company auditors, audit office locations, company directors and their affiliations with audit firms. The PCR provides information on directors' career histories and their professional qualifications.

In deciding whether companies are affiliated with audit firms, we attempt to identify for each company, the director who has the strongest boardroom influence over audit appointments. We generally assume that finance directors are most influential as they have regular contact with audit firms. If a finance director discloses that he/she previously worked for a large (small) audit firm, we expect that the company will be more likely to hire a large (small) audit firm. We should note that some directors disclose past employments with both large and small audit firms. In such cases, we assume that the affiliation is with the most recent audit firm.

In approximately 10% of sample companies, finance directors are not identified. In such cases we adopt the following rules for choosing the most influential director:

(a) We choose the company secretary, if (i) the company secretary is a qualified accountant, or (ii) neither the company secretary nor the CEO nor the Chairman are qualified accountants. We rank the company secretary above the CEO and Chairman in terms of influence, because the posts of company secretary and finance director are often carried out by the same person.

(b) We choose the CEO, if (i) the CEO is a qualified accountant and the company secretary is either not qualified or not identified, or (ii) neither the CEO nor Chairman are qualified accountants and the company secretary is not identified.

(c) We choose the company chairman, if (i) the chairman is a qualified accountant and neither the CEO nor company secretary are qualified, or (ii) neither the CEO nor company secretary are identified.

These rules enable us to identify an influential director for each company. Another issue is that directors frequently do not disclose full career histories in the PCR. It is likely that some directors previously worked for audit firms but do not disclose this, perhaps because the employment was a long time ago or because it was for a relatively short period. We do not believe that this lack of disclosure presents a serious problem since directors may disclose past audit employments more readily when personal affiliations are particularly strong.[5]

Information on SIC codes and subsidiaries is collected from Extel. Data on audit fees, assets, sales, profits, gearing and directors (executive or non-executive) are collected from Datastream. Because of missing Datastream data for 217 companies, the final sample consists of 1326 observations.

3.2. Descriptive statistics

Descriptive statistics for the dependent and explanatory variables are reported in Table 2. Audit fees (AF_i) range from a minimum of £2,000 to a reported maximum of £9.6m, with mean and median values of £243,000 and £73,000, respectively. Large audit firms (AUD_i) are chosen by 76% of the companies in our sample and 43% of companies are audited by offices located in London (LON_i).

[Insert Table 2 here]

The mean values for assets (ASS_i) and sales (SA_i) are £343m and £519m, respectively. The means for these size variables are much larger than their medians

[5] These affiliation variables are admittedly arbitrary and may be measured with some error. Since we have no reason to believe that measurement error is correlated with auditor choice, we do not feel that bias is likely to be a problem. A potentially more important problem is that measurement error may increase coefficient standard errors. However, our affiliation variables have statistically significant effects on auditor choice which suggests that lack of precision is not a problem.

(£28m and £61m, respectively) which reflects the fact that there are many small listed companies and relatively few large companies. The number of main SIC codes (SIC_i) ranges from one to ten and there is also a considerable range in the number of domestic (DS_i) and overseas subsidiaries (OS_i).

Only 22% of companies make accounting losses ($LOSS_i$) in one or more of the past three years and there is considerable variation in gearing levels (G_i). Nearly half of the companies (48%) have year-ends which fall during the four-month busy period ($BUSY_i$). The average proportion of directors who are non-executives (NX_i) is 30% and ranges from zero to 80%.

Affiliations with large audit firms (LAF_i) are disclosed by 25% of influential directors and affiliations with small audit firms (SAF_i) are disclosed by a further 5%. The remaining 70% either did not previously work for audit firms or do not disclose past audit employments. As explained above, these directors are categorized as having no affiliation with either large or small audit firms.

3.3. Rank Transformations

The means and medians reported in Table 2 reveal that the audit fee (AF_i), company size (ASS_i and SA_i), complexity (SIC_i, DS_i and OS_i) and gearing (G_i) variables are highly skewed. Two statistical problems faced by previous audit fee studies are skewness and outlying observations. Researchers have controlled for the former problem by performing logarithmic and square root transformations (Francis and Simon, 1987, Simon and Francis, 1988, Chan et al., 1993, Craswell et al., 1995). Outlying observations have generally been confronted by trimming or truncating sample distributions.

