PRICEWATERHOUSECOOPERS

Competition and choice in the UK audit market – a review of the Oxera report

August 2006

Contents

1 Executive Summary

Introduction

1.1 Following the demise of Arthur Andersen, when the big 5 audit firms became the big 4, concerns have frequently been raised about a possible lack of competition and choice in the UK audit market. As a response to this, the Department of Trade and Industry (DTI) and the Financial Reporting Council (FRC) commissioned Oxera to carry out a study of competition and choice in the UK audit market. One of the main issues that Oxera hoped to consider was the likely impact on competition if market concentration increased further, and, in particular, if the big 4 became the big 3.

1.2 To address this and other questions Oxera conducted a series of interviews with market participants. In addition, Oxera developed an econometric model which sought to determine the extent to which increases in audit market concentration result in higher audit fees.

1.3 The aim of this report is to provide a review of the econometric model within the Oxera study – we do not provide a review of the study as a whole. We first consider the appropriateness of their general approach from an economic perspective. Secondly, we carry out a technical review of their econometric modelling. We are able to comment on Oxera's approach simply by examining their reported modelling and critically interpreting this from the perspective of good econometric practice and previous studies of the audit market.

1.4 This analysis by itself raises a number of serious problems with Oxera's analysis which appear to undermine their conclusions. However, in order to quantify the implications of these problems it is necessary to adjust the econometric models used. We were denied access to Oxera's dataset and were thus forced to attempt to replicate their results by compiling our own dataset and model. This allows us to correct for the identified errors in Oxera's model, to carry out appropriate robustness checks, and to identify the key factors that appear to drive Oxera's results. However, whilst our dataset and model are very similar to those of Oxera, they are not identical, and therefore we cannot be certain that the same results would be obtained if similar changes were made to Oxera's own model. The results drawn from our model are necessarily indicative therefore rather than definitive, but this affects only our quantification of the effects of correcting for identified problems; it does not undermine the identification of the problems themselves.

1.5 Based on both our review of their general approach and of the technical quality of the econometrics we then critically appraise the interpretations Oxera have drawn from their study.

Findings and conclusions

1.6 Our review identified a series of very significant problems with Oxera's econometric modelling, which, we believe, undermine the conclusions reached in the study. We conclude that the evidence does not appear to support the various findings of Oxera, most notably that the merger of Price Waterhouse (PW) and Coopers & Lybrand (C&L) to create PricewaterhouseCoopers (PwC) was likely to have led to a 12% increase in prices.

1.7 Our key findings are:

Observations on Oxera's general approach

- Oxera's use of a price-concentration model may be capable of identifying a *correlation* between concentration and price but cannot demonstrate that the *causality* runs from higher concentration to higher prices. For example, such a correlation is also fully consistent with a market where there is severe competitive pressures on non-price factors (e.g. the pressure to improve quality) leading both to higher concentration and higher prices.

- Such a model is not designed to predict the likely impact on competition and prices of a specific merger or exit of a firm.

- The inclusion of both individual market share and the HHI as explanatory variables in Oxera's model is not, as is stated in the Oxera report, fully consistent either with economic theory or previous academic studies in this area.

Technical review of Oxera's econometric modelling

- Oxera make mistakes in constructing their model.

    - The inclusion of the lagged audit fee in their preferred specification is erroneously carried out using levels rather than the log form used for all the other variables.

    - Oxera's calculation of the market share variable has introduced a problem of endogeneity whereby audit fee effectively appears on both sides of the equation. This imposes a correlation regardless of whether there is in fact any behavioural relationship between market share and audit fee and therefore biases their results.

- Oxera's analysis fails to control adequately for omitted variables.

    - Oxera's use of a limited number of dummy variables effectively assumes that increases in regulation and quality over time have been even across sectors.

    - Their approach fails to deal with the impact of increased restrictions on the joint provision of non-audit services.

    - Oxera's approach to testing for omitted variables bias is flawed.

- Oxera's robustness analysis is flawed and incomplete.

    - The flawed way in which the lagged dependent variable is included undermines the conclusion that coefficients are stable across different specifications of their model. It also undermines their conclusion that there is no evidence of autocorrelation.

