



# Audit pricing analysis

# Contents

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|                                    |    |
|------------------------------------|----|
| Executive Summary                  | 1  |
| 1 Introduction                     | 2  |
| 2 Quality of the data              | 3  |
| 3 Trends and drivers of audit fees | 6  |
| 4 Econometric analysis             | 12 |
| 5 Conclusions                      | 18 |
| Appendix 1: Econometric models     | 19 |
| Appendix 2: Regression results     | 21 |
| Appendix 3: References             | 26 |

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# Executive summary

The purpose of this report is to investigate the integrity of the econometric analysis undertaken by Oxera<sup>1</sup> and subsequently by the Office of Fair Trading (“OFT”)<sup>2</sup> regarding the relationship between audit fees and levels of concentration of the UK market for statutory audit services to large companies. This analysis was taken into account by the OFT in reaching its decision to refer the market to the Competition Commission (“CC”) for detailed investigation. Given that the CC has published on its web-site a further presentation by Oxera (which is now advising BDO and Grant Thornton in relation to the CC investigation) it is possible that the CC may also take the results of the Oxera analysis into account in its own deliberations. However, as Deloitte has previously expressed in its submissions to the CC, there are significant concerns over the validity of the results of both Oxera’s and the OFT’s analyses.

Deloitte’s appraisal of the Oxera/OFT analyses has involved a thorough assessment of the data used, the explanatory factors included in the model, and the technical robustness of the model. In all three areas, we have identified significant errors and concerns, and have sought to address these in estimating a revised model. Our assessment of the Oxera/OFT models shows that their purported findings do not withstand scrutiny due to their use of incorrect modelling techniques, poor quality data and the omission of explanatory factors (in particular relating to complexity and risk) that should have been included. No weight should therefore be placed on them.

When the model is re-estimated with a more complete set of explanatory factors, and with modelling techniques that are not flawed, the results show that the previous results are spurious, and that there is no demonstrable causal relationship between concentration and audit fees. Audit fees are instead shown to be driven by other factors including changes in complexity resulting from changes in the auditees’ circumstances, changes in regulation, and by the risks to which the auditor is exposed through auditing those companies.

This is an important result as it shows that there is no detriment resulting from changes in the level of concentration in the statutory audit market. The proposition that audit fees are driven by concentration levels is not consistent with how the market for statutory audits operates; it neither reflects the ongoing and significant competitive pressures in the market, nor takes into account the full range of fee drivers. There are significant competitive pressures exerted on each major auditor by the other major auditors as well as pressures exerted by well-informed and professional audit committees. In practice the drivers of audit fees are numerous, complex and often highly company specific.

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1 Oxera (2006), *Competition and Choice in the UK audit market*.

2 OFT (2011), *UK Audit Services Market – Updated Econometric Analysis of Drivers of Audit Fee Levels*, 21st July.

# 1. Introduction

In its decision to refer the UK market for statutory audit services to the CC, the OFT<sup>3</sup> took into account econometric analysis of the relationship between audit fees and levels of concentration that it had undertaken, which updated previous analysis undertaken by Oxera.<sup>4</sup> The purpose of this report is to investigate the integrity of those previous analyses and to expand on the concerns over the validity of the results of both Oxera's and the OFT's analyses that we expressed in our Initial Submission<sup>5</sup> and in our Response to the CC's Issues Statement.<sup>6</sup>

The Oxera and the OFT analyses both purport to show that market concentration has been a contributing and causal factor behind increased audit fees in recent years. Some of the problems with the analyses relate to the quality of the data that has been used in the model, but more importantly – in terms of the effect of the results – there are significant issues concerning the technical (econometric) details of the modelling, and the explanatory factors that have been omitted from and not taken into account in the Oxera/OFT models.

The evidence presented in this report shows that:

- The data underpinning the Oxera/OFT analysis contains extensive errors and gaps, requiring up to 30% of the data entries for the key variables to be added or modified;
- Oxera's model does not include factors that should have been taken into account as drivers of fees, and it has mis-specified factors it has included (for example by assuming that relevant corporate activity would only be explicitly included as an explanatory variable where a company's turnover increased by 40% year on year when evidence shows a more realistic figure to be significantly lower than 40%); and
- Oxera's analysis contains technical errors (in addition to those previously identified by PwC<sup>7</sup>) that make its conclusions unreliable.

This report explores these issues in detail.<sup>8</sup> It also presents the results of modelling that we have undertaken which addresses Oxera's errors and is based on a more appropriate specification of the model. Once the factors that the literature has identified as relevant are incorporated, and the modelling revised, the results of our analysis show that there is no statistically significant relationship between concentration and the level of fees. Audit fees are instead shown to be driven by other factors including changes in complexity resulting from changes in the auditees' circumstances, changes in regulation, and by the risks to which the auditor is exposed through auditing those companies.

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3 OFT (2011), UK Audit Services Market – Updated Econometric Analysis of Drivers of Audit Fee Levels, 21st July.

4 Oxera (2006), Competition and Choice in the UK audit market.

5 Deloitte (2011), Initial Submission to the Competition Commission, November 22nd, page 27.

6 Deloitte (2012), Response To Issues Statement, January 12th, paragraph 3.4.

7 PwC (2006), Competition and Choice in the UK audit market – a review of the Oxera report.

8 In this document, confidential information is contained within square brackets. In the accompanying non-confidential version, this has been marked as “[§<]”.

## 2. Quality of the data

We have sought to replicate, as far as possible, the analysis that Oxera had undertaken using the same data. Oxera's analysis was based on 700 UK listed companies including the FTSE350, FTSE Small Cap, and FTSE Fledgling as well as a sample of private companies. The data used was extracted from the FAME database, which collates information from companies' annual returns.

Not having access to the actual dataset that Oxera/OFT used, we have undertaken our own steps to source and verify a relevant dataset extracted from the FAME database. However, upon examination it is apparent that the data are unreliable. Not only are there significant gaps in the company data extracted from the FAME dataset (in some cases no data are provided for a company for the entire period when that data was publically available) but we have also identified numerous data points that have been incorrectly and inconsistently recorded from the annual reports.

Most concerning is the discovery that the audit fees, the variable at the crux of the Oxera analysis, has often been incorrectly recorded in the FAME database. In some cases audit services unrelated to the statutory audit or non-audit services have been included in the statutory audit fee thus upwardly biasing the audit fee.

We have therefore taken steps to update and correct the database using data from publically available annual reports. We have focused on updating the variables most relevant to the analysis, following the same sample selection approach as had previously been adopted by Oxera, namely identifying companies that were in the various indices at the end of the period of analysis, and collating data for those companies for the preceding years.

The dataset that we have used for the econometric analysis is a combination of original FAME dataset and data sourced from company annual reports. We describe in more detail below the issues identified with the FAME dataset and the improvements to the extracted data that we have made.

### Time period

Ideally we would have tested the same dataset as that used by Oxera and the OFT. However, as the FAME dataset only stores a maximum of ten years' worth of data for each company at any point in time we were only able to undertake the analysis based on the current FAME dataset for the period 2002 – 2011, and not for the same period covered by Oxera's original analysis (1995 – 2004).

In order to assess the impact of correcting the modelling errors identified in Oxera's original research it has been necessary to re-run Oxera's model using the data from the available time period. The results of this comparison are presented in Section 4 below.

### Companies in the sample

We have followed Oxera's approach in identifying the current constituents of the FTSE 350, FTSE Small Cap, FTSE Fledgling and the 150 largest private companies to form the sample set for econometric analysis. Data for each of these companies has been extracted from FAME for the time period available, 2002 – 2011.

It should be stressed that, while the approach for selecting the sample that Oxera adopted allows for a panel model to be constructed for the companies in the indices at the end of the period of analysis, it necessarily leads to the exclusion of any company that may have been a constituent of one of the indices during the last ten years but has since exited. Only constituents in 2011 are included and some of these may have only recently had an initial public offering resulting in data not being available for all years. The overall impact of this is that there is a diminishing number of companies in the dataset in earlier years.

In addition, gaps in the data for the key variables *Auditor*, *Audit Fee* and *Turnover* also lead to a declining sample size for the earlier years of the period. For example, in 84% of the 342 FTSE350 companies provided by FAME the dataset had data on all three variables in 2010. However, this falls to 53% in 2002. This is discussed further below. Table 1 shows the overall decline in the sample size for the earlier years.

Table 1. Fame data availability

|                   | Sample | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 |
|-------------------|--------|------|------|------|------|------|------|------|------|------|------|
| FTSE 350          | 342    | 100% | 84%  | 81%  | 77%  | 73%  | 70%  | 65%  | 61%  | 57%  | 53%  |
| FTSE Small Cap    | 261    | 100% | 74%  | 62%  | 61%  | 59%  | 54%  | 51%  | 48%  | 46%  | 46%  |
| FTSE Fledgling    | 135    | 100% | 85%  | 67%  | 62%  | 58%  | 59%  | 58%  | 53%  | 53%  | 53%  |
| Private companies | 142    | 100% | 77%  | 85%  | 79%  | 72%  | 68%  | 56%  | 52%  | 47%  | 34%  |

Source: Deloitte analysis of FAME database

## Variables

Table 2 provides an overview of the variables extracted from FAME for each company.

**Table 2: FAME variables**

| #  | Variable               | Description   |
|----|------------------------|---|
| 1  | FTSE Index             | FTSE 350, FTSE Small Cap, FTSE Fledgling, Private company   |
| 2  | Audit fee              | Total fee to auditor for group statutory audit – will include international fee and is not UK only. |
| 3  | Company turnover       | Total revenue for audited group.  |
| 4  | International turnover | International turnover  |
| 5  | Company industry       | Industry based on SIC (Service industry code)   |
| 6  | Auditor name           | Name of auditor by year   |
| 7  | Total assets           | Total assets (total current and non-current assets)   |
| 8  | SIC code               | SIC – Service industry code for audited company   |
| 9  | Accounts receivable    | Accounts receivable of audited company  |
| 10 | Inventory              | Inventory of audited firm. Not relevant for all companies.  |
| 11 | Current assets         | Current assets of audited company   |
| 12 | Debt/Equity ratio      | Gearing ratio of audited company  |

### Audit fees

A review of the audit fee data included in the FAME dataset has identified a number of inconsistencies when compared to the audit fees recorded in the published company annual reports. These errors included:

- data that are simply omitted;
- the misspecification of currencies – for example, some entries were in US Dollars and not in Sterling; and
- incorrect recording of audit fees – for example, fees for the group audit, audit of subsidiaries and for non-audit services are inconsistently reported.