More recently, Kane and Meade (1998) have shown that rank transformations perform better in resolving both these problems. The procedure involves replacing each observation with its rank within the sample and then dividing each observation by N+1 (where N is the number of observations). Thus, the ranked variables are uniformly distributed between zero and one. Following this approach, we replace the audit fee (AF_i), company size (ASS_i and SA_i), complexity (SIC_i, DS_i and OS_i) and gearing (G_i) variables with their rank-transformed equivalents (AFR_i, $ASSR_i$, SAR_i, $SICR_i$, DSR_i, OSR_i and GR_i, respectively).

The descriptive statistics for the rank-transformed and other variables ($LOSS_i$, $BUSY_i$, NX_i, LAF_i, SAF_i, LON_i) are reported in Table 3, which partitions the sample into 1013 companies audited by large audit firms and 313 companies audited by small audit firms.

[Insert Table 3 here]

The results for audit fees (AFR_i) confirm that large audit firms earn significantly higher fees than small audit firms. The size ($ASSR_i$ and SAR_i) and complexity ($SICR_i$, DSR_i, OSR_i) variables show that companies audited by large firms are significantly larger and more complex than those audited by small firms. The loss dummy ($LOSS_i$) and the gearing variable (GR_i) show that the clients of large audit firms are more profitable and more highly-geared compared to the clients of small audit firms.

The association between large audit firms and the proportion of directors who are non-executives (NX_i) is positive and significant. This is consistent with the view that audit and board quality are complementary and that non-executives prefer to hire large audit firms. Companies hire large audit firms more often than small audit firms when influential directors are affiliated with large audit firms (LAF_i). Similarly, companies hire large audit firms less often when directors are affiliated with small audit firms (SAF_i).

4. Estimation results

4.1. An overview

In this section, we evaluate the effects of auditor selection bias and auditor size on audit fees. First, we replicate the approach of previous studies by treating auditor choice as exogenous as in the following model

$$AFR_i = \beta_0 + \beta_1' X_i + \beta_2' Z_i + \beta_3 AUD_i + u_i$$

Consistent with extant research, we find a significant positive coefficient on the auditor size dummy ($\widehat{\beta}_3 > 0$).

Next, we estimate an auditor choice model as the first stage of our selectivity model

$$AUD_i^* = \gamma_0 + \gamma_1' X_i + \gamma_2' Y_i + v_i \equiv \gamma' W_i + v_i$$

and we use the estimation results to construct the inverse Mills ratios ($\widehat{\lambda}_{1i}$ and $\widehat{\lambda}_{0i}$).

$$\widehat{\lambda}_{1i} \equiv \frac{\phi(\widehat{\gamma}' W_i)}{\Phi(\widehat{\gamma}' W_i)} \text{ and } \widehat{\lambda}_{0i} \equiv \frac{\phi(\widehat{\gamma}' W_i)}{1 - \Phi(\widehat{\gamma}' W_i)}.$$

In the second stage, we estimate audit fee models for large and small audit firms and evaluate the effects of selection bias.

$$AFR_{1i} = \beta_{10} + \beta'_{11}X_i + \beta'_{12}Z_i + \sigma_{1u}\widehat{\lambda}_{1i} + e_{1i}$$

$$AFR_{0i} = \beta_{00} + \beta'_{01}X_i + \beta'_{02}Z_i + \sigma_{0u}\widehat{\lambda}_{0i} + e_{0i}$$

When we impose the restriction that auditor choice is exogenous ($\sigma_{1u} = \sigma_{0u} = 0$), we find that the estimated fee premium is not significantly different from that using the traditional approach (i.e., $\widehat{\beta}_{10} - \widehat{\beta}_{00} \approx \widehat{\beta}_3 > 0$).

When we allow for selectivity, we find that the estimated coefficients on the inverse Mills ratios are significantly negative in the large auditor model ($\widehat{\sigma}_{1u} < 0$) and weakly positive in the small auditor model ($\widehat{\sigma}_{0u} \geq 0$). More importantly, we find that the estimated fee premium is significantly larger when selectivity is taken into account (i.e., $\widehat{\beta}_{10} - \widehat{\beta}_{00} > \widehat{\beta}_3 > 0$).

