An econometric analysis of the prices of large company audits

Companion paper to PwC's Response to five working papers concerning audit prices, engagement level profitability, costs, tenure and switching

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Contents

1. Executive summary

1.1 This paper sets out the results of our econometric study into the factors that determine the prices of audits for large UK companies.

1.2 We believe that econometrics has an important role to play in answering some of the key questions being considered by the Competition Commission (CC) in its investigation. In particular, it can provide insights into the effectiveness of rivalry outside of tenders. Do, for example, companies that tender or switch achieve better or worse prices over the long-run than those that do not? Are there short-run price benefits of companies tendering, and if so how large are they and how long do they last? Do companies that choose not to tender actively negotiate each year?

1.3 These key questions can be tested rigorously using econometric analysis. While descriptive statistics can aid understanding, they lack rigour and can be misleading as they do not control for changes in scope, complexity, risk, quality, regulation and other factors that influence audit prices. When we control for these features of the market using econometric analysis, the results are different from, and more informative than, those implied by the analysis of descriptive statistics.

1.4 We have carried out an econometric analysis of the data contained in the Industry Data Set (IDS), which we and the other audit firms incurred considerable time and effort to develop in order to help ensure that the CC's investigation is based on as complete and reliable an evidence base as possible. Our analysis has been reviewed and endorsed by Professor Andrew Chesher of University College London.[1]

1.5 Our key findings are:

a. Over the long-run (i.e. the period from 2000-2010[2] for which we have data), companies which tendered or switched did not on average obtain lower prices than those companies which did not. This finding is important because it suggests that competitive pressures are as effective outside formal tenders as they are within them.

b. Although companies obtain, on average, lower prices the year after switching or tendering, the magnitude of the price reduction depends on the specific context. In its working paper (WP) on Descriptive Statistics, the CC estimated that real audit prices fall on average by 19% in the year following a switch.[3] In our response to that WP we explained that:

i. It is important to differentiate between "direct" and "consequential" switches. We defined "direct" switches as those which arose from direct decisions by companies (e.g. due to dissatisfaction or for corporate governance purposes) to switch auditor. We defined "consequential" switches as: (i) those which were brought about by the company being taken over by an entity outside the IDS but remaining in the IDS (in which case the scope of the company's audit reduces significantly as it changes from being a group audit to a subsidiary audit), and (ii) those which were brought about by the demise of Arthur Andersen.

ii. It is also important to consider the impact of companies that tender but do not switch.[4] Identifying the price changes associated with companies that conduct "direct" tenders – irrespective of whether or not the company actually switches – provides the most meaningful measure of the immediate price reductions achieved when companies tender as part of their activity to secure a competitively priced audit.

[1] Professor Andrew Chesher's opinion on our research is provided in Appendix F.

[2] The IDS covers the period 1999-2011. However, there is only partial data for 1999 and 2011, so we have restricted our analysis to the years 2000-2010 inclusive.

[3] "Descriptive Statistics", CC Working Paper, 28th September 2012, Figure 6.

[4] We have identified 50 observations of companies in the IDS tendering but not switching in the data period.

iii. Our analysis of descriptive statistics which incorporates the above indicates that prices fall by 6% in real terms (or about 9% in nominal terms) the year after a tender or switch, i.e. by significantly less than the 19% estimated in the CC's WP.[5]

c. Our econometric analysis allows us to analyse this more rigorously. It shows that tenders or switches that arose from direct decisions by companies on average led to an immediate reduction in prices of 9%, as compared with those companies which did not tender or switch.[6] By contrast, when switches occur as a result of a company being taken-over (and hence having the scope of its audit reduced from being a group to a subsidiary audit) our econometric analysis shows that there is an immediate 29% reduction in prices (again, as compared with those companies which did not tender or switch).

d. The price benefit of these "direct" tenders and switches is temporary (i.e. prices move back up, over a period of two to three years, to or above the level they would have been without tendering or switching). More specifically, prices in the second and third year[7] after a "direct" tender or switch were respectively 8% and 4% lower than they would have been had the company not chosen to tender or switch. However, in the fourth year, on average the price paid by a company was actually 3% higher than that paid by companies that did not tender or switch.[8]

e. The effect of changes in audit scope and complexity on price is greater than the impact of changes in the previous year's audit fee. This provides evidence that the annual scope and fee negotiations between non-switching companies and their auditors are substantial and important exercises which involve detailed discussions of the costs that will need to be incurred to conduct an audit of the appropriate scope and quality.

f. There is no evidence that audit prices increase with tenure.

1.6 For completeness we have also examined whether there is any relationship between audit prices and concentration. The lack of variation in concentration observed in the IDS makes it difficult to reach firm conclusions, as discussed in the CC's Price Concentration Analysis (PCA) working paper, but we have found no evidence that audit prices are higher in more concentrated parts of the market.

[5] Note that this analysis is based on FTSE350 companies, whereas the IDS also includes companies in the Top Track.

[6] Note that this a different type of price change to that which is analysed in the CC's Descriptive Statistics WP. Our econometrics analyses the change in price relative to the price that would have been obtained if there had been no tender or switch. By contrast, the Descriptive Statistics WP simply analyses the change in price relative to the prior year.

[7] i.e. in the second and third year of the new auditor's tenure.

[8] Prices in the third and fourth year following a switch are not statistically significantly different from zero at the 5% level of significance.

2. Introduction

2.1 Previous econometric studies of the UK audit sector (by, for example, Oxera, the OFT and Deloitte) have sought to answer a single question – to what extent are audit prices correlated with market concentration?

2.2 However, as the CC rightly points out in its working paper[9] the audit market is not a good "fit" for a PCA. Such studies require variation across a number of distinct markets or across time so that it is possible to observe how prices vary with different levels of concentration. They also tend to work well where the products or services are relatively homogeneous (or undifferentiated) and where there is limited non-price competition. These conditions do not apply to the audit market: there is a single market for auditing large companies;[10] concentration in that market has not changed substantially during the period for which we have data; audit is a bespoke product; and quality is a key aspect of competition.

2.3 A further issue with PCAs is that even if price and concentration were correlated this might be for reasons unrelated to market power. For example, if companies or regulators demand higher levels of audit quality, prices are likely to rise (as quality is costly to provide) and concentration may increase (as companies switch to higher quality auditors). A finding that audit prices are correlated with market concentration might simply reflect demand for, and the higher costs of providing, a higher quality service (rather than market power).[11] We therefore agree with the CC that there is limited value in conducting a PCA.

2.4 However, our view is that econometric analysis can provide potentially important insights into the nature and intensity of competition in the large company audit market. Such analysis can assist in assessing how competitive pressures are brought to bear outside of formal tenders (where, for example, companies may be able to exert countervailing bargaining power through an explicit or implicit threat to tender or switch).[12] Econometrics enables a much more rigorous analysis of empirical data than simple descriptive statistics. It can help test:

a. whether companies that tender or switch obtain lower prices over the longer-run than those that do not;

b. whether companies that tender or switch obtain a short-run price benefit, and if so how long that benefit lasts; and

c. more generally, what are the key determinants of the audit fee.

2.5 We have built two econometric models. Both models attempt to explain the price of audits with respect to scope, risk, complexity, tenders, switching, tenure, and market concentration.

2.6 Our first, and preferred, "company specific effects" model is based on the assumption that there is a unique and specific element of cost associated with auditing each individual company. The coefficients of this model are estimated using a fixed effects estimator using the Arellano-Bond method. This is the general approach adopted by Deloitte.[13] We use this model to obtain the best understanding possible

[9] "Price Concentration Analysis", CC Working Paper (Audit Market Investigation), 2012, available at http://www.competition-commission.org.uk/assets/competitioncommission/docs/2011/statutory-audit-services/price_concentration_analysis_wp.pdf

[10] The CC has provisionally concluded that there is a single large company audit market, see, CC Market Definition Working Paper, 7 September, 2012, para. 1.

[11] This issue (which is often referred to as "endogeneity") may be addressed by having good proxies for quality and regulation and/or by using a technique known as "instrumental variables".