It is essential that the audit fees included in the data are correct and not over- or under-stated because they are pivotal to the econometric analysis. To remedy this, we have undertaken an extensive data collection exercise to collect audit fees from company annual reports for the FTSE350 companies for the years 2002 – 2011.

A sample of audit fees in the FAME dataset for the FTSE Small cap and FTSE Fledgling companies was tested and there were fewer errors relative to the FTSE350. As the financial statements of the companies in these two indices tend to be less complex than the FTSE350, there may be a lower likelihood of the inclusion of incorrect figures. Accordingly, correct audit fees were only collected from Annual Reports for the FTSE350 and the raw, uncorrected FAME dataset has been used for companies in the other indices.

### Auditor

The name of the auditor was collected alongside the audit fee for the FTSE350 companies. Although there are fewer errors in the FAME dataset regarding the identification of the auditor, there are a significant number of errors and omissions. As set out in Table 3 below, we have added or amended 10% of the data entries for auditor, hence significantly reducing the number of data gaps.

### Revenue

We have checked the company revenue data extracted from FAME for those companies where outliers were identified. Outliers were identified in the FAME dataset for FTSE350 companies for any year where there was greater than a 100% change in the audit fee to revenue ratio. The audit fees and revenue figures for these identified outliers were then checked against annual reports for the relevant periods to identify whether these changes reflected errors or were the result of genuine changes (such as mergers, acquisitions or disposals) for the companies in question. The most common source of FAME revenue recording error was inconsistency in the figure taken from the annual report to represent revenue in each year. This was a particular issue in the finance and gambling industries due to the nature of revenue generation. For example:

- Revenues in FAME have been incorrectly reported for financial companies such as JP Morgan American Investment Trust and Edinburgh Dragon Trust. Inconsistencies arise as in some years revenue is reported as interest revenue while in other years total capital gains or losses are used. This has led to apparently large percentage changes in revenue between years that do not reflect changes in the position of the companies.
- FAME also includes inconsistent reporting of revenues for William Hill and Ladbrokes, both in the gambling sector. For a period of years the value of wagers was recorded whilst in another the actual revenue was taken.

Where such errors were identified annual reports were used to correct the data and to ensure consistency across the period. However, given the poor quality of data for the outlier companies that were identified there are no doubt further, less prominent, errors that still exist within the dataset.

### International turnover

The Oxera analysis makes use of the International turnover variable from the FAME dataset as an indicator of audit complexity. Many companies included in the sample have global operations which increases the complexity of the audit. However financial statements are commonly presented at the aggregate or regional (or supra-national) level and so it is not always possible to identify turnover that is either 'International' or 'Domestic'. In such cases international turnover is reported in FAME as a zero value which is misleading and fails to signal that the company has international operations.

We have sought to identify an alternative variable that would indicate the added complexity that the audit of an international company entails. Unfortunately as companies do not consistently report the number of countries in which they operate and do not report turnover by international and domestic segments (in fact for some of the companies in the sample it would be difficult to define what constitutes domestic turnover) a satisfactory proxy has not been identified.<sup>9</sup>

### Summary of data changes

Table 3 provides an overview of the percentage of data points for the 880 companies in the Deloitte sample where either corrections or additions have been made in respect of the three key variables: Audit Fee, Turnover and Auditor. Given the importance of these variables in the econometric modelling, and the likelihood that Oxera and the OFT have performed no similar data cleansing (since they make no comments on data cleansing) the scale of this data correction is a matter of some concern.

Across the period where Annual Report data were readily available (2002 – 2010) a minimum of 17% of data points relating to audit fees in each year have been either corrected or added to the dataset (where previously omitted), with a maximum of 30% of all audit fees in 2005 requiring amendment. Given the approach of only updating turnover figures that were identified as outliers, there is a less dramatic 1-2% correction to recorded turnover data.<sup>10</sup> However, the name of the company auditor is corrected for approximately 10% of companies. This correction is particularly concerning as this data should be readily and reliably sourced from annual reports.

**Table 3. Percentage of data corrections for FTSE350 summary**

| Variable  | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | Total |
|-----------|------|------|------|------|------|------|------|------|------|------|-------|
| Audit fee | 3%   | 17%  | 19%  | 19%  | 19%  | 19%  | 30%  | 29%  | 27%  | 24%  | 21%   |
| Turnover  | 0%   | 1%   | 2%   | 1%   | 2%   | 1%   | 1%   | 1%   | 1%   | 1%   | 1%    |
| Auditor   | 2%   | 6%   | 8%   | 9%   | 10%  | 10%  | 9%   | 9%   | 10%  | 9%   | 8%    |

Source: Deloitte analysis of FAME dataset and company annual reports

Overall our data cleansing exercise has shown that the FAME dataset is incomplete and of poor quality. It is worth noting that the level of inaccuracy is greatest in the earlier years of the database – including three of the years that Oxera used in their analysis. As Oxera's econometric findings are entirely based on this dataset, and the Oxera paper does not describe what, if any, data cleansing it had undertaken, this raises concerns about the impact that the identified weaknesses in the dataset have had on the results.

<sup>9</sup> We note that PwC has included a figure presenting international turnover as a percentage of total turnover in their response to the Statement of Issues at paragraph 3.4. However, it is also clear from the notes provided that PwC has combined data from various sources in constructing that Figure. This carries risks of inconsistency in the data.

<sup>10</sup> Given the errors that were identified with these particular variables, it is certain that there are further inconsistencies in the data that have not yet been corrected.

# 3. Trends and drivers of audit fees

This section discusses the drivers of audit fees. It begins by setting out a list of the main drivers of audit fees that have been discussed in the literature analysing audit fees. Next, it presents analysis of the main drivers of audit fees. This is supported both by analysis of trends drawn from the updated FAME dataset and a qualitative analysis of audit fee drivers based on information provided by Deloitte audit team.<sup>11</sup> This qualitative analysis of audit fee drivers is particularly relevant when discussing econometric models of audit fees that necessarily involve some simplification of the relevant audit fee drivers.

## Overview of audit fee drivers

A review of some of the relevant literature<sup>12</sup> indicates that statutory audit fees are likely to be determined by many if not all of the following factors:

- audit complexity, driven by the relative complexity of the auditee's operations and business model;
- audit quality;
- company size/complexity;
- geographic spread;
- organisational structure of the auditee;
- companies' financial systems and control processes;
- the regulatory environment and changes to that environment;
- the risk to which the auditor is exposed;
- audit staff costs;
- exchange rates;
- corporate activity, involving mergers and acquisitions and demergers;
- audit efficiency;
- pressure from buyers exerted through the annual renegotiation procedures adopted by auditees; and
- the industry in which the company operates.

In seeking to model the drivers of audit fees and in particular to identify whether there is any evidence that prices are or have been driven by increased concentration among the major auditors, it is important to control for these factors. This is supported by the analysis presented below.

## Audit fees and scale

### Audit fees and company turnover

Figure 1 presents the average audit fee to turnover ratio for the companies in the FTSE 100, FTSE 250 and FTSE 350. This provides an indication of changes in audit fees, while controlling for the impact of turnover on audit fees.<sup>13</sup>

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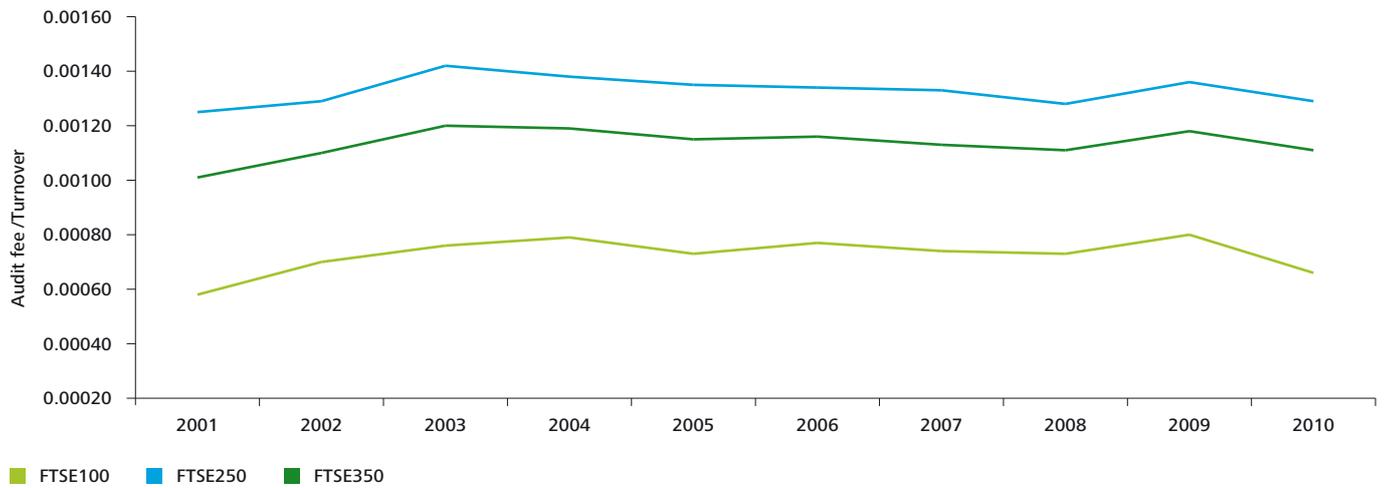
11 We have discussed with [redacted] of our audit engagement teams various possible drivers of audit fees to identify reasons for changes in audit fees from one year to the next. These discussions have been with engagement managers (and partners) of FTSE 100, FTSE 250, FTSE Small Cap, FTSE Fledgling and Large Private clients.

12 See Appendix 3 for a list of references.

13 The relationship between turnover and audit fees is complex, and depends not only on the level of turnover, and the risks inherent in the sector of the auditee, but when auditees are growing, it also depends on how that growth is achieved. For example, an acquisition of a firm within the same jurisdiction would lead to a one-off impact on audit fees while integration is achieved, whereas an acquisition in another jurisdiction to enter a new geographic market would lead to one-off costs, as well as higher ongoing costs.

This indicates that, although there has been movement in audit fees over the years, there is no evidence of any upwards trend. In fact, this measure of price has fallen since 2003, other than between 2009 and 2010, and is at a similar level to that in 2002.