4.2. Audit Fees and Auditor Choice

Consider first the estimation results presented in Table 4. Column (1) replicates the customary approach by including the auditor size dummy (AUD_i) as an exogenous predictor of audit fees.[6] Columns (2)-(3) are auditor choice probit models.[7]

[Insert Table 4 here]

The results in Column (1) are consistent with those reported in prior audit fee studies. The coefficient on auditor size is positive ($\widehat{\beta}_3 = 0.05$) and statistically significant. Therefore, large audit firms earn higher fees than small audit firms after controlling for client characteristics and audit office location. As expected, there is a significant positive relationship between company size ($ASSR_i$ and SAR_i) and audit fees. Audit fees are significantly associated with client complexity as measured by the number of SIC codes (SIC_i) and the number of domestic (DSR_i) and overseas (OSR_i) subsidiaries. High-risk companies are charged higher fees, as shown by the significant positive coefficients on the loss dummy ($LOSS_i$) and gearing (GR_i). Audit fees are also higher during the busy season ($BUSY_i$) and when the audit office is located in London (LON_i).

[6] In unreported results, we find that logarithmic and square root transformations do not satisfactorily remove the estimation problems associated with highly skewed variables. In addition, we wish to avoid the loss of information associated with sample trimming and truncation when dealing with outliers. Consistent with Kane and Meade (1998), we find that rank transformations result in better fitting audit fee models (higher R^2) and that the residuals in these models conform more closely to OLS assumptions. The residuals are normally distributed, spherical and uncorrelated with the explanatory variables.

[7] To assess the validity of the auditor choice models, we generate simulate residuals and find no evidence of heteroscedasticity or omitted variables problems (Gourieroux et al., 1987).

In Columns (2)-(3), the coefficient estimates for the auditor choice models are consistent with prior expectations. The coefficients on the company size variables ($ASSR_i$ and SAR_i) show that large companies hire large audit firms more often than small audit firms. Companies also hire large audit firms more often when they have subsidiaries located overseas (OSR_i). Affiliations between audit firms and influential directors (LAF_i and SAF_i) are important in explaining auditor choice. Companies hire large (small) audit firms more often when directors disclose past employments with large (small) audit firms. Audit firm size is positively associated with the proportion of directors who are non-executives (NX_i). This suggests that either non-executives have a stronger preference for high quality audits or that audit and board quality are complementary. The remaining explanatory variables (SIC_i, DSR_i, GR_i and $BUSY_i$) do not significantly affect auditor choice and are omitted from Column (3). The results in Column (3) are used to construct the inverse Mills ratios ($\widehat{\lambda}_{1i}$ and $\widehat{\lambda}_{0i}$), which are next used to evaluate the effects of auditor selection bias.

4.3. Evaluating the Effects of Selection Bias on Audit Fees.

Table 5 reports audit fee models for large and small audit firms, with and without controlling for selectivity bias. Columns (1)-(2) omit the inverse Mills ratios ($\widehat{\lambda}_{1i}$

and $\widehat{\lambda}_{0i}$) whilst Columns (3)-(4) control for selectivity. Columns (1) and (3) are estimated for large audit firms, whilst Columns (2) and (4) are estimated for small audit firms. There are three key findings.

[Insert Table 5]

Firstly, the estimated large audit firm fee premium ($\widehat{\beta}_{10} - \widehat{\beta}_{00}$) is 0.06 ($= -0.12 - (-0.18)$) in Columns (1) and (2). This is insignificantly different from the premium estimated in Column (1) of Table 4 ($\widehat{\beta}_3 = 0.05$). Columns (3) and (4) show that, after controlling for selectivity, the estimated fee premium is 0.16 ($= -0.03 - (-0.19)$). The difference between these estimates (0.16 and 0.06) is statistically significant at the 1% level. The effect of selectivity bias on the fee premium is also significant from an economic point of view. Evaluated at the median level of audit fees, the estimated premium is £14,000 in Columns (1)-(2) but is £39,000 after controlling for selectivity. We conclude that the large audit firm fee premium is more than twice as large when one controls for auditor selection bias.

Secondly, the estimated effects of selectivity are negative and statistically significant for large audit firms ($\widehat{\sigma}_{1u}\widehat{\lambda}_{1i} < 0$). Intuitively, this means that companies which choose large audit firms pay lower fees than randomly selected companies would pay ($E[AF_{1i} \mid AUD_i = 1] < E[AF_{1i}]$). The effects of selectivity are positive but not statistically significant for small audit firms ($\widehat{\sigma}_{0u}\widehat{\lambda}_{0i} \geq 0$). Intuitively, companies which hire small audit firms do not pay lower fees than randomly selected companies would pay ($E[AF_{0i} \mid AUD_i = 0] \geq E[AF_{0i}]$).