[12] "Nature and strength of competition in the supply of FTSE 350 audits" CC Working Paper, 2nd October, 2012. Paras. 6-9, available at: http://www.competition-commission.org.uk/assets/competitioncommission/docs/2011/statutory-audit-services/nature_and_strength_of_competition.pdf

[13] "Audit pricing analysis", Deloitte, Submission to CC's Statutory Audit Services market investigation, 27th February, 2012, available at: http://www.competition-commission.org.uk/assets/competitioncommission/docs/2011/statutory-audit-services/deloitte_audit_pricing_paper_non_confidential_version.pdf

using the IDS of the factors that are important in determining audit fees. More specifically we use this model to explore whether, and if so the extent to which, the prices of audits change with tendering or switching.

2.7 Our second "industry and index effects" model has a specification that is similar to that set out in the CC's PCA working paper.[14] In addition to individual company effects we also include controls for different sectors (of which there are 11) and different indices (FTSE 100, FTSE 250, Other FTSE, and Private). We estimate our coefficients using the random effects estimator. This is unlikely to provide us with as good an overall specification – there is a risk that our estimated coefficients may be biased[15] – but it does allow us to compare the absolute levels of audit fees paid by different types of company. Importantly, and by way of example, we can compare the average audit fee paid by companies that tendered or switched with the fees that are paid by companies that did not.

2.8 The remainder of this paper is structured as follows: in Section 3, we discuss the data that we have used to estimate our models and, in Section 4, we report our key results. In Appendix A, we set out our modelling approach. Our more detailed results, including sensitivity and robustness checks, are set out in Appendices B to E. Appendix F contains the comments of Professor Andrew Chesher who has advised us on our analysis.

[14] Op cit., paragraph 9.

[15] The random effects estimator will be unbiased where all the exogenous variables in the model are uncorrelated with the unobserved fixed company effects. This assumption is unlikely to hold. For example, larger companies (where company size is an exogenous variable) may be more likely to be more complex or to demand higher quality audits (both of which are largely unobserved factors that we model as fixed effects).

3. Data

3.1 The primary source of our data is the IDS. This data covers the period 1999 to 2011 and includes 828 companies that were either in the FTSE 350 at some point during the period or in the list of the 100 'Top Track' companies. The IDS contains information on:

a. Group global audit and audit-related fees.

b. Group global turnover and total assets.

c. Group global inventories.

d. Group global profit/loss.

e. Year of initial engagement of auditor.

f. Group industry sector, group auditor name and both the calendar year in which the period of the financial report ended, and the calendar year to which the majority of the report related.

3.2 To construct our panel of data we used the calendar year to which the majority of the financial report related. For example, a report for the year ended 31 March 2010 was treated as belonging to 2009. The IDS is not complete for all companies in all years. In particular, the years 1999 and 2011 have significantly fewer observations than other years. We therefore limited our data set to the period 2000-2010.[16] There are 7,303 audit fee observations in this period.

3.3 The IDS was created specifically for this investigation and has been checked extensively. We have not sought to clean the data further or to remove "outliers". We prefer instead to use all the data that are available to us.[17]

3.4 We have used the raw data to identify a number of variables. These include:

a. Measures of auditor market concentration (HHI and n-firm concentration indices).[18]

b. Whether a company switched auditor in a given year.

c. The number of years a company has been with its current auditor (tenure).

3.5 We have also classified switches[19] of auditor into three different types:

a. Switches that arose as a consequence of the take-over of the company in the IDS by an entity that is outside the IDS (with the company remaining in the IDS).

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[16] We did, however, use data from 1999, where available, to identify switches and tenders that took place in 2000.

[17] We note that 33% of all client engagements are coded as having started in 2000. This is clearly an error. We have therefore taken care to ensure that our results do not depend upon this data. First, in our "company specific effects" model we estimate the coefficient on the tenure variable by estimating the effect of a *change* in tenure on audit prices. As tenure increases by one year each period (except where there is a switch) the estimated coefficient does not depend upon the year of engagement. Second, in our "industry and index effects" model, we have excluded companies which are coded as having begun their engagement in 2000 from our analysis of the effects of long tenure.

[18] We have estimated HHI based on "market shares" in the 11 sectors reported in the IDS. These sector shares do not correspond to the relevant economic market – we believe that there is a single market for large company audits in the UK. However, if we use the single market definition to compute HHI we have a single observation for HHI for each year. This variable is indistinguishable from the other factors that affect the prices charged in a particular year which are our captured by our year dummies. As the variables are collinear our regression would have to drop either HHI or year dummies.

[19] Using the IDS we identify a switch in a particular year where a) the listed auditor is different to that recorded in the previous year, and b) there are fee data in both the year of the switch and the previous year. There are 8 observations where a switch is recorded but where there are incomplete audit fee data.

b. Switches associated with the collapse of Arthur Andersen. We refer to switches of types (i) and (ii) as "consequential" switches, because they only occurred as a consequence of other events.

c. Switches that arose from deliberate and voluntary decisions of companies, for example because they were dissatisfied with their existing auditors, or wanted to conduct formal tenders for reasons of corporate governance. We refer to these as "direct" switches, because they did not occur as a consequence of other events, but arose directly because the companies chose to tender as part of their activity to secure competitively priced audits.

3.6 Andersen switches were identified using the IDS.[20]

3.7 Take-over switches were identified using information from company annual reports together with other business news sources and our own business intelligence. Where company reports were not available[21] or where we could not otherwise positively identify that a switch occurred as a consequence of a take-over by, or merger with, an entity outside the IDS, then we classified the switch as a "direct" switch.

3.8 Previous studies[22] have found that company mergers[23] lead to a permanent change in audit prices. However, mergers have frequently been identified through large increases in turnover rather than through direct observations. For example, Oxera classify any situation where there is a year-on-year change in company turnover of greater than 40% as a "merger" whereas Deloitte, using the same approach, use a 10% figure.[24]

3.9 This approach will identify some mergers but miss others. We have therefore identified mergers directly by using data on deals from Datastream.

3.10 The IDS does not contain information on tenders. There is no good reason to judge the price effect of conducting a tender purely with respect to those tenders that lead to a switch of auditor. We have therefore developed a "direct tenders" variable which includes all "direct" switches together with tenders which did not result in a switch. We identified tenders without a switch from our own business intelligence and evidence found in company annual reports.[25] We were able to identify 50 observations where there was a tender with no switch.[26] When added to the 219 switches in the IDS that we identified as "direct", this gives us 269 observations where there was a "direct tender"[27] (see table 1 below).

[20] We classify all changes in auditor from Arthur Andersen that took place after 2000 (i.e. from 2001) as Andersen switches

[21] There were 19 such instances.

[22] For example, those by Oxera, the OFT, and Deloitte.

[23] Including acquisitions.

[24] It is also worth noting that the variable used by both Oxera, the OFT and Deloitte is the cumulative number of times a company has merged over the data period. This specification presumes that a merger results in a permanent change in the complexity of the audit rather than a one-off adjustment cost.

[25] We submitted a list of tenders in our response to the Descriptive Statistics working paper.

[26] There may have been a number of tenders that took place without switches that we have not identified.

[27] All tenders and switches, whatever the reason they take place, are fiercely contested, and threaten the continued appointment of the existing auditor. Therefore, when examining tendering and switching frequency, we should consider all tenders and switches, whether "direct" or "consequential". However, we believe that there may be important differences in the implications for audit fees of the tenders and switches in the IDS which were consequent on the collapse of Arthur Andersen or company take-overs, as compared with those that were triggered directly by the audited company. In particular, "direct tenders and switches" were deliberate and voluntary decisions by companies as part of their activities to secure competitively priced audits. By contrast, companies that were audited by Arthur Andersen had no choice but to switch, regardless of whether they were satisfied with the price and quality of their existing auditor. There are also examples of companies in the IDS that were taken-over by companies outside of the IDS but remained in the IDS that had no choice but to switch. The scope of these company audits often changes significantly as it changes from a group to a subsidiary audit.

Table 1: Switches and Tenders by type

Switch type	Number
All switches (IDS)	339
Less	
Consequential switches – Andersen	(67)
Consequential switches – Take-over	(53)
Direct switches	219
Tenders no switch	50
Direct Tenders and switches	269

3.11 Where data is partially missing for a company in a particular year we drop the observation in that year.[28] The implication of this is that banks and financial services companies, who often do not have any meaningful inventories (in the IDS the inventories for such companies are often coded as "n/a" or left blank), are typically excluded from our analysis.[29]

3.12 Banks and financial service companies could be included in our analysis but only if we either (1) amend the IDS so that companies are assigned a notional value to the inventories/assets variable, or (2) drop the inventories/assets variable from our analysis. The former approach does not permit any within-company variation in this risk measure over time. The alternative of dropping the inventories/assets variable is not appropriate as it has been found by other researchers to be statistically significant, e.g. by Deloitte.