**Figure 1. Audit fee to turnover ratio trend**



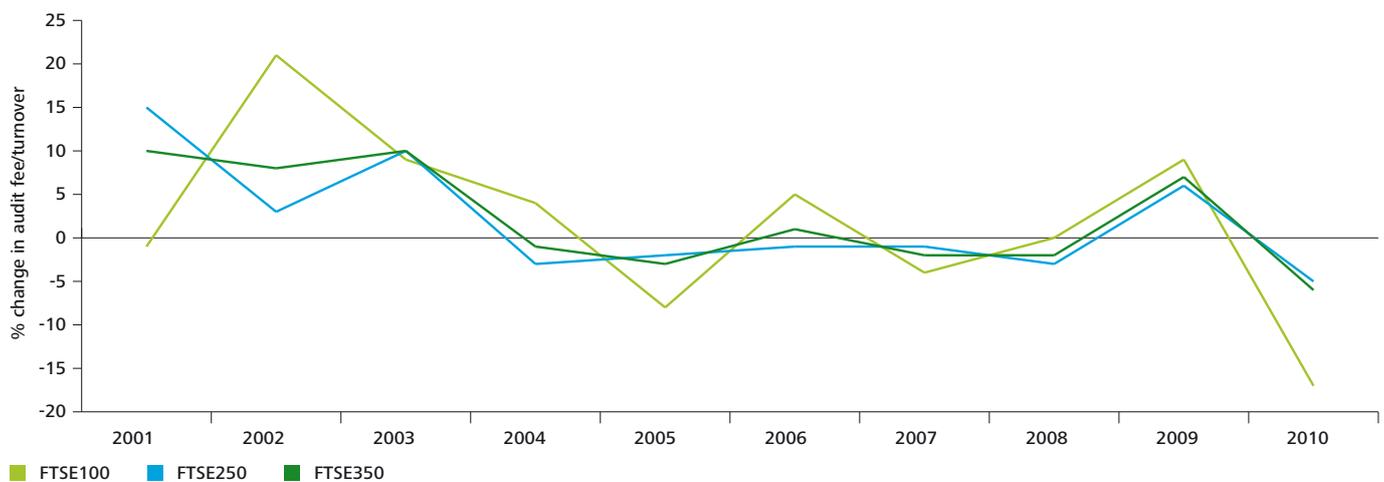
Source: Deloitte analysis of FAME dataset and company annual reports

As well as reflecting economies of scale, a potential driver of this relationship is the pressure that large auditees place on auditors' pricing. A significant proportion of audit teams have provided specific examples of cost pressures driving down audit fees. For example, one audit manager told us that Deloitte was subjected to significant pressure from his client to reduce the audit fee given the client's difficult trading position and their focus on cost control throughout the business. This pressure contributed to an 8% reduction in the audit fee in 2011.

In addition to pricing pressure from auditees, fees can be reduced through the achievement of efficiencies on the part of the auditor that are then passed on to auditees. The opportunity for such efficiency improvements may be expected to be greater where the underlying audit client is larger. The number of examples of efficiency improvements driving audit fees highlighted by audit teams was similar to the number of instances where cost pressure from clients was cited as a fee driver.

Figure 2 further reinforces the finding that whilst there have been changes in audit fees as a percentage of turnover these changes have been both positive and negative.

**Figure 2. Annual percentage change in audit fee to turnover ratio**



Source: Deloitte analysis of FAME dataset and company annual reports

### Asset size as a driver of audit fees

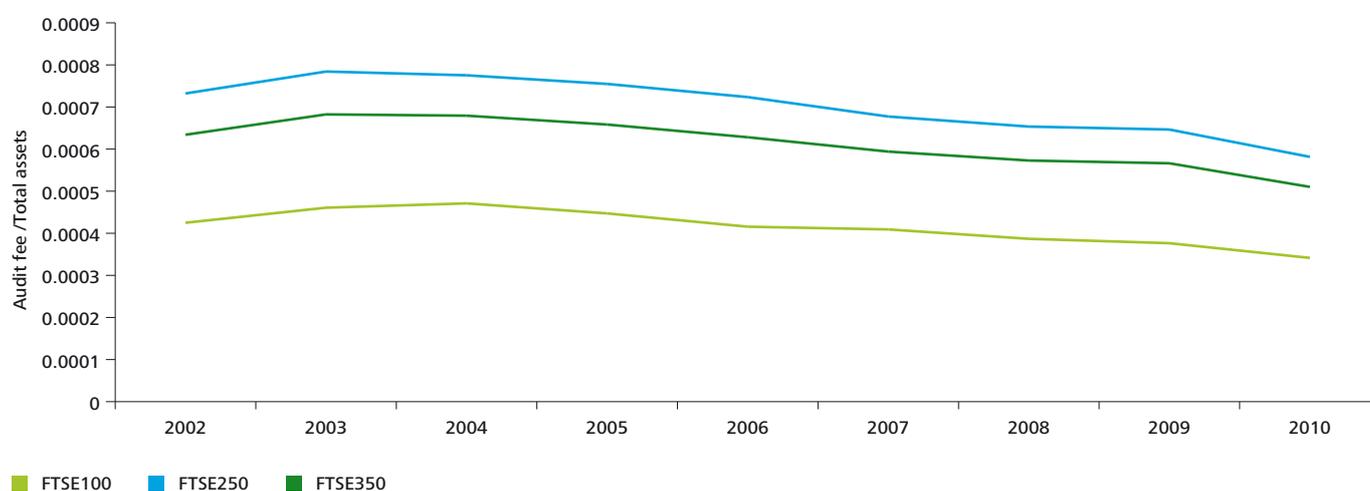
The importance of size – which may be considered a proxy for complexity and risk - in driving audit fees can be examined not just in terms of turnover but also the overall size of the asset base. The significance of the size of the asset base is noted in the literature,<sup>14</sup> as a potentially relevant driver of audit fees.

Accordingly, as an initial test of the potential relationship between audit fees and the turnover or asset measures, we have calculated the correlation coefficients for these variables. While the correlation coefficient provides no insight into the causality of movement between two variables, where close relationships are observed in accordance with expectations, this provides a sound reason to incorporate the measure in more detailed econometric modelling.

In this regard, it is striking that while the correlation between audit fees and turnover and audit fees and total assets are both high (over 0.8), the correlation with assets was highest. Further, the correlation between turnover and total assets was significantly lower, indicating that the correlations of these two variables with audit fees are driven by different factors.

The ratio of audit fee to total assets has been averaged over time for the FTSE 350 sample companies and presented in Figure 3. The ratio has been persistently declining since 2002 for both FTSE 100 and FTSE 250 companies. The average ratio for FTSE 250 companies is consistently higher than that of the FTSE 100, mirroring the trend for the audit fee to turnover relationship. This supports the proposition that audits of larger companies may benefit from some economies of scale.

Figure 3. Audit fee to total asset ratio trend



Source: Deloitte analysis of FAME dataset and company annual reports

Audit teams also emphasised the relationship between company size, scope and audit fees. A large number of [8<] examples of organic changes in company size were cited by audit teams as driving a change in audit fees from one year to the next. This was usually in relation to entry into new markets or geographies or changes to company structure (such as number of subsidiaries).

The analysis presented here supports the inclusion of a Total assets variable in econometric modelling of the drivers of audit fees. This is set out in the next section. However, it should be recognised that size, measured by either turnover or asset base, is at best a proxy for the complexity of audit, which will depend on the specific circumstances of each auditee. Many of these idiosyncratic features cannot be easily captured in a market model on a systematic basis, but can be expected to have a significant impact on fees. For example, changes in company complexity was reported as a driver of audit fees by a significant proportion [8<] of the Deloitte audit teams questioned but such changes may be quite specific in nature. Thus, one audit team noted that the movement of their client's corporate headquarters to [8<], which entailed no substantive change to the countries in which the auditee was active, led to a significant increase in costs and, correspondingly, a higher audit fee. Such changes to corporate complexity are difficult to find reflected in any generic variable that may be defined on a common basis across all companies.

14 See for example, Simunic (1980), The Pricing of Audit Services: Theory and Evidence, Journal of Accounting Research

## Other audit fee drivers

### Regulation

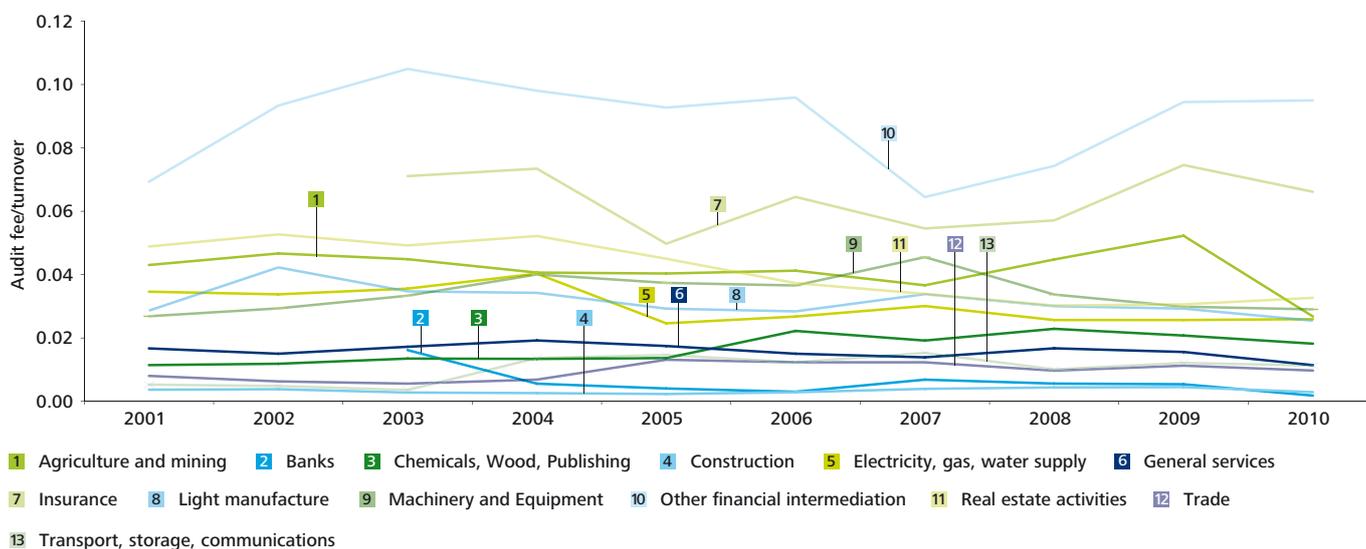
Given that statutory audits are a legal requirement that must adhere to specific standards, changes to the regulatory environment have a significant impact on the required scope of audit services. The introduction of Sarbanes-Oxley in 2002 is such an example. This is particularly relevant for the current analysis as the changes resulting from Sarbanes-Oxley were coincident with a change in the structure of the audit market resulting from the dissolution of the Andersen business. More demanding reporting requirements were introduced together with an increased focus on audit risk by auditors which together led to an upward pressure on audit fees. Similarly, changes to IFRS over the years that have introduced more rigorous reporting standards have also had the impact of increasing audit fees. In particular, the 2005 transition from UK GAAP to IFRS increased the reporting requirements and audit scope for UK listed companies.