Finally, the coefficient estimates for the other explanatory variables are similar across Columns (1)-(4) and are consistent with those reported in Column (1) of Table 4. The coefficients have the same signs for both large and small audit firms and, in general, there are no significant differences between coefficient estimates ($\beta'_{11} = \beta'_{01}$ and $\beta'_{12} = \beta'_{02}$). The only exception is the domestic subsidiaries variable (DSR_i), which has a significantly smaller impact on the fees of large audit firms (0.07) than on the fees of small audit firms (0.18). This is possibly due to the fact that large audit firms have more offices located within the UK and therefore have lower transport costs compared to small audit firms.

5. Conclusions

This paper examines the determinants of audit fees for large and small audit firms, where the choice to hire large or small firms is endogenous. After controlling for client characteristics, existing studies report that large audit firms earn significantly higher fees than small audit firms. However, extant research on audit fees has treated auditor choice as exogenous. In contrast, this paper takes into account the fact that companies are not randomly assigned to audit firms.

We find that the effects of auditor selection on audit fees are statistically significant. The results indicate that the premium earned by large audit firms is more than twice as large when selectivity bias is taken into account. The importance of selectivity bias should not be too surprising since both theory and empirical research treat auditor choice as endogenous. Overall, our results indicate that previous studies significantly underestimate the returns attributable to higher audit quality.

Table 1. Variable definitions.

Variables (X_i) included in both the Auditor Choice and Audit Fee Models.

ASS_i	Assets employed (£000)
SA_i	Sales turnover (£000)
SIC_i	Number of SIC codes
DS_i	Number of domestic (UK) subsidiaries
OS_i	Number of overseas subsidiaries
$LOSS_i$	= 1 if the company made a loss during the past 3 years; = 0 otherwise.
G_i	$\frac{\text{Preference capital + Subordinated Debt + Loan Capital + Short-term borrowings}}{\text{Capital employed + Short-term borrowing - Intangibles}}$
$BUSY_i$	= 1 if the year-end is between the 1st December and 31st March; = 0 otherwise.

Variables (Y_i) included in the Auditor Choice Model only.

NX_i	$= \frac{\text{Number of non-executive directors}}{\text{Number of directors}}$
LAF_i	= 1 if the influential director is affiliated with a large audit firm; = 0 otherwise.
SAF_i	= 1 if the influential director is affiliated with a small audit firm; = 0 otherwise.

Variable (Z_i) included in the Audit Fee Models only.

LON_i	= 1 if the audit office is located in London; = 0 otherwise.

Table 2. Descriptive statistics.

Variable	Mean	Median	Minimum	Maximum
AF_i	243	73	2	9600
AUD_i	0.76	1	0	1
ASS_i	343585	28431	-13579	42400000
SA_i	519499	60647	0	56666666
SIC_i	2.96	2	1	10
DS_i	5.73	4	0	53
OS_i	4.25	1	0	96
$LOSS_i$	0.22	0	0	1
G_i	33.38	27.15	-4552	3020
$BUSY_i$	0.48	0	0	1
NX_i	0.30	0.3	0	0.8
LAF_i	0.25	0	0	1
SAF_i	0.05	0	0	1
LON_i	0.43	0	0	1

See Table 1 for variable definitions.
The AF_i, ASS_i and SA_i variables are in £000.

Table 3. Descriptive statistics for large and small audit firms.

Variable	Large audit firms ($AUD_i = 1$) Mean	Median	Small audit firms ($AUD_i = 0$) Mean	Median
AFR_i	0.5692**	0.6059**	0.2994	0.2495
$ASSR_i$	0.5411**	0.5588**	0.3081	0.2723
SAR_i	0.5789**	0.6058**	0.3430	0.2997
$SICR_i$	0.5302*	0.6243**	0.4838	0.4057
DSR_i	0.5049**	0.4915**	0.4083	0.3969
OSR_i	0.5455**	0.5678**	0.4029	0.2567
$LOSS_i$	0.2024**	0	0.2716	0
GR_i	0.5042**	0.4993**	0.4449	0.4269
$BUSY_i$	0.4985**	0	0.4026	0
NX_i	0.3061**	0.3077**	0.2702	0.2857
LAF_i	0.2774**	0	0.1565	0
SAF_i	0.0306**	0	0.1022	0
LON_i	0.4087**	0	0.5144	1
Observations	1013		313	

** Significant difference between large and small audit firms (1%).
* Significant difference between large and small audit firms (5%).
See Table 1 for variable definitions.
The AFR_i, $ASSR_i$, SAR_i, $SICR_i$, DSR_i, OSR_i and GR_i variables are rank-transformations of AF_i, ASS_i, SA_i, SIC_i, DS_i, OS_i and G_i, respectively.