3.13 We prefer instead to drop observations of companies where inventories are coded as n/a, and blank as: (1) we have a very large data set (even without this data we have 3733 observations in our preferred model specification, and (2) we have no reason to believe that the price effects of direct tenders and switches or concentration would be different for companies in the banking and financial services industries to those in other sectors.[30] However, to check the robustness of our approach in append E we present the results of our model when banks are included in our analysis.

[28] In order to include an observation (i.e. data from a particular company in a given year) in a regression analysis we need to have data for every explanatory variable included in the model.

[29] If a company has a non-zero entry for inventories in the IDS it is included in our analysis.

[30] For example, the median change in audit fee following a direct tender or switch is -7% in the banking and financial services sectors compared to -9% in all other sectors.

4. Results

4.1 In this section we discuss the results of our "company specific effects" and "industry and index effects" models, explaining briefly how we arrived at our final preferred model specifications.

Variables included in our models

4.2 Tables 2 and 3 summarise the complete set of variables that we have included in our two models together with the reasons why they might influence audit prices. A more detailed definition of these variables is presented in Appendix A.

4.3 Most of the variables are common between our two models. The main differences are:

a. The "company specific effects" model is a dynamic model. Its main focus is on how prices evolve over time, and, in particular, after a tender or switch. It includes the audit fee in the previous year as an explanatory variable as well as a variable that measures the effect of tendering and switching on prices in years 1, 2, 3 and 4 following a tender or switch.

b. The "industry and index effects" model is a static model. Its main focus is on the level of audit fees paid by different types of companies. To this end it includes industry and index dummies. It also includes a dummy variable which takes the value 1 for companies that have switched in the data period and 0 otherwise, and a dummy variable that similarly distinguishes between companies that have a relatively long (10 years or more) and short (less than 10 years) audit firm tenure.[31]

Table 2: Variables included in our "company specific effects" model

Variable	Reason for inclusion
Last year's audit fees (log)	Scope, complexity and unobserved influences (including the costs of achieving quality and meeting regulations)
Assets (log)	Scope
Turnover (log)	Scope
Company merger	Scope, Complexity
Loss	Risk
Inventories to assets ratio (log)	Risk
Length of tenure	Competition
Take-over switches – dummies in the year of switch, second year, third year and fourth year of switch	Competition, Scope, Complexity
Direct tenders and switches – dummies in the year of tender/switch, second year, third year and fourth year after tender/switch	Competition
HHI/ n- firm concentration ratios (log)	Competition
Year dummies	Market developments over time, e.g. changes in regulation, buyer power, and quality

[31] The dummy variables for companies with relatively long audit tenure and companies that switched in the data period are highly correlated. We therefore ran two specifications of the model, one with a "long tenure" dummy only, and one with a "switched in data period" dummy only. Both of these dummies are also highly correlated with our switching variables. As our focus is on obtaining unbiased values for these dummies, we excluded switching variables from our model specification.

Table 3: Variables included in our "industry and index effects" model

Variable	Reason
Assets (log)	Scope
Turnover (log)	Scope
Company merger	Scope, Complexity
Loss	Risk
Inventories to assets ratio (log)	Risk
Length of tenure	Competition
Dummy variable for companies of longer tenure	Competition
Dummy variable for company that has switched in data period	Competition
HHI/ n- firm concentration ratios (log)	Competition
Year dummies	Market developments over time, e.g. changes in regulation, buyer power, and quality.
Industry sector dummies (11)	Controls for different costs of auditing companies in different sectors
Index dummies (FTSE 100, FTSE 250, FTSE small cap, Private)	Controls for different costs of auditing companies in different indices
Sector * year dummies	Controls for different costs of auditing companies

Company specific effects model

4.4 The first version of our model (Model 1) includes all the variables that we hypothesise might have an influence on the price of an audit. The results of this model are set out in detail in Appendix B.

4.5 We find that audit fees depend upon scope (assets, turnover), complexity (merger), risk (loss, inventory to assets ratio), switching and tendering and the previous year's audit fee. However, the coefficients on market concentration (HHI) and tenure are not statistically significantly different from zero at the 5% level of significance.[32]

4.6 To test the robustness of the conclusion that market concentration has no statistically significant effect on audit prices we have used 2-firm, 3-firm, and 4-firm concentration indices as alternatives to HHI. All of these variations give the same finding – that there is no significant effect of market concentration on audit price. The details of these alternative model specifications are presented in Appendix C. Market concentration is also not statistically significantly different from zero in the static version of our "company specific effects" model (Model 4) or in our "industry and index effects" model (see Appendix D).

4.7 The confidence interval for our estimate of the coefficient on the HHI variable is relatively wide – there is a 95% chance that the effect of HHI on price lies within the range -0.10 to +0.26. This uncertainty reflects the lack of variation in market concentration in the data. This is the main point that the CC has made in rejecting the use of PCA[33] so the result is not surprising. Nevertheless, the results are still informative. For example, even if the HHI coefficient took a value at the very upper end of our estimated range, it would imply that a 33% increase in HHI – broadly what we would expect if the number of audit firms was reduced from 4 to 3 – would only lead to a 9% increase in audit prices.[34] Of course, if the value of the HHI coefficient was the very low end of our estimated range, a similar 4 to 3 merger would be predicted to lead to a 3% reduction in audit prices.

[32] The estimated coefficient on HHI is also not statistically significantly different from zero at the harder to pass 10% level of significance.

[33] In our view, rather than concluding that there is limited value in testing whether there is a link between concentration and price in the large company audit market because of data and statistical issues, the CC should recognise that there is no *a priori* evidence or theory to

4.8 As HHI has no significant effect on audit price under any specification, we have chosen to omit measures of market concentration from our preferred model specification.

4.9 Our central estimate is for tenure to have a zero effect on audit prices.[35] The confidence interval is also narrow which suggests that any effect of tenure on price it is likely to be small. In our "industry and index effects" model we use an alternative measure of tenure which identifies those companies whose tenure is greater than or equal to 10 years.[36] The coefficient on this measure is also insignificantly different from zero, again with a narrow confidence interval. As tenure does not appear to affect price we omit tenure from our preferred model specification.

4.10 Our preferred model specification (Model 3) is reported in Table 4 below. The table sets out the predicted effect (coefficient) of each of our explanatory variables on audit fees (log). Where the predicted effect is statistically significantly from zero (at the 95% confidence level) the estimated coefficient is in bold type. The coefficient is our model's central estimate of the effect of the variable on audit price. We also report our model's estimate of the uncertainty associated with our coefficient estimates (standard errors and 95% confidence range).[37]

Table 4: Preferred Audit Fee (log) Model (Model 3)

Explanatory Variables	Coefficient	Standard error	95% confidence range	
			Lower bound	Upper bound
lagged audit fee (log)	**0.19**	0.03	0.12	0.25
total assets (log)	**0.28**	0.02	0.23	0.32
turnover (log)	**0.23**	0.02	0.19	0.27
merger dummy	**0.04**	0.02	0.01	0.07
loss dummy	**0.05**	0.02	0.02	0.09
Inventories to assets (log)	**0.02**	0.01	0.00	0.04
direct tender/switch year 1	**-0.09**	0.03	-0.15	-0.03
direct tender/switch year 2	**-0.06**	0.03	-0.12	-0.00
direct tender/switch year 3	-0.02	0.03	-0.09	0.04
direct tender/ switch year 4	0.04	0.03	-0.03	0.10
takeover switch year 1[38]	**-0.29**	0.07	-0.44	-0.15

hypothesise such a link. Variables should only be included in econometric models where there are *a priori* grounds for doing so. The lack of variability in concentration in the audit market means that there has been no possibility of observing any relationship between concentration and price, and hence no obvious *a priori* reason to include it in any econometric model (other than that it has been used in certain studies in the past and is used in other sectors). We see no theoretical reason to include it because of the limited relevance of concentration in a market where non-price (or quality) competition is so important and where competition is akin to that in a bidding market.

[34] If we assume that market shares of 4 audit firms are 25% each, the HHI would be 2500. For 3 firms with symmetric market shares the HHI would be 3333 – a 33% increase.

[35] The coefficient on audit tenure is +0.01 with a standard error of < 0.01 (see Appendix B, Model 1).