A significant minority of audit teams [3<] cited regulation as a driver of changes in audit fees. These typically related to IFRS, Sarbanes Oxley, changes in listing regulations and other industry specific regulations (especially in financial services). For example, the audit manager for one FTSE Small Cap client noted that adoption of IFRS in 2009 contributed to a £[3<] increase in audit fees for that year (£[3<] of this increase was non-recurring).

### Industry differentials and compositional effects

Audit fees may also be driven by the industry sector in which the audited company operates because the different characteristics of different sectors can have an impact on the complexity of the audit. To highlight this point, the average audit fee to turnover ratios for each main industry sector are presented in Figure 4.

Figure 4. Industry average audit fee to turnover ratio - FTSE 350



Source: Deloitte analysis of FAME dataset and company annual reports

Figure 4 shows that there is a wide dispersion between the levels of audit fee/turnover ratios for each industry. Industries that have higher than average audit fees include: Other financial intermediation, Insurance, Real Estate and Agriculture and mining. This is not unexpected as these industries incorporate more complex transaction structures in comparison to other industries such as Trade or Construction. Changes in the mix of sectors represented in the indices could therefore have a significant impact on the aggregate relationship between audit fees observed and turnover. This needs to be controlled for in the modelling (as indeed Oxera have done).

### Wage trends

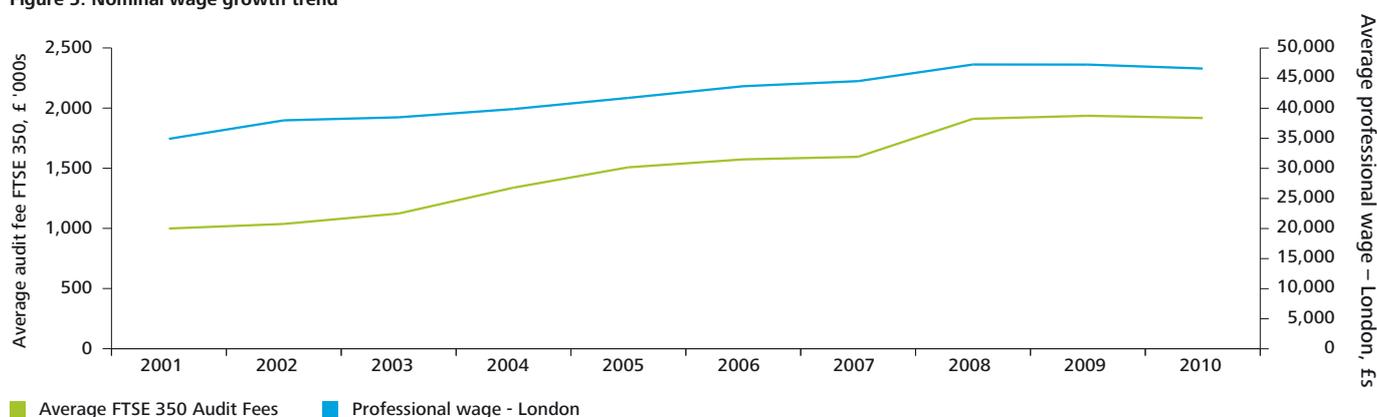
Staff wage costs represent the single most important cost for Deloitte and other professional services firms, with the ongoing success of Deloitte in the audit and the other markets in which it operates dependent on the recruitment of high calibre staff. To maintain successful recruitment and deliver the quality demanded by our clients, investors and regulators, Deloitte must provide competitive wages that both attract and retain the best graduates and experienced professionals.

In a competitive market, increases in the marginal cost of delivering a service (that affect all operators in an industry equally) will be expected to be passed through to consumers of those services.<sup>15</sup> This is a somewhat counter-intuitive result, but leads to the conclusion that the more competitive the downstream market, the greater the proportion of cost increases that would be passed on to customers.

<sup>15</sup> This is analogous to the pass-on defence in a damages case, whereby the margins earned by customers of a cartelised input would not experience any direct impact from the unduly high input cost, as any overcharge would in turn be passed on to their customers.

Figure 5 presents the movement in wages and audit fees over time. While this does not control in any manner for changes in input requirements (in other words, whether more hours of work were required to undertake audits over time), it should be noted that the trends in audit fees and staff costs of the operators providing those audit services (proxied with an index of professional staff salaries in London) are highly correlated; growth between 2003 to 2007 for both wages and audit fees are followed by a period of low or negative growth after 2008.

**Figure 5. Nominal wage growth trend**



Source: Audit fee data, FAME and Annual reports. Annual average wage data for London based Professional Occupations sourced from the ONS, Annual Survey of Hours and Earnings, Table 15.7a Annual pay – Gross 2002 -2011

### Switching

The Deloitte updated FAME dataset identifies the auditor, and therefore enables changes in the auditor to be identified which in turn enables the relationship between audit fees and switching to be analysed. We considered the FTSE 100 switches that took place between 2002 and 2009,<sup>16</sup> and the percentage change in audit fees that was concurrent with the change in auditor. Of the 12 switches identified, fees increased for 8 companies, decreased for 1 company and stayed constant for 3 companies in the year of the switch. As this highlights, there are frequently other changes that happen at the same time as an auditor switch and it is therefore necessary to control for those other events before the impact of switching on audit fees can be isolated.

A similar analysis has been undertaken for companies in the FTSE250 that switched between 2002 and 2010.<sup>17</sup> This shows diversity similar to that observed for the FTSE100 companies that switched. Of the 43 FTSE 250 switches in this time period, audit fees increased for 20 companies, decreased for 18 companies and remained constant for 5 companies.

### Corporate activity

Corporate activity was among the most common reasons cited by audit teams for a change in absolute audit fee. This corporate activity took a number of forms, including mergers, demergers and divestments. Examples of this include the following:

- In 2006, a FTSE 250 company was involved in a reverse takeover of another listed company. The increased scale of the company's operations and complexity of the audit in the year of the transaction contributed to an increase in the audit fee of [8<] % compared to the previous year.
- In 2007, a conglomerate made acquisitions in [8<]. These acquisitions contributed to an increase in the audit fee of approximately [8<] % for that year.
- In 2007, one of our audit clients acquired a significant subsidiary and this contributed to an increase of approximately [8<] % in their audit fee for that year.

Audit managers informed us that mergers and acquisitions tend to result in fee increases because there are costs associated with combining two audit processes (those of the acquiring and acquired parties) and defining a new integrated audit approach. Such merger and acquisition activity may have only a transitory effect on the audit fee, while the systems of the merged entity are combined. But merger and acquisition activity may also generate a step change in required audit fees, such as may occur for example, where an acquisition enables a company to enter a new geography.

<sup>16</sup> It is important to note that this analysis does not capture all of the FTSE 100 switches that took place between 2002 and 2009. This is because, consistent with Oxera's approach, the focus is on the constituents of the FTSE 100 in 2011. Given that the constituents of the FTSE 100 would have changed over time, this analysis does not capture switches made by companies that were FTSE 100 constituents prior to 2011 (and subsequently fell out of the FTSE 100).

<sup>17</sup> Similarly for the FTSE 250, the 43 switches do not represent all of the FTSE 250 switches across the time period as our data set does not capture the change in constituents of the FTSE 250 index over time.

While Oxera/OFT include a variable to capture the effects of corporate activity in their analysis, our review of available evidence has highlighted concerns about Oxera's specification of the proxy it uses for corporate activity. A "merger" is defined by Oxera as an increase in company turnover of 40% or more from one year to the next. However, the experience of our audit teams shows that this 40% threshold is somewhat arbitrary and is in any case set at too high a threshold. We have identified many examples of corporate activity leading to fee changes, but at turnover changes far below the 40% threshold which Oxera (and subsequently the OFT) use. For example:

- In 2007, a FTSE 250 company was involved in an acquisition; the audit fee increased by 50% in this year however, turnover only increased by 17%.
- In 2004, one of our FTSE 250 clients was involved in two acquisitions, which contributed to an [3<] increase in audit fees. In this year, the increase in turnover was less than 10%.

Therefore, in the Oxera/OFT models, the impact of a significant driver of fees is defined incorrectly and as such is incorrectly measured. As a result, the estimated causal effect of the merger variable will be biased, and will not capture all of the impact that corporate activity has had on audit fees.

### Fee negotiation process

One factor which cannot be straightforwardly included in empirical models of audit fees but which should be considered is the negotiation process which is involved in agreeing the audit fee each year.

We have found a number of examples of clients exerting downward pressure on audit fees outside of an actual or threatened tender. By way of example, during 2011 we were asked to perform an extensive exercise for one of our FTSE 100 clients to demonstrate to the audit committee why we continued to be the best external auditor for the client (looking at audit quality, audit fees, etc). The process was treated internally as equivalent to a formal tender and we made significant investment in the process. This process was ultimately successful and resulted in reappointment.<sup>18</sup> A further example involved one of our FTSE Small Cap clients, which had received a lower quote from one of our competitors. This led us to reconsider the audit fee and resulted in a reduction in the audit fee.

The annual fee negotiation process is often particularly rigorous and lengthy. For example, the audit partner for a major multi-national client told us that "a detailed audit fee negotiation takes place every year. The client's central finance team requests detailed analysis of fees per underlying unit as well as hours for each Deloitte global office (to enable the client to compare the \$/h recover for each unit). Negotiations start at the underlying unit level, then further negotiations are held with the Group Reporting Manager and Financial Controller, and finally the CFO. The fee itself will then be debated at the planning Audit Committee meeting before being formally approved. The process itself takes up a significant amount of time. For the FY11 audit fee, the negotiation took over four months to finalise."

There were also a number of examples of clients conducting fee benchmarking exercises.

### Summary

The factors identified in this section provide a solid basis for assessing which factors to incorporate within a model of audit fees. As has been noted, Oxera/OFT incorporate some of these, but, importantly, fail to include most of the broader set, and have mis-specified the variable that is used to proxy for merger and acquisition activity. These omissions and mis-specification could have biased the results. In the following section, we describe the modelling approaches we have adopted, and compare the results achieved with our re-estimation of the Oxera/OFT model.

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<sup>18</sup> The audit manager for the client told us that during this process, a large audit firm competitor provided an unsolicited proposal for the client's audit, offering a [3<] per cent discount on the fees that we were charging. As a result, our audit team worked with the client to establish efficiency savings which could be made and this resulted in a fee reduction of [3<] per cent.