Table 4. Audit Fees and Auditor Choice.

$AFR_i = \beta_0 + \beta_1' X_i + \beta_2' Z_i + \beta_3 AUD_i + u_i$
$AUD_i^* = \gamma_0 + \gamma_1' X_i + \gamma_2' Y_i + v_i \equiv \gamma' W_i + v_i$

	Expected sign	(1) AFR_i	Expected sign	(2) AUD_i^*	(3) AUD_i^*
$ASSR_i$	+	0.16	+	0.73	0.72
		(6.28)**		(2.65)**	(2.65)**
SAR_i	+	0.59	+	1.66	1.49
		(21.93)**		(5.37)**	(5.22)**
$SICR_i$	+	0.06	+	-0.23	.
		(4.96)**		(-1.38)	.
DSR_i	+	0.09	+	-0.28	.
		(6.97)**		(-1.55)	.
OSR_i	+	0.23	+	0.53	0.50
		(17.76)**		(2.84)**	(2.72)**
$LOSS_i$	+	0.04	?	0.37	0.37
		(5.22)**		(3.47)**	(3.50)**
GR_i	+	0.05	?	0.08	.
		(4.76)**		(0.52)	.
$BUSY_i$	+	0.01	?	0.07	.
		(2.33)**		0.80	.
LON_i	+	0.05	.	.	.
		(7.89)**		.	.
AUD_i	+	0.05	.	.	.
		(6.80)**		.	.
LAF_i	.	.	+	0.29	0.29
		.		(2.78)**	(2.76)**
SAF_i	.	.	-	-0.55	-0.56
		.		(-3.07)**	(-3.13)**
NX_i	.	.	+	2.17	2.19
				(3.99)**	(4.02)**
$CONSTANT$	?	-0.18	?	-1.19	-1.27
		(-18.45)**		(-5.85)**	(-6.61)**
R^2		86.6%		18.9%	18.5%

See Tables 1 and 3 for variable definitions. Observations = 1326.
** Significant at the 1% level. * Significant at the 5% level.

Table 5. Evaluating the Effects of Selection Bias on Audit Fees.

$$AFR_{1i} = \beta_{10} + \beta'_{11}X_i + \beta'_{12}Z_i + \sigma_{1u}\widehat{\lambda}_{1i} + e_{1i}$$
$$AFR_{0i} = \beta_{00} + \beta'_{01}X_i + \beta'_{02}Z_i + \sigma_{0u}\widehat{\lambda}_{0i} + e_{0i}$$

	Expected sign	(1) AFR_{1i}	(2) AFR_{0i}	(3) AFR_{1i}	(4) AFR_{0i}
$ASSR_i$	+	0.15	0.17	0.12	0.15
		(5.35)**	(3.25)**	(4.07)**	(2.62)**
SAR_i	+	0.60	0.57	0.54	0.53
		(19.79)**	(9.33)**	(15.82)**	(7.60)**
$SICR_i$	+	0.05	0.05	0.05	0.06
		(4.02)**	(2.22)*	(4.20)**	(2.29)*
DSR_i	+	0.07	0.18	0.07	0.18
		(4.69)**	(5.95)**	(4.60)**	(5.93)**
OSR_i	+	0.24	0.19	0.22	0.18
		(17.02)**	(5.99)**	(14.77)**	(5.64)**
$LOSS_i$	+	0.05	0.02	0.04	0.01
		(5.11)**	(1.59)	(3.15)**	(0.78)
GR_i	+	0.06	0.05	0.06	0.05
		(4.03)**	(2.60)**	(4.12)**	(2.62)**
$BUSY_i$	+	0.02	0.01	0.02	0.01
		(2.39)*	(0.37)	(2.46)*	(0.35)
LON_i	+	0.05	0.04	0.05	0.04
		(6.75)**	(3.72)**	(6.92)**	(3.77)**
$\widehat{\lambda}_{1i}$	?	.	.	-0.09	.
		.	.	(-3.02)**	.
$\widehat{\lambda}_{0i}$	?	.	.	.	0.04
		.	.	.	(1.19)
$CONSTANT$	?	-0.12	-0.18	-0.03	-0.19
		(-9.69)**	(-9.77)**	(-0.96)	(-9.08)**
Observations		1013	313	1013	313
R^2		84.7%	82.4%	84.8%	82.5%

See Tables 1 and 3 for variable definitions.
** Significant at the 1% level. * Significant at the 5% level.