[36] Approximately 33% of the companies in the IDS are coded as having a year of initial engagement coded as year 2000. As this is clearly an error, we have chosen to exclude companies whose are coded as having begun their tenure in 2000 for the purposes of estimating the "long tenure" coefficient. We have however included these companies in our other "industry and index effects" model specifications and in our "company specific effects" model.

[37] As an illustration of the interpretation of these coefficients, our model predicts that that a 10% increase is company turnover leads to a 2.3% increase in audit fees. Our model predicts that we can be 95% confident that the true effect is between 1.9% and 2.7.

%.

[38] Year 1 is the first audit fee charged by the new auditor following a switch (or the first audit fee following a tender)

Explanatory Variables	Coefficient	Standard error	95% confidence range	
takeover switch year 2	**-0.18**	0.09	-0.35	-0.02
takeover switch year 3	-0.15	0.09	-0.33	0.03
takeover switch year 4	0.06	0.09	-0.12	0.25
Constant	**-1.81**	0.31	-2.41	-1.21

4.11 The key findings of our analysis are:

a. Tenders and switches that resulted from direct choices by companies on average led to a 9% reduction in audit fees compared to companies that did not tender or switch.

b. However, the effect of direct tenders and switches was temporary – in the fourth year following a direct tender or switch, our model finds that prices were on average 3% higher than for companies that did not tender or switch (see Figure 1 below).

c. A take-over switch was associated with an average reduction in price of 29% in the first year of the new auditor.

d. Scope (assets, turnover), complexity (merger), and risk (loss, inventory to assets ratio) are all significant drivers of audit fees.

e. Last year's audit fee is a significant driver of the current year's audit fee, but one that has less impact on price than does assets or turnover.

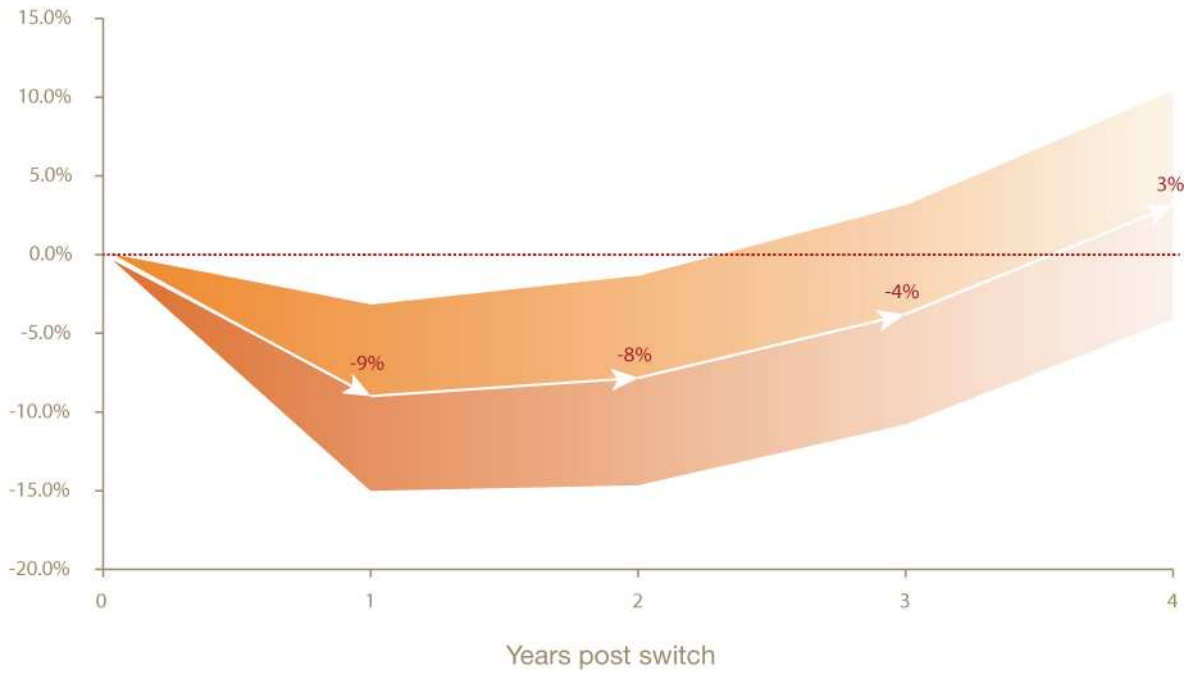
4.12 The switching results are of particular interest. Our model predicts that price reductions following a direct tender or switch are temporary before moving back up towards or beyond the audit prices that a company would have obtained had it not tendered or switched.

4.13 The predicted change in audit price following a direct tender or switch is illustrated in Figure 1. On average, a company that made a direct choice to tender or switch obtained an immediate price reduction of 9% (compared to a company that did not tender or switch). In the second year and third years following the switch, prices are found to have been on average 8% and 4% lower.[39] But by the fourth year after the direct tender or switch our model finds that audit prices were on average 3% higher than those paid by a company that did not tender or switch.[40]

[39] Because our model is a dynamic one, the impact of tenders and switches on prices cannot be observed simply by considering the coefficients in the table. The audit fee paid by a company that tendered or switched depends upon: (1) the coefficient on the switching/tendering variable in a given year and (2) the coefficient on the previous year's audit fee. For example, audit fees are found to have fallen by 9% immediately following a switch. The price reduction in year 2 following the switch is (0.19 * 0.09) + 0.06 = 8%.

[40] The price effects in years 3 and 4 after the switch are not statistically significantly different from zero. This can be seen visually in figure 4 – the 95% confidence range for the predicted effect of a switch on the audit price includes 0% as a possible value.

Figure 1: Observed price change following a direct tender or switch (relative to price if no tender or switch had occurred)



4.14 Figure 1 also illustrates the uncertainty associated with our model's central estimates – the model predicts that there is a 95% probability that the true effect of direct tenders and switches on audit prices will lie somewhere within the shaded area.

4.15 The standard errors associated with the "direct tender/switch" variable do not increase significantly over time.[41] This is an important result as it suggests that we can be confident that audit prices return quickly towards or beyond the levels that the company would have obtained had it not tendered or switched. Specifically, the model finds that there is a 95% probability that a company that voluntarily tendered or switched on average paid a price that was between 5% lower and 11% higher than a company that had not tendered or switched in year 4 following the switch.[42]

4.16 Also of interest is the relatively low value of the estimated coefficient on the previous year's audit fee. Our results indicate that a 10% increase (decrease) in the previous year's audit fee increases (decreases) the estimated audit fee by only 1.9%. In comparison, a 10% increase in company assets or turnover increases the estimated audit fee by 2.8% and 2.3% respectively.

4.17 The relatively low importance of the previous year's audit fee suggests that we can obtain a good prediction of the audit fee using controls for scope, complexity, risk, and company specific fixed effects. As company turnover and assets vary from year to year as businesses evolve, this suggests that companies actively negotiate audit scope and hence fees each year – and therefore that negotiations on price, scope and quality are intense outside as well as inside formal tenders. [43]

4.18 We have already presented the CC with evidence that the range of annual audit fee changes for non-switching companies is wide, with companies and audit firms frequently agreeing to large changes in audit fees from one year to the next (both increases and decreases). This finding further demonstrates this. Whilst the previous year's fee is a significant variable in determining fee – and this accords with our experience that we and our clients use this as the starting point for negotiations – of far more importance are other factors that affect scope, complexity and risk. This means that for most non-switching companies in most years the annual negotiation involves serious discussions with the audit firm over

[42] These standard errors have been estimated using the NLCOM command in Stata. This takes into account the combined effect of errors in estimating the coefficient on the direct tender/switch variables and the lagged dependent variable.

[43] "Nature and strength of competition", CC Working paper, published 2nd October 2012, paragraph 175.

significant changes in scope; and such changes in scope involve material negotiations over quality (scope changes being driven by what is necessary to ensure quality) and fee.

Industry and index effects model

4.19 We developed this model to obtain evidence on whether companies:

a. That tendered/switched paid higher prices than those that did not over the long-term (which we take as the data period 2000-2011)

b. With relatively long audit tenure paid higher than average audit fees.