# 4. Econometric analysis

The key findings from our review of the econometric analysis undertaken by Oxera and the OFT are that:

- The econometric models used to estimate the effects of market share and Herfindahl- Hirschman Indices (“HHIs”)<sup>19</sup> on audit fees are incorrectly specified, undermining the validity of the conclusions reached; and
- The significant measurement errors in the FAME dataset raise concerns about the validity of the Oxera/OFT findings.

This section discusses the technical errors in the econometric model specified by Oxera and then presents Deloitte’s revised model and results.

## Overview of the Oxera and OFT methodology

The OFT, in their review of the Oxera analysis, claim that there is evidence to support the hypothesis that auditors with larger market shares exhibit greater market power (comprising an ability to charge a fee higher than cost) and that an increase in concentration in the provision of audit services is associated with an increase in audit fees. This evidence is based on the estimates of an econometric model using the FAME dataset over the period 1995-2004 and subsequently updated by the OFT, to examine the period 2001-2010. Both studies find that auditor share<sup>20</sup> and market concentration, as measured by the HHI, have a positive and significant effect on audit fees after controlling for the effects of other influencing factors. In particular, the OFT report concludes that a doubling of auditor-share and HHI would lead to increases in audit-fees of 5% and 16% respectively.

As standard when constructing an econometric model, both Oxera and the OFT include a number of cost-side and demand side explanatory factors in addition to market concentration. These additional explanatory factors include turnover as a measure of audited company size, international turnover as a measure of a company’s complexity, the cumulative number of times an audited company has switched auditor over the time period reflecting potential bargaining power and the cumulative number of mergers undertaken by the audited company.

Further variables are also included to capture the different characteristics across markets, industries and time-periods that potentially drive audit fees. Finally, the models also include the audit-fee paid in the previous year as an explanatory variable, which is justified by Oxera on the grounds that the negotiated fee for each year is closely related to the fee in the previous year after any necessary adjustments have been taken into account.<sup>21</sup>

## Econometric issues

An econometric model allows the modeller to specify and test for relationships between audit fees and the casual factors identified. Oxera and the OFT measure the effects of these explanatory variables on audit fee using two standard econometric methods: the fixed effects and the random effects models. However, when the explanatory factors include the previous period’s audit fee (a ‘lagged dependent variable’), neither of these approaches is appropriate. Technically, these estimators do not make the adjustments that are necessary when the previous year’s audit fee is included as an explanatory factor (a ‘lagged dependent variable’), and the estimates produced are not reliable.<sup>22</sup> Specifically, the coefficient estimates will be biased and inconsistent estimates of the true causal effects. This is a crucial factor that has a significant bearing on the validity of the results.

Recognising the issues raised by the inclusion of the lagged audit fee variables in the model, the correct approach is to use an alternative method, such as an Arellano-Bond estimator, that produces consistent estimators. Such methods are well documented in the econometrics literature.<sup>23</sup> This is the method that we have applied in the modelling results presented below.

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19 HHI (Herfindahl-Hirschman Index) is a widely used indicator of the level of concentration in a particular industry. In this case it is calculated by summing the square of each auditor’s market share by industry and year.

20 Share is defined as the percentage of total audit fees in a particular year and industry earned by an auditor.

21 The previous year’s audit fee is likely to represent the starting point for any negotiation over audit fees; however, an auditee’s position in a subsequent year may be very different to that in the previous year for the reasons noted in paragraph 8.9 of Deloitte’s response to the Statement of Issues.

22 For the parameter estimates to be consistent under random/fixed effects, the explanatory variables must be uncorrelated with the error terms. The lagged dependent variable is correlated with the individual specific effect by definition; the random/fixed effects estimators will be inconsistent as the resulting within and GLS transformations still yield right hand side (explanatory) variables that are correlated with the transformed error. The Arellano-Bond estimator instead proceeds by taking a first difference and then using lagged values of the dependent variable in time t-2 as instruments for the resulting lagged differenced variable. This yields a GMM estimator that is consistent.

23 See Cameron(2006): *Microeconometrics, Cambridge University Press* p.763

## Empirical specification

In addition to the mis-specification of the econometric model, factors that would be expected to have an influence on audit fees are not included in the analysis undertaken by Oxera and the OFT. By not including relevant variables in the analysis, the models are likely to suffer from omitted variable bias which again would undermine the reliability of the results. Our re-estimation of the model includes those variables where suitable data exists. The two particular explanatory factors where we have identified relevant omissions in the Oxera/OFT work relate to audit risk and company size.

- **Audit risk.** A company may select the auditor that minimises their expected costs after taking into account both the expected quality of the audit and the audit fee. However no allowance has been made by Oxera or the OFT for the potential cost that is associated with audit risk. As pointed out by Pong & Wittington (1994), this is an important consideration, due to the possibility of legal action caused by auditor negligence and the associated loss of future income from any reputational damage. Many audit fee models in the literature use debt to equity, profit and the ratios of receivables and inventories to assets as proxies for the risk associated with an audit.<sup>24</sup> However, these have not been considered in the Oxera/OFT analysis, which raises the potential for omitted-variables bias. This issue is addressed in the model specified by Deloitte, which includes these variables (as set out in more detail in Table 4).
- **Company size.** The size of the audited company, which is a key determinant of cost of the audits, is usually measured by total assets in addition to sales or turnover.<sup>25</sup> As discussed in Section 3, no measure of assets appears in the Oxera or OFT analysis. In our analysis, this omission is addressed: in accordance with expectations and prior research in this area, assets are found to be a significant driver of audit fees.

## Model data and variables

Our analysis is based on the updated and expanded FAME dataset, as discussed in Section 2. However, we note that there are still potential errors in the FAME dataset that have not explicitly been checked against Annual Reports, and so we have sought to identify and exclude outliers from the analysis. Each of the models tested has been run firstly using the complete dataset then a second time after removing statistical outliers. The statistical outliers have been identified using the same methodology as the OFT.<sup>26</sup>

We have re-estimated Oxera and the OFT's econometric specifications using our updated data set. As noted above, the results we obtain when running these models necessarily differ from those originally published due to different time periods of data, and as a result of the extensive development of the database we undertook. A further model with an adapted specification, as developed by Deloitte, ("the DT model"), includes additional variables that measure audit size and risk and has been estimated using the correct Arellano – Bond method. Table 4 sets out the variables used in each specification and their corresponding description.

**Table 4. Description of variables used in Oxera and DT specifications**

| Variable            | Description   | Purpose  | Model   |
|---------------------|---|--|---|
| <i>log fee(t-1)</i> | Log of audit fee (2002 prices)                                    | Fee adjustment                                 | Oxera & DT  |
| <i>log share</i>    | Log of auditor fee-share by broad category SIC                    | Market power                                   | Oxera & DT  |
| <i>log hhi</i>      | Log of HHI by broad category SIC                                  | Concentration                                  | Oxera & DT  |
| <i>log sales</i>    | Log of turnover (2002 prices)                                     | Size   | Oxera & DT  |
| <i>log assets</i>   | Log of total assets (2002 prices)                                 | Size   | DT  |
| <i>switches</i>     | Cumulative changes of auditor by auditee                          | Pricing pressure from switching                | Oxera & DT  |
| <i>log export</i>   | Log of international turnover/total turnover ratio                | Complexity                                     | Oxera   |
| <i>mergers</i>      | Cumulative times an auditee has merged                            | Increased complexity due to corporate activity | Oxera – defined as a >40% increase in turnover<br>DT – defined as a >10% increase in turnover |
| <i>log de</i>       | Log of debt/equity ratio  | Risk   | DT  |
| <i>loss</i>         | Indicator for loss in the current year (dummy variable)           | Risk   | DT  |
| <i>log recv</i>     | Log of receivables/total assets ratio                             | Risk   | DT  |
| <i>log inv</i>      | Log of inventories/total assets ratio                             | Risk   | DT  |
| <i>tdum</i>         | Dummy variables for each year (with one base category)            | Market wide developments in a given year       | Oxera & DT  |
| <i>sdum</i>         | Dummy variables for each industry sector (with one base category) | Sector specific complexity                     | Oxera & DT  |
| <i>mdum</i>         | Dummy variables for market segment (with one base category)       | Market specific audit requirements             | Oxera & DT  |

24 See for example Numan & Willekens (2009), Industry specialization as a means to soften price competition in the audit market.

25 See for example, Simunic (1980), The Pricing of Audit Services: Theory and Evidence, Journal of Accounting Research.

26 Values which are above  $Q3+2*IQR$ , and below  $Q1-2*IQR$  are identified as outliers and removed from the dataset.

Following extensive data cleansing, the Deloitte updated FAME dataset consists of a sample of 372 UK listed companies (332 when excluding outliers) covering the FTSE 350, FTSE Small Cap and FTSE Fledgling indices and a sample of the largest private companies.

The dependent variable (audit fees) averages £756,000 across the sample, with a maximum of nearly £40 million. The mean exceeds the median, indicating that the distribution of fees is positively skewed.

Company turnover averages £2.1 billion across the sample and the average value of total assets per company is £4.1 billion.

International turnover (the variable 'exports' in Oxera's specification) – defined as the ratio of sales outside the UK to total sales – has an average of 50%. The maximum values exceed 100% in some cases which, as discussed in Section 3 indicates an obvious variable-measurement error.

The remaining variables are auditor share with an average of 24%, industry HHI with an average of 3235, cumulative auditee switching, mergers, loss indicators, gearing and the ratios of inventories and receivables to total assets. Following Oxera and the OFT, time-specific variables are also included in both models to allow for market-wide effects in specific years to be controlled for in the model. This would capture the impact of the implementation of more demanding regulatory requirements in a particular year.

## Model results

Using the updated dataset, we have re-estimated the Oxera and OFT models using the (inconsistent) fixed effects and random effects techniques. A further specification as adapted by Deloitte (DT model) which also includes the lagged (log) audit fee was estimated using the consistent Arellano-Bond method. The parameter estimates of these models using the full sample (i.e. without excluding outliers) are presented in Table 5. The results presented here exclude the parameter estimates of the dummy variables; see Appendix 2 for the full results. The most noteworthy finding is that no measure of concentration (neither market share nor HHI), has significant explanatory power in the Deloitte model. There is therefore no statistical evidence to show that an increase in concentration leads to an increase in audit fees when the parameters are being estimated consistently.