4.20 Our "company specific effects" model examined both the short- and long-run impact of a tender/switch on audit fees. However, companies that voluntarily tendered or switched may have been self-selecting. For example, we know from the CC's market questionnaire that dissatisfaction with the current audit is the most frequently cited reason for a company choosing to tender or switch (and satisfaction with the current auditor the main reason for choosing not to tender or switch). It seems plausible therefore that companies that chose to tender or switch may have been paying higher than average prices prior to the tender.

4.21 To test this we used a dummy variable which takes the value 1 if a company tendered or switched[44] in the data period and 0 otherwise. The estimated value of this coefficient is -0.04 or +0.03 depending upon whether we use the random effects or the between effects estimator (see Appendix D). These coefficients suggest that companies that switched in the data period, on average paid audit prices that were 4% lower or 3% higher than those paid by companies that did not switch over the same period. The coefficient is not, however, statistically significant (at the 5% level) when estimated either using random effects or between effects. This suggests that the prices paid by companies that tender/switch are, on average, similar to those paid by other companies over the long-term.

4.22 We then tested whether companies with a relatively long tenure pay higher than average prices by including a dummy variable which takes the value of 1 if audit tenure is 10 years or more and 0 otherwise. The estimated coefficient is -0.01 (using either the random effects or the between effects estimator). This suggests that on average companies with long tenure pay audit prices that are 1% lower than companies of short tenure. However, this variable is statistically insignificant at the 5% level. The model therefore finds no evidence that companies with a relatively long tenure pay higher audit fees.

4.23 The results of our "industry and index effects" model need to be treated with caution. If the company specific effects are correlated with any exogenous variables in our model then our estimated coefficients may be biased. Nevertheless, the results are consistent with those of our "company specific effects" model – in both models we see no evidence of any relationship between audit prices and tenure.

[44] We include direct tender and switches only. We have excluded observations for companies that switched away from Arthur Andersen in all periods prior to 2004.

Appendices

Appendix A: Our modelling approach

Factors that affect the price of an audit

A.1 There is a considerable academic literature on the factors that determine the price of an audit.[45] At a high level, the following factors have been found to be important:

a. Scope of the audit (the main, but far from sole, determinant of which is company size).

b. Complexity of the audit.

c. The risk to the auditor.

d. The quality of the audit.

e. Variables that might be considered to indicate the intensity of competition (including, tendering and switching, market concentration, and buyer power).

f. Regulation.

Our modelling approach

A.2 Different studies have used different variables for each of these factors. Some, such as scope, have relatively easily found variables in publicly available data. Company turnover and company assets, for example, are likely to influence audit scope, and both variables have been found to be correlated with audit fees. Other factors, such as the quality of the audit and audit complexity are more difficult to observe. Although proxies can be found for these variables – quality, for example, has been measured with respect to financial restatements and earnings accruals[46] – these at best reflect just one aspect of quality.

A.3 This means that there are important factors that most likely influence audit prices for which we cannot find suitable variables for inclusion in our modelling. The importance of these "unobserved variables" should be reflected in our modelling approach. Unobserved variables are likely to have values which are specific to companies and which vary greatly from one company to another. The standard, and best, way of dealing with this is to use a model in which each company has its own overall level of audit fees employing what is called a "company specific effects" model. This is the approach used by (amongst others) the OFT, ELSE, and Deloitte.[47]

A.4 In such models, all the information about the effects of explanatory variables on audit fees is derived from within-company across-time variation in audit fees, on the one hand, and observable explanatory variables on the other. The main advantage of this approach is that the estimated effects of the explanatory factors on audit fees are not biased as a result of any correlations between unobserved company effects and observed explanatory variables.

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[45] See for example, "CC Statutory Audit Investigation: Initial review of the academic literature", Professor Beattie (2012), available at http://www.competition-commission.org.uk/assets/competitioncommission/docs/2011/statutory-audit-services/initial_review_of_relevant_academic_literature_in_the_audit_market.pdf

[46] See for example, Dechow, P., Ge, W. and Schrand, C. (2010). Understanding earnings quality: a review of the proxies, their determinants and their consequences. Journal of Accounting and Economics, 50(2-3): 344-401.

[47] We note that the fixed effects estimator is the standard approach to estimating this type of model. It was used by the OFT, Deloitte, ELSE, Evans and Schwartz and the GAO amongst others. Oxera used the alternative random effects estimator, but this was explicitly criticised by the OFT as the conditions required for its efficient use were unlikely to be met (it effectively requires us to assume that auditors of higher quality do not charge higher fees).

A.5 The "company specific effects" model is our preferred approach.

A.6 This model does, however, have some disadvantages. In particular, with such a model we cannot test whether the absolute level of audit fees is higher or lower for one group of companies compared to another. This could be useful to test certain hypotheses about how audit prices are formed. For example, it is of great relevance to the CC's investigation to understand whether companies that tendered or switched obtained higher or lower prices over the long-run than those that do not.

A.7 In order to provide evidence on these questions we have developed an alternative "industry and index effects" model based on the specification set out by the CC in its PCA working paper. The model has controls for scope, complexity, risk, and variables that may be proxies for competition which are similar to those in our preferred "company specific effects" model. We have also included dummy variables which identify the costs of auditing companies in different industry sectors (of which there are 11) and different indices (e.g. the FTSE 100 and the FTSE 250). The model also allows for the possibility that individual companies may have unobserved individual effects. The coefficients of this model are estimated using the random effects estimator.

A.8 The results of this model need to be treated with more caution as our estimated coefficients may be biased if unobserved company effects (such as the complexity or the quality of the audit) are correlated with some of the other explanatory variables. For example larger company audits may, on average, be more complex.

A.9 This problem should be mitigated by the inclusion of the industrial sector and index dummies, since these are intended to act as proxies for unobserved individual company effects such as audit quality and complexity. However, we recognise that companies of similar size in the same industrial sector may have quite different levels of complexity depending upon the way that their business is structured. This is the reason that we prefer the "company specific effects" model.

Static or dynamic model?

A.10 The other important modelling decision is whether the model should be static or dynamic. The key difference is that dynamic models include the audit fee in the previous year as an explanatory variable for the fee in the current year.

A.11 There are good theoretical reasons to include the previous year's audit fee in our model, not least because last year's fee is often taken as the starting point for discussing and agreeing the following year's fee. Most UK studies have chosen to include the previous year's audit fee as an explanatory variable including those by Oxera, the OFT and Deloitte.[48]

A.12 For our preferred "company specific effects" model we include the previous year's audit fee as an explanatory variable. We estimate our coefficients using the Arellano-Bond method to avoid obtaining biased estimates due to the presence in the model of the previous year's audit fee.[49]

A.13 For our "industry and index effects" model our preference is to exclude the previous years' audit fee as an explanatory variable. Our focus here is on the average price paid by certain groups of companies over time (switchers/non-switchers).

Switching and tendering

A.14 Previous studies of the audit market have placed limited emphasis on switching. While Oxera, the OFT, and Deloitte all included a switching variable, this was the cumulative number of switches by each

[48] There are some examples of static models being used, e.g. GAO.

[49] The Arellano-Bond method is the standard approach for estimating fixed effects models where there is a lagged dependent variable. This method was used by Deloitte and endorsed by the CC in its Price Concentration Analysis working paper.

company in the data period. Their approach raises a number of issues which are taken into account in our approach:

a. They do not distinguish between different types of switches.

b. They do not consider what happens to prices when there is a tender but no switch.

c. They assume that when companies switch, audit fees stay at the post-switch level until the next switch, at which point they are assumed to fall further.

A.15 We explained previously how our approach deals with different types of switches where we define "direct" switches and "consequential" switches (thus dealing with (i) above) and includes tenders which resulted in no switch (dealing with (ii)). With regard to (iii) above, we believe the model specification needs to allow us to understand not just what happens to prices in the first year after the tender or switch, but also how post-tender prices evolve over time.

A.16 The use of cumulative switches is unhelpful in this respect. If prices fall but then return to pre-switch levels the model may find that switching has no impact on prices. Conversely if the model finds that switching leads to lower prices, by construction, these lower prices are "banked" by the company and remain at the lower level through the remainder of the data period. Indeed because of the influence of the lagged audit fee as an explanatory variable, if prices fall after a switch, by construction the model assumes they fall further in year 2 and further still in year 3. And if there is a further switch, the model is set up on the assumption that prices will fall further again. This structure of price changes is implausible. However, the more important point is that we believe the specification of our model should allow us to test empirically what actually happened to prices in the years subsequent to a "direct tender".