**Table 5. Estimates of Oxera, OFT and Deloitte models (including outliers)**

|              | (1)<br>Oxera_RE       | (2)<br>Oxera_FE       | (3)<br>OFT_RE         | (4)<br>OFT_FE         | (5)<br>DT             |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| L.fee        | 0.7648***<br>(0.0272) | 0.3436***<br>(0.0487) | 0.7746***<br>(0.0373) | 0.4974***<br>(0.0453) | 0.2129*<br>(0.0872)   |
| lsales       | 0.1126***<br>(0.0143) | 0.1861**<br>(0.0710)  | 0.1229***<br>(0.0232) | 0.2165**<br>(0.0759)  | 0.1659*<br>(0.0704)   |
| lshare       | 0.0302***<br>(0.0074) | 0.0622***<br>(0.0152) | 0.0413*<br>(0.0181)   | 0.0649<br>(0.0330)    | 0.0362<br>(0.0337)    |
| lhhi         | 0.2131<br>(0.1154)    | 0.1390<br>(0.1182)    | 0.2486<br>(0.1406)    | 0.0801<br>(0.1550)    | 0.0402<br>(0.1116)    |
| switches     | -0.0190<br>(0.0190)   | -0.0961**<br>(0.0351) | -0.0344<br>(0.0372)   | -0.1314*<br>(0.0598)  | -0.0812<br>(0.0640)   |
| export_oxera | 0.2245***<br>(0.0404) | 0.0000<br>(.)         |                       |                       |                       |
| mergers      | -0.0000<br>(0.0058)   | 0.0488*<br>(0.0228)   | 0.0142<br>(0.0081)    | 0.0321<br>(0.0205)    | -0.0296<br>(0.0184)   |
| export       |                       |                       | 0.1117*<br>(0.0504)   | -0.0561<br>(0.1188)   |                       |
| mdum_250     |                       |                       | -0.0174<br>(0.0345)   |                       |                       |
| lassets      |                       |                       |                       |                       | 0.3772***<br>(0.0544) |
| Lde          |                       |                       |                       |                       | 0.0348*<br>(0.0167)   |
| loss         |                       |                       |                       |                       | 0.0586*<br>(0.0233)   |
| lrecv        |                       |                       |                       |                       | 0.0288<br>(0.0301)    |
| linv         |                       |                       |                       |                       | 0.0030<br>(0.0096)    |
| N            | 1952                  | 1952                  | 829                   | 829                   | 1667                  |
| N_g          | 274.0000              | 274.0000              | 191.0000              | 191.0000              | 372.0000              |
| F            |                       | 47.6952               |                       | 47.1782               |                       |
| chi2         | 3.50e+04              |                       | 7681.8426             |                       | 338.4783              |

Standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

The DT model varies from the Oxera model in several respects. First, the variable for exports (international turnover) has been omitted due to the measurement error of international turnover previously raised. The merger variable has also been redefined to reflect a more realistic change in turnover of 10% or more (as discussed in Section 3).

Due to the nature of the Arellano-Bond estimation technique the industry dummies have been removed from the Deloitte specification.<sup>27</sup> This does not have a negative impact on the ability of the model to explain audit fees, nor does it affect the estimation of the remaining parameters.

Additional variables have been incorporated in the DT model to take into account risk and audit complexity. These include the company's assets, gearing (measured by the debt to equity ratio), a loss indicator, and ratios of accounts receivable and inventory to assets. The regression results from the DT model indicate that, in addition to lagged audit fees, turnover, assets, gearing and a loss in the current year have a causal effect significantly different from zero in determining audit fees. Accounts receivable and inventory have not been demonstrated to have a significant causal effect.

There is no evidence that concentration is a driver of audit fees; variables that are more indicative of the complexity and risk of audit services prove to have more explanatory power.

The same set of five models has been re-run after excluding outliers from the dataset. These results are set out in Table 6. The results presented here exclude the parameter estimates of the dummy variables; see Appendix 2 for the full results. As a result of excluding outliers, the turnover and gearing variables (debt to equity ratio) are no longer significant in the DT model and instead the only significant estimates are those for lagged audit fee, total assets and loss.<sup>28</sup> The market concentration variables remain insignificant in this version of the DT specification.

Our results can be interpreted as follows:

- A 100% increase in total assets leads to a 37% increase in audit fees;
- A 100 % increase in lagged audit fee leads to a 40% increase in audit fees; and,
- On average, audit fees are 6.3% higher for firms that incur a loss in the current year than for companies that do not incur a loss in the current year.

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<sup>27</sup> The Arellano-Bond methodology involves first-differencing of variables to remove the individual effect before GMM is applied. As a consequence time-invariant variables such as industry dummies cannot be identified in the model.

<sup>28</sup> Total assets is significant at the 0.1% significance level, lagged audit fee is significant at the 1% significance level and the loss variable is significant at the 5% significance level.

**Table 6. Estimates of Oxera, OFT and Deloitte models (excluding outliers)**

|              | (1)<br>Oxera_RE       | (2)<br>Oxera_FE       | (3)<br>OFT_RE         | (4)<br>OFT_FE         | (5)<br>DT             |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| L.fee        | 0.7536***<br>(0.0309) | 0.3190***<br>(0.0521) | 0.7233***<br>(0.0489) | 0.4720***<br>(0.0469) | 0.4002**<br>(0.1345)  |
| Lsales       | 0.1012***<br>(0.0146) | 0.1878*<br>(0.0750)   | 0.1311***<br>(0.0267) | 0.2225*<br>(0.0864)   | 0.1440<br>(0.0878)    |
| Lshare       | 0.0311***<br>(0.0077) | 0.0593***<br>(0.0150) | 0.0360<br>(0.0189)    | 0.0523<br>(0.0276)    | 0.0269<br>(0.0344)    |
| Lhhi         | 0.1764<br>(0.1225)    | 0.0725<br>(0.1191)    | 0.2432<br>(0.1467)    | -0.0515<br>(0.1483)   | 0.0244<br>(0.1364)    |
| Switches     | -0.0211<br>(0.0191)   | -0.1064**<br>(0.0359) | -0.0671<br>(0.0379)   | -0.1410*<br>(0.0582)  | -0.0391<br>(0.0726)   |
| export_oxera | 0.2119***<br>(0.0422) | 0.0000<br>(.)         |                       |                       |                       |
| Mergers      | 0.0017<br>(0.0062)    | 0.0541*<br>(0.0248)   | 0.0152<br>(0.0092)    | 0.0374<br>(0.0232)    | -0.0430<br>(0.0220)   |
| Export       |                       |                       | 0.1269*<br>(0.0554)   | -0.0660<br>(0.1094)   |                       |
| Lassets      |                       |                       |                       |                       | 0.3745***<br>(0.0677) |
| Lde          |                       |                       |                       |                       | 0.0109<br>(0.0173)    |
| Loss         |                       |                       |                       |                       | 0.0634*<br>(0.0285)   |
| Lrecv        |                       |                       |                       |                       | 0.0549<br>(0.0354)    |
| Linv         |                       |                       |                       |                       | 0.0023<br>(0.0113)    |
| N            | 1697                  | 1697                  | 627                   | 627                   | 1425                  |
| N_g          | 250.0000              | 250.0000              | 152.0000              | 152.0000              | 332.0000              |
| F            |                       | 43.1241               |                       | 35.9573               |                       |
| chi2         | 2.07e+04              |                       | 2864.4369             |                       | 204.5340              |

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

We have conducted diagnostic tests to confirm the robustness of our model specifications (equation five in Tables 5 and 6 above).

Consistency of the Arellano-Bond estimator requires that the residuals are not serially correlated and that the instruments used to identify the parameter estimates (essentially lagged audit fees in t-2 backwards) are not correlated with the error term of the model. Both of these requirements have been tested using the following methods:

- a. Arellano-Bond test for autocorrelation;
- b. Sargan test of over-identifying restrictions.

The results of these tests suggest that the Arellano-Bond method is a consistent estimator for the parameters in the regression model. Further details of the tests are provided in Appendix 1.

The dynamic panel data model makes a few assumptions on the structure of the variance/covariance of the error term – in particular this is assumed to be homoskedastic. If the true error term exhibits heteroskedasticity and autocorrelation across firms, then the usual estimate of the standards errors will be wrong.<sup>29</sup> As such, it is common to use an estimator of the standard errors that is “robust” to arbitrary heteroskedasticity and autocorrelation, and this is what we have done (for all models presented above).

<sup>29</sup> If this is the case then the calculated z values will also be wrong and this will affect our interpretation of regression coefficients, leading to false conclusions.

We note that the inclusion of a lagged dependent variable and a time specific dummy variable in the Arellano-Bond estimator may lead to a biased standard error due to the high level of collinearity, given the relatively small time sample. As such, to confirm the validity of our results, we have also estimated the standard-errors using the paired boot-strap method. The parameter estimates and boot-strap standard errors are set out in Table 7. The results presented here exclude the parameter estimates of the dummy-variables (see Appendix 2 for the full results).

Table 7 shows that the bootstrapped standard errors are broadly similar to the robust standard errors, with the exception that the merger variable is now significant based on these standard-error estimates. Market share and HHI remain insignificant in this specification. Thus, using bootstrapped standard errors confirms the consistency and robustness of our model.

**Table 7. Estimates of Deloitte model (excluding outliers) with bootstrapped standard errors**

|          | (6)<br>DT             |
|----------|-----------------------|
| L.fee    | 0.4002***<br>(0.1177) |
| lsales   | 0.1440<br>(0.0962)    |
| lshare   | 0.0269<br>(0.0294)    |
| lhi      | 0.0244<br>(0.1176)    |
| switches | -0.0391<br>(0.0640)   |
| mergers  | -0.0430*<br>(0.0207)  |
| lassets  | 0.3745***<br>(0.0660) |
| Lde      | 0.0109<br>(0.0159)    |
| loss     | 0.0634*<br>(0.0259)   |
| lrecv    | 0.0549<br>(0.0345)    |
| linv     | 0.0023<br>(0.0104)    |
| N        | 1667                  |
| N_g      | 372.0000              |
| F        |                       |
| chi2     | 338.4783              |

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 5. Conclusions

This report has investigated the validity of the original conclusions of Oxera, later supported by the OFT, that there has been a positive causal relationship between market concentration and audit fees in the UK audit market in recent years. It is evident from the analysis presented in this note that these results are not robust due to both the poor quality of the dataset employed and serious errors in the econometric analysis performed.

Oxera base their findings on the FAME dataset. Through analysis and cross checking of a more recent version of a FAME dataset sample we have found the data to be incomplete and in some cases erroneous. Upward biases in the recording of audit fees by FAME are of particular concern. The poor quality and unreliability of this data would lead to inconsistent estimates of the effects of share, HHI and other variables in the econometric model, due to data measurement error. Notwithstanding the other empirical issues identified in this report, this alone is reason enough to call the Oxera analysis into question.

Most concerning is that the econometric model specified by Oxera suffers from fundamental technical errors. As the previous year's audit fee was included in the model, it was incorrect to have used either the fixed or random effects approaches. The Oxera and OFT models also failed to incorporate sufficient variables to capture the impact of audit risk and complexity which we found to be significant.

After replicating the Oxera model with an improved specification and appropriate methodology, we have found that the estimated effects of market share and market concentration do not significantly differ from zero. This refutes the claim by the OFT that there is a positive relationship between higher market concentration and audit fees.

# Appendix 1: Econometric models

The purpose of this appendix is to provide a more comprehensive overview of the econometric models that we have estimated to support our evaluation of the Oxera pricing analysis.

As discussed in the previous sections, the reliability of the FAME dataset that Oxera and the OFT have used is questionable. Whilst we have undertaken a data collection exercise to improve the data quality measurement error may still be present in the data. Taking this into account we have estimated each of the models twice, once with and once without including outliers. Outliers have been identified using the same method as the OFT in the econometric analysis that was undertaken to support their consultation document. Any value that is more than two inter-quartile ranges above the upper or below the lower quartile is excluded from the data sample.

All price sensitive data (i.e. audit fees, turnover, exports, assets, accounts receivable and inventory) have been inflation adjusted to 2002 prices.

Table 8 provides a description of each of the models that have been referred to in previous sections of this report including the replication of the original Oxera and OFT models and an updated Deloitte specification.

**Table 8. Overview of econometric models**

| Model          | Description   | Reference   |
|----------------|---|---|
| Oxera Model    | <ul style="list-style-type: none"> <li>Replication of the model originally specified by Oxera. Independent variables include: log of lagged audit fee, log of turnover, log of market share, log of industry HHI, cumulative switches, exports (Oxera definition), mergers (defined as &gt;40% increase in turnover), market index dummies, time dummies and industry dummies.</li> <li>All markets included in data: FTSE 350, FTSE Fledgling. FTSE Small Cap, Private companies.</li> <li>The Export_Oxera variable is defined as international turnover as a ratio of total turnover for 2010, consistent with the OFT update of the Oxera model.</li> <li>Due to the inclusion of the lagged dependent variable the estimators produced by the Oxera model under random and fixed effects are inconsistent.</li> </ul>  | (1) Oxera_RE, random effects<br>(2) Oxera_FE, fixed effects |
| OFT Model      | <ul style="list-style-type: none"> <li>Replication of the OFTs update of the Oxera model. Independent variables include: log of lagged audit fee, log of turnover, log of market share, log of industry HHI, cumulative switches, exports, mergers (defined as &gt;40% increase in turnover), market index dummies, time dummies and industry dummies.</li> <li>Data sample includes FTSE 350 only.</li> <li>The Export variable is defined as international turnover as a ratio of total turnover for each year not 2010 only as in the Oxera model.</li> <li>Due to the inclusion of the lagged dependent variable the estimators produced by the OFT model under random and fixed effects are inconsistent.</li> </ul>   | (3) OFT_RE, random effects<br>(4) OFT_FE, fixed effects     |
| Deloitte Model | <ul style="list-style-type: none"> <li>The Deloitte model is based on the Oxera model but includes further explanatory variables. Parameters are estimated using the Arellano-Bond method to prevent inconsistency.</li> <li>Independent variables include: log of lagged audit fee, log of turnover, log of market share, log of industry HHI, cumulative switches, mergers (defined as &gt;10% increase in turnover), and time period dummies. Additionally log of total assets, log of ratio of accounts receivable to total assets, log of inventory and a loss indicator have been included as measures of audit complexity and risk.</li> <li>All markets are included in the data: FTSE 350, FTSE Fledgling. FTSE Small Cap, Private companies but market dummies are not.</li> <li>An Export variable is not included in the Deloitte model due to lack of reliable data.</li> <li>Industry dummies are not included in the Deloitte model as time invariant variables cannot be identified with the Arellano-Bond method.</li> </ul> | (5) DT, Arellano-Bond                                       |

## Model Testing

The specification of the Deloitte model was tested to ensure that the Arellano-Bond estimator produces consistent and reliable results. In particular, the following tests were carried out:

- The Arellano-Bond test for autocorrelation; and
- The Sargan test of over-identifying restrictions.

The Arellano Bond test for autocorrelation of the error term has a null-hypothesis of no autocorrelation, and is applied to the differenced residuals of the model. The test focuses on second or higher order autocorrelation<sup>30</sup> and examines the significance of the correlation between the differenced residuals in the current period, and two periods before. If autocorrelation is present in the errors, then the Arellano-Bond estimator is no longer consistent for the parameters of the model, hence the importance of considering this specification test. The results of the test are set out in Table 9 below, and as indicated by the p-values, there is no statistical evidence of autocorrelation in the errors

Consistency of the Arellano-Bond estimator also relies (as per all GMM methods) on the assumption that the instruments are exogenous. That is they should not be included in the model as extra variables (e.g. a second or third lag of audit fees) and are also uncorrelated with the error term. This assumption can be tested using the Sargan-test of over-identifying restrictions, and is again a function of the estimated residuals. The results of the Sargan test are set out in Table 10. Examination of the p-values shows that we do not reject the null hypothesis that the instruments are exogenous and conclude that the Arellano Bond estimator is consistent for the parameters.

**Table 9. Results of Arellano-Bond test for autocorrelation**

| Order | z statistic | Prob > z |
|-------|-------------|----------|
| 1     | -3.7289     | 0.0002   |
| 2     | 0.13548     | 0.8922   |

**Table 10. Results of the Sargan test of over-identifying restrictions**

|           |          |
|-----------|----------|
| Chi2(27)  | 18.74384 |
| Prob > ch | 2 0.8791 |

<sup>30</sup> Note that first order or AR(1) type autocorrelation will reject by definition, due to the error being in first differences. This is not a cause for concern.

# Appendix 2: Regression results

This appendix presents the full results of the regressions which we have run, including parameter estimates for all dummy variables.

Using an updated data set, we have re-estimated the Oxera and OFT models using the (inconsistent) fixed effects and random effects techniques. A further specification as adapted by Deloitte (DT model) which also includes the lagged (log) audit fee was estimated using the consistent Arellano-Bond method. The parameter estimates of these models using the full-sample (i.e. without excluding outliers) are presented in Table 11 below. In our model, no measure of concentration (neither market share nor HHI) has significant explanatory power.

**Table 11. Estimates of Oxera, OFT and Deloitte models (including outliers) – full form**

|              | (1)                    | (2)                   | (3)                   | (4)                   | (5)                 |
|--------------|------------------------|-----------------------|-----------------------|-----------------------|---------------------|
|              | Oxera_RE               | Oxera_FE              | OFT_RE                | OFT_FE                | DT                  |
| L.fee        | 0.7648***<br>(0.0272)  | 0.3436***<br>(0.0487) | 0.7746***<br>(0.0373) | 0.4974***<br>(0.0453) | 0.2129*<br>(0.0872) |
| lsales       | 0.1126***<br>(0.0143)  | 0.1861**<br>(0.0710)  | 0.1229***<br>(0.0232) | 0.2165**<br>(0.0759)  | 0.1659*<br>(0.0704) |
| lshare       | 0.0302***<br>(0.0074)  | 0.0622***<br>(0.0152) | 0.0413*<br>(0.0181)   | 0.0649<br>(0.0330)    | 0.0362<br>(0.0337)  |
| lhhi         | 0.2131<br>(0.1154)     | 0.1390<br>(0.1182)    | 0.2486<br>(0.1406)    | 0.0801<br>(0.1550)    | 0.0402<br>(0.1116)  |
| switches     | -0.0190<br>(0.0190)    | -0.0961**<br>(0.0351) | -0.0344<br>(0.0372)   | -0.1314*<br>(0.0598)  | -0.0812<br>(0.0640) |
| export_oxera | 0.2245***<br>(0.0404)  | 0.0000<br>(.)         |                       |                       |                     |
| mergers      | -0.0000<br>(0.0058)    | 0.0488*<br>(0.0228)   | 0.0142<br>(0.0081)    | 0.0321<br>(0.0205)    | -0.0296<br>(0.0184) |
| mdum_sc      | -0.0622**<br>(0.0203)  |                       |                       |                       |                     |
| mdum_f       | -0.1091**<br>(0.0337)  |                       |                       |                       |                     |
| mdum_p       | -0.0931*<br>(0.0427)   |                       |                       |                       |                     |
| sdum1        | -0.0893<br>(0.0655)    |                       | 0.0134<br>(0.0822)    |                       |                     |
| sdum2        | 0.1065<br>(0.0887)     |                       | 0.1102<br>(0.1124)    |                       |                     |
| sdum3        | -0.1091*<br>(0.0503)   |                       | 0.0008<br>(0.0668)    |                       |                     |
| sdum4        | -0.1169*<br>(0.0486)   |                       | -0.0757<br>(0.0715)   |                       |                     |
| sdum5        | -0.2023*<br>(0.0809)   |                       | -0.1940<br>(0.1128)   |                       |                     |
| sdum6        | -0.0227<br>(0.0552)    |                       | 0.0414<br>(0.0619)    |                       |                     |
| sdum7        | 0.2224***<br>(0.0672)  |                       | 0.1434<br>(0.1029)    |                       |                     |
| sdum8        | -0.2069***<br>(0.0593) |                       | -0.1598*<br>(0.0762)  |                       |                     |
| sdum9        | -0.0915<br>(0.0486)    |                       | 0.0429<br>(0.0614)    |                       |                     |
| sdum10       | -0.1448<br>(0.0983)    |                       | -0.1655<br>(0.1404)   |                       |                     |
| sdum11       | 0.0162<br>(0.0613)     |                       | 0.0968<br>(0.0803)    |                       |                     |
| sdum12       | -0.0921<br>(0.0568)    |                       | -0.0180<br>(0.0656)   |                       |                     |
| tdum3        | 0.0408<br>(0.0284)     | 0.0387<br>(0.0454)    | 0.0929*<br>(0.0376)   | 0.0990*<br>(0.0411)   | -0.0424<br>(0.0517) |
| tdum4        | 0.0413<br>(0.0250)     | 0.0648<br>(0.0398)    | 0.0838**<br>(0.0320)  | 0.1161**<br>(0.0367)  | -0.0264<br>(0.0437) |