A.17 Our approach is therefore to have separate (dummy) variables for years 1, 2, 3 and 4 following a "direct tender". This allows the model to choose the structure of post-tender or switch prices that best fits the data.

Andersen switches

A.18 The circumstances surrounding the demise of Andersen were unusual, with companies being forced to switch audit firm. We believe that audit prices may have been affected by the collapse of Andersen, and the forced switches that ensued, so we have chosen to exclude observations for companies formerly audited by Arthur Andersen for the first three years following the enforced switch. Thereafter, these companies are treated in the same way as other companies.

Tenure

A.19 We test whether there is a link between audit fees and tenure in two ways. In our "company specific effects" model we use a length of tenure variable to test whether companies pay higher audit fees as their tenure increases. In our "industry and index effects" model we use a dummy variable to test whether companies with a relatively longer tenure (which we define as any period above 10 years) pay a price premium compared to other companies.[50]

A.20 Modelling of tenure is complicated through its interaction with switching variables. There are two issues:

a. When a company switches, its tenure ends, so tenure and switching are naturally correlated.[51]

[50] The "company specific effects" model allows us to test whether prices for individual companies increase with tenure. But we are also interested in whether companies with a relatively longer tenure as a group pay higher or lower prices than those of relatively short tenure. This depends not just on the relationship between price and tenure but also on the characteristics of the relatively longer tenure group. For example, they may, as a group, have greater buyer power or have developed effective activities to secure competitive audit prices without recourse to a formal tender. As these effects are indistinguishable from company specific fixed effects we use the "industry and index effects" model to test whether on average companies with a relatively longer tenure pay higher audit fees.

[51] When a company switches auditor it's tenure is reset to zero. If the switch led to a price reduction, this reduction in tenure would be correlated with a reduction in price which could lead to the erroneous inference that tenure and price were positively correlated.

b. We want to test how prices change during the first few years of tenure after a switch.

A.21 To address the above points, we have estimated the tenure variable only when companies can reasonably be assumed to be in something akin to a "steady-state" i.e. we do not estimate the tenure variable in the year of a switch or in the three following years.[52]

Company mergers

A.22 Oxera, the OFT and Deloitte all used a cumulative company mergers variable. This is analogous to the cumulative switching variable discussed previously. By design, the model structure is based on an assumption that if a merger leads to higher (lower) prices in year 1 after the merger, prices remain high (low) until the next acquisition. This is a more plausible structure for price changes related to company mergers than is the case with cumulative switching. However, there are likely to be both short-run and long-run changes to the costs of auditing following a merger. In the short-run there are often added complexities as the merging companies are integrated. In the longer-run, the costs will change as the new firm is bigger or smaller. Our preference is to model the short-run effects of a merger by having a (dummy) variable for mergers in years 1 and 2 following the merger. This leaves the long-term effects of a merger to be explained by our variables that control for the changes in scope, i.e. turnover, assets, and lagged audit fees.

A.23 Note that our merger dummy captures the effect of where a company in the IDS makes an acquisition. This typically (but not invariably) increases audit scope, at least during a transitional period. In contrast our "take-over" switches dummy applies where a company in the IDS is acquired by a company outside the IDS. This typically (but not invariably) leads to a permanent reduction in audit scope.

[52] Our tenure variable starts in the fourth year after the switch where it takes a value of 1.

Appendix B: Results of "company specific effects" model

Model	Specification details
1	This is our most generalised model. It includes all variables which we consider may have an impact on audit prices
2	We drop tenure from model 1 (as it is insignificant) and rerun the model. HHI remains insignificant.
3	We drop HHI from model 2 as it is insignificant. This is our preferred model.
4	We drop the lagged audit fee and run the model with the standard fixed-effects estimator to test the robustness of our preferred specification. We obtain similar estimates for all our coefficients.

Variable	Model 1	Model 2	Model 3	Model 4
lagged audit fee (log)	**0.19** **(0.03)**	**0.19** **(0.03)**	**0.19** **(0.03)**	n/a
total assets (log)	**0.27** **(0.02)**	**0.27** **(0.02)**	**0.28** **(0.02)**	**0.34** **(0.01)**
turnover (log)	**0.23** **(0.01)**	**0.23** **(0.02)**	**0.23** **(0.02)**	**0.25** **(0.01)**
merger dummy	**0.04** **(0.01)**	**0.04** **(0.02)**	**0.04** **(0.02)**	**0.03** **(0.01)**
Inventories/assets (log)	**0.02** **(0.01)**	**0.02** **(0.01)**	**0.02** **(0.01)**	**0.03** **(0.00)**
loss dummy	**0.06** **(0.02)**	**0.06** **(0.02)**	**0.05** **(0.02)**	**0.09** **(0.02)**
tenure	0.01 (0.01)	n/a	n/a	**0.02** **(0.01)**
takeover switch year 1	**-0.27** **(0.07)**	**-0.29** **(0.07)**	**-0.29** **(0.07)**	**-0.29** **(0.07)**
takeover switch year 2	-0.16 (0.09)	**-0.19** **(0.09)**	**-0.18** **(0.09)**	**-0.35** **(0.09)**
takeover switch year 3	-0.13 (0.09)	-0.15 (0.09)	-0.15 (0.09)	**-0.22** **(0.10)**
takeover switch year 4	0.08 (0.10)	0.07 (0.09)	0.06 (0.09)	0.02 (0.10)
direct tender/ switch year 1	**-0.07** **(0.03)**	**-0.09** **(0.03)**	**-0.09** **(0.03)**	**-0.06** **(0.03)**
direct tender/ switch year 2	-0.04 (0.03)	**-0.06** **(0.03)**	**-0.06** **(0.03)**	-0.04 (0.02)
direct tender/switch year 3	0.00 (0.09)	-0.02 (0.03)	-0.02 (0.03)	0.01 (0.09)
direct tender/switch year 4	0.05 (0.04)	0.04 (0.03)	0.04 (0.03)	0.08 (0.04)

Variable	Model 1	Model 2	Model 3	Model 4
HHI (log)	0.08 (0.09)	0.08 (0.09)	n/a	-0.09 (0.06)
Constant	**-2.57** **(0.80)**	**-2.46** **(0.79)**	**-1.81** **(0.31)**	**-1.39** **(0.48)**

Note: Standard errors in parentheses; **bold** indicates significance at the 5% level. Our model also includes time dummies for each year (not reported).

B.1 As part of our robustness checks we test whether our results are sensitive to the inclusion of lagged audit fees. When we drop this variable, the magnitude of some coefficients changes, but there is no change in the significance or sign of any of any of the estimated coefficients with the exception of tenure, which is significant at the 5% level of significance. This suggests that our key results are robust to the exclusion of lagged audit fees.

Diagnostics tests of preferred specification estimated with Arellano-Bond

B.2 We carried out two diagnostic tests: a test for autocorrelation of the first-differenced residuals and the Sargan test of the correctness of the over-identifying restrictions.

B.3 The inclusion of a lagged dependent variable means that we expect first-order autocorrelation. Our test confirms this. However we find no evidence of second-order autorcorrelation of the first-differenced residuals.

Autocorrelation test	Z-stat	P > z
Order 1	**-5.07**	**0.00**
Order 2	0.22	0.83

B.4 The Sargan test indicates that there is no evidence to suggest that the model's over-identifying restrictions fail to hold.

Overidentifying restrictions test (Sargan)	Chi-square stat	P > Chi-square
Chi^2 (16)	**14.85**	**0.54**

Appendix C: Audit prices and industry concentration

C.1 In this Appendix we check whether our finding that there is no statistically significant relationship between audit price and HHI is robust to alternative measures of market concentration (n-firm concentration indices). We find that the coefficient on market concentration is insignificantly different from zero (at the 5% level of significance) in all specifications of our model.

C.2 The full results are reported in the table below.