|          | (1)                 | (2)                   | (3)                 | (4)                 | (5)                   |
|----------|---------------------|-----------------------|---------------------|---------------------|-----------------------|
|          | Oxera_RE            | Oxera_FE              | OFT_RE              | OFT_FE              | DT                    |
| tdum5    | -0.0015<br>(0.0327) | 0.0331<br>(0.0354)    | 0.0260<br>(0.0354)  | 0.0828*<br>(0.0380) | -0.0027<br>(0.0354)   |
| tdum6    | 0.0546<br>(0.0312)  | 0.0706*<br>(0.0281)   | 0.0606<br>(0.0387)  | 0.0968*<br>(0.0473) | -0.0110<br>(0.0270)   |
| tdum7    | 0.0586<br>(0.0307)  | 0.0832***<br>(0.0240) | 0.0610<br>(0.0350)  | 0.0851*<br>(0.0429) | 0.0023<br>(0.0209)    |
| tdum8    | -0.0321<br>(0.0312) | 0.0264<br>(0.0165)    | -0.0203<br>(0.0387) | 0.0366<br>(0.0521)  | -0.0005<br>(0.0147)   |
| tdum9    | -0.0257<br>(0.0327) | 0.0000<br>(.)         | -0.0543<br>(0.0420) | -0.0209<br>(0.0514) |                       |
| tdum2    |                     | -0.0117<br>(0.0520)   |                     | 0.0000<br>(.)       | -0.0875<br>(0.0563)   |
| export   |                     |                       | 0.1117*<br>(0.0504) | -0.0561<br>(0.1188) |                       |
| mdum_250 |                     |                       | -0.0174<br>(0.0345) |                     |                       |
| lassets  |                     |                       |                     |                     | 0.3772***<br>(0.0544) |
| lde      |                     |                       |                     |                     | 0.0348*<br>(0.0167)   |
| loss     |                     |                       |                     |                     | 0.0586*<br>(0.0233)   |
| lrecv    |                     |                       |                     |                     | 0.0288<br>(0.0301)    |
| linv     |                     |                       |                     |                     | 0.0030<br>(0.0096)    |
| N        | 1952                | 1952                  | 829                 | 829                 | 1667                  |
| N_g      | 274.0000            | 274.0000              | 191.0000            | 191.0000            | 372.0000              |
| F        |                     | 47.6952               |                     | 47.1782             |                       |
| chi2     | 3.50e+04            |                       | 7681.8426           |                     | 338.4783              |

Standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

The same set of five models has been re-run after excluding outliers from the dataset. These results are set out in Table 12 below. As a result of excluding outliers the turnover and gearing variables are no longer significant in the DT model and instead the only significant estimates are those for lagged audit fee, total assets and loss. The market concentration variables remain insignificant in this version of the DT specification.

**Table 12. Estimates of Oxera, OFT and Deloitte models (excluding outliers) – full form**

|              | (1)<br>Oxera_RE        | (2)<br>Oxera_FE       | (3)<br>OFT_RE         | (4)<br>OFT_FE         | (5)<br>DT            |
|--------------|------------------------|-----------------------|-----------------------|-----------------------|----------------------|
| L.lfee       | 0.7536***<br>(0.0309)  | 0.3190***<br>(0.0521) | 0.7233***<br>(0.0489) | 0.4720***<br>(0.0469) | 0.4002**<br>(0.1345) |
| lsales       | 0.1012***<br>(0.0146)  | 0.1878*<br>(0.0750)   | 0.1311***<br>(0.0267) | 0.2225*<br>(0.0864)   | 0.1440<br>(0.0878)   |
| lshare       | 0.0311***<br>(0.0077)  | 0.0593***<br>(0.0150) | 0.0360<br>(0.0189)    | 0.0523<br>(0.0276)    | 0.0269<br>(0.0344)   |
| lhhi         | 0.1764<br>(0.1225)     | 0.0725<br>(0.1191)    | 0.2432<br>(0.1467)    | -0.0515<br>(0.1483)   | 0.0244<br>(0.1364)   |
| switches     | -0.0211<br>(0.0191)    | -0.1064**<br>(0.0359) | -0.0671<br>(0.0379)   | -0.1410*<br>(0.0582)  | -0.0391<br>(0.0726)  |
| export_oxera | 0.2119***<br>(0.0422)  | 0.0000<br>(.)         |                       |                       |                      |
| mergers      | 0.0017<br>(0.0062)     | 0.0541*<br>(0.0248)   | 0.0152<br>(0.0092)    | 0.0374<br>(0.0232)    | -0.0430<br>(0.0220)  |
| mdum_sc      | -0.0589**<br>(0.0197)  |                       |                       |                       |                      |
| mdum_f       | -0.1295***<br>(0.0359) |                       |                       |                       |                      |
| mdum_p       | -0.0857*<br>(0.0419)   |                       |                       |                       |                      |
| sdum1        | -0.0761<br>(0.0761)    |                       | 0.0914<br>(0.0898)    |                       |                      |
| sdum2        | 0.0837<br>(0.0946)     |                       | 0.1934<br>(0.1356)    |                       |                      |
| sdum3        | -0.1139<br>(0.0624)    |                       | 0.0326<br>(0.0747)    |                       |                      |
| sdum4        | -0.1187*<br>(0.0573)   |                       | -0.0147<br>(0.0802)   |                       |                      |
| sdum5        | -0.2252*<br>(0.0922)   |                       | -0.1485<br>(0.1214)   |                       |                      |
| sdum6        | -0.0344<br>(0.0650)    |                       | 0.1039<br>(0.0730)    |                       |                      |
| sdum7        | 0.2229**<br>(0.0747)   |                       | 0.2826***<br>(0.0854) |                       |                      |
| sdum8        | -0.1954**<br>(0.0682)  |                       | -0.1483<br>(0.0889)   |                       |                      |
| sdum9        | -0.1024<br>(0.0609)    |                       | 0.0847<br>(0.0724)    |                       |                      |
| sdum10       | -0.1668<br>(0.1107)    |                       | -0.1225<br>(0.1444)   |                       |                      |
| sdum11       | 0.0165<br>(0.0686)     |                       | 0.1826*<br>(0.0875)   |                       |                      |
| sdum12       | -0.0914<br>(0.0678)    |                       | 0.0587<br>(0.0775)    |                       |                      |
| tdum2        | 0.0211<br>(0.0353)     | 0.0000<br>(.)         |                       | 0.0000<br>(.)         |                      |
| tdum3        | 0.0784*<br>(0.0311)    | 0.0577*<br>(0.0258)   | 0.0847*<br>(0.0399)   | 0.0683<br>(0.0425)    | 0.0132<br>(0.0231)   |
| tdum4        | 0.0785**<br>(0.0278)   | 0.0866**<br>(0.0266)  | 0.0980**<br>(0.0339)  | 0.0956*<br>(0.0367)   | 0.0178<br>(0.0336)   |
| tdum5        | 0.0253<br>(0.0331)     | 0.0471<br>(0.0355)    | 0.0129<br>(0.0389)    | 0.0419<br>(0.0381)    | 0.0137<br>(0.0475)   |
| tdum6        | 0.0826**<br>(0.0277)   | 0.0845*<br>(0.0401)   | 0.0699<br>(0.0400)    | 0.0599<br>(0.0475)    | 0.0064<br>(0.0481)   |
| tdum7        | 0.0885***<br>(0.0247)  | 0.1019*<br>(0.0454)   | 0.0476<br>(0.0379)    | 0.0306<br>(0.0438)    | 0.0148<br>(0.0603)   |
| tdum8        | -0.0146<br>(0.0232)    | 0.0344<br>(0.0515)    | -0.0294<br>(0.0403)   | -0.0166<br>(0.0525)   | -0.0018<br>(0.0691)  |

|          | (1)      | (2)                | (3)                 | (4)                 | (5)                   |
|----------|----------|--------------------|---------------------|---------------------|-----------------------|
|          | Oxera_RE | Oxera_FE           | OFT_RE              | OFT_FE              | DT                    |
| tdum9    |          | 0.0084<br>(0.0572) | -0.0668<br>(0.0467) | -0.0819<br>(0.0560) | 0.0121<br>(0.0700)    |
| export   |          |                    | 0.1269*<br>(0.0554) | -0.0660<br>(0.1094) |                       |
| mdum_250 |          |                    | 0.0197<br>(0.0443)  |                     |                       |
| lassets  |          |                    |                     |                     | 0.3745***<br>(0.0677) |
| lde      |          |                    |                     |                     | 0.0109<br>(0.0173)    |
| loss     |          |                    |                     |                     | 0.0634*<br>(0.0285)   |
| lrecv    |          |                    |                     |                     | 0.0549<br>(0.0354)    |
| linv     |          |                    |                     |                     | 0.0023<br>(0.0113)    |
| N        | 1697     | 1697               | 627                 | 627                 | 1425                  |
| N_g      | 250.0000 | 250.0000           | 152.0000            | 152.0000            | 332.0000              |
| F        |          | 43.1241            |                     | 35.9573             |                       |
| chi2     | 2.07e+04 |                    | 2864.4369           |                     | 204.5340              |

Standard errors in parentheses  
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

The standard-errors of the coefficients for equation 5 above were also estimated using the paired boot-strap method. This is an alternative way to obtain panel-robust standard errors, and these are computed by re-estimating the model on a sample of the same size, drawn at random with replacement over companies. It is asymptotically equivalent to the robust standard errors, but it is a useful way to verify and compare the results previously reported. The estimates of the standard errors using the boot-strap method are set out in Table 13. These broadly correspond to the robust estimates, with the exception that the merger variable is now significant based on these standard-error estimates.

Table 13. Estimates of Deloitte model (excluding outliers) with bootstrapped standard errors – full form

|          | (6)                   |
|----------|-----------------------|
|          | DT                    |
| L.fee    | 0.4002***<br>(0.1177) |
| lsales   | 0.1440<br>(0.0962)    |
| lshare   | 0.0269<br>(0.0294)    |
| lhhi     | 0.0244<br>(0.1176)    |
| switches | -0.0391<br>(0.0640)   |
| mergers  | -0.0430*<br>(0.0207)  |
| tdum3    | 0.0132<br>(0.0606)    |
| tdum4    | 0.0178<br>(0.0549)    |
| tdum5    | 0.0137<br>(0.0464)    |
| tdum6    | 0.0064<br>(0.0351)    |
| tdum7    | 0.0148<br>(0.0289)    |
| tdum8    | -0.0018<br>(0.0220)   |
| tdum9    | 0.0121<br>(0.0173)    |
| lassets  | 0.3745***<br>(0.0660) |
| lde      | 0.0109<br>(0.0159)    |
| loss     | 0.0634*<br>(0.0259)   |
| lrecv    | 0.0549<br>(0.0345)    |
| linv     | 0.0023<br>(0.0104)    |
| N        | 1425                  |
| N_g      | 332.0000              |
| F        |                       |
| chi2     | 204.5340              |

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

# Appendix 3: References

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# Notes

# Notes



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