Robustness of findings on auditor market concentration

Variable	HHI, 11 sectors (model 2)	1-firm conc. ratio, 11 sectors	2-firm conc. ratio, 11 sectors	3-firm conc. ratio, 11 sectors
lagged audit fee (log)	**0.19** **(0.03)**	**0.19** **(0.03)**	**0.19** **(0.03)**	**0.19** **(0.03)**
total assets (log)	**0.27** **(0.02)**	**0.27** **(0.02)**	**0.27** **(0.02)**	**0.27** **(0.02)**
turnover (log)	**0.23** **(0.02)**	**0.23** **(0.02)**	**0.23** **(0.02)**	**0.23** **(0.02)**
merger dummy	**0.04** **(0.02)**	**0.04** **(0.02)**	**0.04** **(0.02)**	**0.04** **(0.02)**
loss dummy	**0.06** **(0.02)**	**0.06** **(0.02)**	**0.06** **(0.02)**	**0.06** **(0.02)**
Inventories/ assets (log)	**0.02** **(0.01)**	**0.02** **(0.01)**	**0.02** **(0.01)**	**0.02** **(0.01)**
takeover switch year 1	**-0.29** **(0.07)**	**-0.30** **(0.07)**	**-0.29** **(0.07)**	**-0.29** **(0.07)**
takeover switch year 2	**-0.19** **(0.09)**	**-0.19** **(0.09)**	**-0.18** **(0.09)**	**-0.19** **(0.09)**
takeover switch year 3	-0.15 (0.09)	-0.15 (0.09)	-0.15 (0.09)	-0.15 (0.09)
takeover switch year 4	0.07 (0.09)	0.06 (0.09)	0.06 (0.09)	0.06 (0.09)
direct tender/switch year 1	**-0.09** **(0.03)**	**-0.09** **(0.03)**	**-0.09** **(0.03)**	**-0.09** **(0.03)**
direct tender/switch year 2	**-0.06** **(0.03)**	**-0.06** **(0.03)**	**-0.06** **(0.03)**	**-0.06** **(0.03)**
direct tender/switch year 3	-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)
direct tender/switch year 4	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)
Concentration (log)	0.08 (0.09)	0.08 (0.07)	0.06 (0.12)	-0.40 (0.26)

Variable	HHI, 11 sectors (model 2)	1-firm conc. ratio, 11 sectors	2-firm conc. ratio, 11 sectors	3-firm conc. ratio, 11 sectors
Constant	**-2.46** **(0.79)**	**-1.73** **(0.31)**	**-1.77** **(0.31)**	**-1.86** **(0.31)**

Note: Standard errors in parentheses; **bold** indicates significance at the 5% level. Our model also includes time dummies for each year (not reported). All specifications are variations of model 2 which excludes the tenure variable.

Appendix D:Results of our "Industry and index effects" model

D.1 Results of Random Effects and Between Effects estimation

	Random Effects		Between Effects	
	Long tenure model	**Switcher model**	**Long tenure model**	**Switcher model**
Switcher dummy	n/a	-0.04 (0.06)	n/a	0.03 (0.05)
long tenure (>10 years)	-0.01 (0.02)	n/a	-0.01 (0.07)	n/a
Total assets (log)	**0.33** **(0.02)**	**0.34** **(0.01)**	**0.33** **(0.04)**	**0.28** **(0.03)**
Turnover (log)	**0.27** **(0.02)**	**0.26** **(0.01)**	**0.31** **(0.04)**	**0.37** **(0.04)**
Merger	0.01 (0.02)	0.02 (0.02)	0.25 (0.14)	0.19 (0.13)
Inventories/assets (log)	**0.02** **(0.01)**	**0.02** **(0.01)**	-0.02 (0.02)	-0.03 (0.02)
Loss dummy	**0.12** **(0.02)**	**0.11** **(0.02)**	**0.46** **(0.13)**	**0.66** **(0.11)**
FTSE 100	0.32 (0.25)	0.16 (0.26)	2.62 (1.84)	1.12 (2.03)
FTSE 250	**0.41** **(0.17)**	0.06 (0.14)	-0.01 (1.56)	0.82 (1.51)
Private	-0.37 (0.35)	-0.50 (0.36)	0.05 (4.49)	1.2 (3.33)
Other index	0.16 (0.14)	0.01 (0.13)	**3.69** **(1.5)**	1.24 (3.36)
Banking	n/a	n/a	n/a	n/a
Basic Materials	0.06 (0.69)	0.05 (0.70)	0.34 (4.27)	1.2 (3.24)
Consumer Goods	-0.35 (0.69)	-0.34 (0.69)	-3.21 (4.34)	0.38 (3.33)
Consumer Services	-0.75 (0.68)	-0.73 (0.69)	0.54 (4.18)	1.5 (3.13)
Other financial services	-0.78 (0.69)	-0.76 (0.70)	-0.85 (4.22)	0.76 (3.18)
Healthcare	-0.39 (0.7)	-0.23 (0.7)	-0.33 (4.32)	0.97 (3.31)

	Random Effects		Between Effects	
	Long tenure model	**Switcher model**	**Long tenure model**	**Switcher model**
Industrial products	-0.10 (0.68)	-0.12 (0.69)	-0.83 (4.21)	0.34 (3.19)
Oil and gas	-0.27 (0.70)	-0.08 (0.70)	-1.79 (4.46)	0.14 (3.29)
Technology	-0.2 (0.69)	-0.22 (0.69)	-1.52 (4.42)	0.75 (3.25)
Telecommunications	-0.56 (0.71)	-0.58 (0.71)	0.3 (4.32)	1.67 (3.33)
Utilities	-0.84 (0.7)	-0.86 (0.71)	-0.64 (1.09)	-0.27 (0.88)
Constant	**-1.84** **(0.70)**	**-1.92** **(0.70)**	-3.04 (4.11)	-4.41 (3.08)

Note: Standard errors in parentheses; **bold** indicates significance at the 5% level.

Appendix E: Estimated coefficients including all banks and financial services companies

E.1 Including inventories to assets ratio as a variable in our model automatically results in our estimation dropping observations from companies in years where no data exists on inventories. This leads to the exclusion of all banks and many financial services companies from the data used to estimate the model's coefficients.

E.2 To test the robustness of our model estimates to the inclusion of banks and financial service companies we need to impose a notional constant value of the inventory/assets ratio for these companies. The precise value employed does not matter in our "company specific effects" model as the estimates are based entirely on within company variation in fees and other variables, including inventories. In the "industry and index" variation of our model the value employed is subsumed in the coefficient of the industry and index dummy variables.

E.3 The results of including observations from all banks and financial service companies to estimate our coefficients are presented below. This does not alter the significance or sign of any of our estimated coefficients (with the exception of the mergers variable in the switcher variation of our industry and index effects model).

Company Specific Effects Model

Variable	Model 3 (preferred specification)	Model 3 with all banks and financial service companies included
Sample size	**3,733**	**4,683**
lagged audit fee (log)	**0.19** **(0.03)**	**0.24** **(0.04)**
total assets (log) – non-FS	**0.28** **(0.02)**	**0.28** **(0.02)**
total assets (log) – FS	**n/a**	**0.22** **(0.03)**
turnover (log) – non-FS	**0.23** **(0.02)**	**0.24** **(0.02)**
turnover (log) – FS	**n/a**	**0.04** **(0.02)**
merger dummy	**0.04** **(0.02)**	**0.04** **(0.01)**
inventories/assets (log)	**0.02** **(0.01)**	**0.03** **(0.01)**
loss dummy	**0.05** **(0.02)**	**0.05** **(0.02)**
takeover switch year 1	**-0.29** **(0.07)**	**-0.26** **(0.07)**

Variable	Model 3 (preferred specification)	Model 3 with all banks and financial service companies included
takeover switch year 2	**-0.18** **(0.09)**	-0.11 (0.08)
takeover switch year 3	-0.15 (0.09)	-0.11 (0.09)
takeover switch year 4	0.06 (0.09)	0.09 (0.10)
direct tender/switch year 1	**-0.09** **(0.03)**	**-0.13** **(0.03)**
direct tender/switch year 2	**-0.06** **(0.03)**	**-0.09** **(0.03)**
direct tender/switch year 3	-0.02 (0.03)	-0.06 (0.03)
direct tender/switch year 4	0.04 (0.03)	0.01 (0.03)
Constant	**-1.81** **(0.31)**	**-1.81** **(0.28)**

	Long tenure model		**Switcher model**	
Industry and index effects model (random effects)	Excluding most banks and financial services	Including all banks and financial services	Excluding most banks and financial services	Including all banks and financial services
Sample size	4,059*	4,821*	5,090	6,139
Switcher dummy	n/a	n/a	-0.04 (0.06)	0.04 (0.06)
long tenure (>10 years)	-0.01 (0.02)	0.02 (0.02)	n/a	n/a
total assets (log) – non-FS	**0.33** **(0.02)**	**0.32** **(0.02)**	**0.34** **(0.01)**	**0.34** **(0.02)**
total assets (log) – FS	n/a	**0.27** **(0.02)**	n/a	**0.31** **(0.02)**
turnover (log) – non-FS	**0.27** **(0.02)**	**0.25** **(0.02)**	**0.26** **(0.01)**	**0.25** **(0.01)**
turnover (log) – FS	n/a	**0.15** **(0.02)**	n/a	**0.14** **(0.01)**
merger	0.01 (0.02)	0.02 (0.02)	0.02 (0.02)	**0.03** **(0.01)**
inventories/assets (log)	**0.02** **(0.01)**	**0.03** **(0.01)**	**0.02** **(0.01)**	**0.04** **(0.01)**
loss dummy	**0.12** **(0.02)**	**0.09** **(0.02)**	**0.11** **(0.02)**	**0.08** **(0.02)**
FTSE 100	0.32 (0.25)	0.25 (0.18)	0.16 (0.26)	0.00 (0.16)
FTSE 250	**0.41** **(0.17)**	0.22 (0.25)	0.06 (0.14)	0.38 (0.21)

	Long tenure model		Switcher model	
Industry and index effects model (random effects)	Excluding most banks and financial services	Including all banks and financial services	Excluding most banks and financial services	Including all banks and financial services
Private	-0.37 (0.35)	-0.38 (0.36)	-0.50 (0.36)	-0.51 (0.37)
Other index	0.16 (0.14)	0.40 (0.24)	0.01 (0.13)	0.30 (0.24)
Banking	n/a	**2.35** **(0.90)**	n/a	1.56 (0.88)
Basic Materials	0.06 (0.69)	0.02 (0.81)	0.05 (0.70)	0.00 (0.81)
Consumer Goods	-0.35 (0.69)	-0.39 (0.80)	-0.34 (0.69)	-0.39 (0.80)
Consumer Services	-0.75 (0.68)	-0.71 (0.79)	-0.73 (0.69)	-0.73 (0.80)
Other financial services	-0.78 (0.69)	0.56 (0.84)	-0.76 (0.70)	0.14 (0.84)
Healthcare	-0.39 (0.7)	-0.43 (0.82)	-0.23 (0.7)	-0.27 (0.82)
Industrial products	-0.10 (0.68)	-0.14 (0.79)	-0.12 (0.69)	-0.17 (0.80)
Oil and gas	-0.27 (0.70)	-0.28 (0.81)	-0.08 (0.70)	-0.14 (0.81)
Technology	-0.2 (0.69)	-0.22 (0.80)	-0.22 (0.69)	-0.27 (0.81)
Telecommunications	-0.56 (0.71)	-0.46 (0.83)	-0.58 (0.71)	-0.53 (0.83)
Utilities	-0.84 (0.7)	-0.80 (0.82)	-0.86 (0.71)	-0.84 (0.82)
Constant	**-1.84** **(0.70)**	-1.50 (0.81)	**-1.92** **(0.70)**	-1.60 (0.81)

* *Note* that the sample size is smaller for the long-tenure models as these drop all observations for which the "year of first audit engagement" is recorded as year 2000 (approximately one third of observations are recorded as having a first year of engagement as 2000 – this is clearly erroneous).

Appendix F: Opinion on the report "An econometric analysis of the prices of large company audits" by Andrew Chesher

Introduction

1. I have been asked by Norton Rose LLP to review the submission by PricewaterhouseCoopers LLP: "An econometric analysis of the prices of large company audits".

2. PwC have conducted an econometric analysis of the determination of fees for audit and audit related services (henceforth "**audit fees**") in the UK. I have had access to the data they employed in the analysis and I have reviewed their work and the report.

Qualifications and prior relationship with PwC

3. I am Professor of Economics at University College London, Director of the ESRC Research Centre for Microdata Methods and Practice (CeMMAP) and Research Fellow of the Institute for Fiscal Studies. Prior to joining UCL, I was Professor of Econometrics at the University of Bristol from 1983 to 1999.

4. I have published extensively in the leading world journals in economics and econometrics. I am a Fellow of the Econometric Society, Fellow of the British Academy and Honorary Foreign Member of the American Economic Association.

5. I have more than thirty years of experience of consulting on economics, econometrics and statistics for companies, international agencies, governments and regulators.

6. I have never previously advised PwC. In 2002, working with Indepen Consulting, I liaised with PwC while offering advice to Eircom Limited. In the 1980s, I advised Coopers and Lybrand in a study of the demand for financial mail services conducted for the Royal Mail Group.

My opinion

7. To prepare their report "*An econometric analysis of the prices of large company audits*", PwC constructed a model for the determination of audit fees and estimated the parameters of the model using data covering 2000-2010 and around 800 companies that were in the FTSE 350 or the list of 100 "Top Track" companies for all or part of that period.

8. PwC employed the data in the CC's industry data set (**IDS**) and some additional data on tendering and switching used to construct measures of the timing of tendering and auditor switching. I am satisfied that these data manipulations have been conducted correctly.

9. In the main part of their analysis, PwC employed a dynamic model in which the current audit fee is determined by the audit fee of the previous year and by company characteristics which change through time and potentially affect the cost to an audit firm of conducting an audit.

10. The main PwC model includes terms specific to companies around which audit fees vary through time. The main part of the analysis employs a "fixed effects" method which eliminates the influence of these company-specific effects on the estimation by focusing entirely on variations in fees and explanatory variables within companies over time.

11. Alternative approaches are taken in a few analyses in which the impact on audit fees of variables that are constant through time is examined.

12. In my view, PwC have made good modelling choices. Their model is similar to other models for audit fees used in the academic and professional literature. It contains measures of factors affecting the cost of performing an audit such as the scale, complexity and risk of audit. The previous year's audit fee embodies information about those time-varying factors that affect the cost of auditing a company and are not captured by the measures of audit scale, complexity or risk included in the model.

13. In my view, the company-specific term must be considered because of the substantial variation across companies in the general level of audit fees. This variation likely reflects the many differences in companies' businesses and organisation which affect audit fees but cannot be captured entirely using the company characteristics recorded in the IDS.

14. The econometric methods used to estimate the model are well-chosen and suitable for the task. Because unobserved and observed company-specific factors affecting audit fees are likely to be correlated, it is prudent to employ a "fixed-effects" estimation procedure as PwC have done. Because of the presence of the lagged audit fee, an instrumental variables procedure should be employed and the Arellano-Bond (**AB**) method chosen by PwC is suitable and a standard method to use in this situation. I believe that, in the context of the problem considered, the sample size is large enough for the AB estimator to produce reliable results.

15. I am satisfied that the estimation has been properly conducted and that the robustness of the results to relevant changes in specification has been properly probed. Standard procedures designed to detect misspecification have been performed and no evidence of misspecification has been found.

16. The AB estimator exploits only that information contained in the company across-time variation in audit fees and explanatory variables. The market concentration variables exhibit rather limited variation through time so it is to be expected that the effects of market concentration are not very precisely estimated. However, other factors do exhibit quite substantial variation and a tolerably accurate estimation of the effects of these factors on audit prices has been obtained.

17. Part of the investigation studies the influence on average fees of explanatory variables which summarised companies' experience over the whole of the 2000-2010 period. Here, a static model was a good choice and, because a fixed effects approach could not deliver estimates of the effects of interest, random effects (**RE**) and between effects (**BE**) estimators were employed, the latter based on company average data.

18. These RE and BE estimators may have some bias arising because of possible correlations between observed and unobserved company specific factors. I believe this problem is unlikely to be a serious one because these models allow for distinct levels of audit fees across ten industry sectors and four market sectors.

19. Banks and financial service (BFS) companies have low or zero levels of inventories and for them the inventory/asset ratio hardly varies and is not a useful measure of risk of audit and change in risk. This motivates the sensible amendment to the model made when BFS companies are brought into the analysis, estimating a coefficient on the log inventory/asset ratio only for non-BFS companies and allowing BFS and non-BFS companies to have different coefficients on assets and turnover.

Conclusion

20. In summary, it is my opinion that PwC's model choices are sound and suitable for the problem studied and for the data to hand. The econometric analysis has been done well. Suitable estimation procedures have been employed and the robustness of the estimates to variations in the specification has been adequately investigated. The conclusions drawn from the econometric study are suitably measured and justified by the econometric analysis that has been conducted.