    - Oxera draw the wrong conclusion from their stepwise comparison robustness test.

- Oxera do not carry out standard technical robustness tests. For indicative purposes, when these are carried out on our version of Oxera's model, they show strong evidence of fatal weaknesses (non-linearity, omitted variables and autocorrelation).

Interpretation of Oxera's analysis

- Oxera have not applied their own model in a consistent manner in performing their simulation of the effects of the PW/C&L merger on audit fees. Adjusting for this, a more consistent application of Oxera's own model predicts price increases significantly lower than the 12% reported by Oxera.

- When compared to what actually happened to audit fees, Oxera's predictions are not even directionally correct. Our analysis suggests that the audit fees charged by PwC after the merger of PW and C&L were on average slightly *lower* than those charged by the two firms separately prior to the merger. This is inconsistent with Oxera's predictions but entirely consistent with the fact that the merger led to PwC increasing its market share (which Oxera's model does not predict).

- We have misgivings about Oxera's view that their findings are also consistent with the academic literature. We carried out a more extensive review of the literature than that reported by Oxera and in the academic literature that we reviewed there appears to be very little consensus on whether audit mergers raise prices.

1.8 In the light of these findings our conclusion is that Oxera's econometric analysis is unreliable and the results of their modelling should not form the basis either for any conclusions regarding the past evolution of the UK audit market or for determining future policymaking.

Oxera's findings

1.9 The main findings of Oxera's econometric analysis are:

- Audit fees have increased over time, although audit fee as a proportion of turnover has declined.

- Audit fees, on average (and controlling for other factors) are higher in more concentrated markets, as measured by the HHI[1].

- Individual audit firms, on average (and controlling for other factors), charge higher audit fees in markets where they have a higher market share.

- Other factors, including regulation and changes in quality, have contributed to the observed increase in audit fees over time.

- On average the big 4 is able to command an 18% premium over other audit firms.

[1] The HHI (Herfindahl-Hirschman Index) is simply the sum of the market shares squared. For example, in a duopoly, where two firms have a market share of 50% each, the HHI = (50*50) + (50*50) = 5000, whilst for a single firm monopoly the HHI = (100*100) = 10000. The more concentrated the market, the higher is the HHI.

- Clients that switch more frequently pay lower audit fees on average.

1.10 Oxera also report that these findings are statistically significant, and are robust to changes in model specification (e.g. using audit fee as a proportion of turnover rather than audit fee as a measure of the price of an audit).

1.11 The observed positive correlation of prices with both market concentration and market share is clearly potentially the most important finding. To illustrate the significance of this correlation Oxera analyse two scenarios for increased concentration. They first examine what their model implies for the impact on prices of the historic merger between PW and C&L and conclude that:

"Oxera's model indicates that the PwC merger led to a price increase which could have been in the order of around 12% from one year to the next – 8% for the market as a whole and another 4% for the clients of the merged entity" (page v).

1.12 The second scenario analysed was a hypothetical future exit of one of the existing big 4 players (KPMG). Based on Oxera's model, this would be expected to lead to a 7% price increase for the remaining big 3 players, and 5.5% for the remainder of the audit industry.

1.13 Oxera conclude that *"competition is not working as well as it would with a greater number of competitors in the markets for auditing FTSE 100 and FTSE 250 companies"* (page vi). The clear implication is that the positive correlation between concentration and price that they find is caused by a direct relationship between market structure and the intensity of competition. Specifically, Oxera appear to suggest that a reduced number of audit firms equates to reduced intensity of competition which in turn leads to higher prices.

Observations on Oxera's general approach

1.14 Our review of Oxera's analysis begins with their overall approach to the remit set by the DTI and FRC, and, in particular, their decision to employ what is essentially a price-concentration econometric model. Whilst price-concentration models have intuitive appeal, these models can only tell us if there is a *correlation* between concentration and price – they cannot tell us in which direction the causality runs. More fundamentally, they are incapable of answering the key questions as to whether the audit market is sufficiently competitive, or whether market concentration has reached, or is approaching, the level at which further increases in market concentration are likely to have a damaging effect on competition. Moreover they do not account adequately for non-price factors (such as quality) and are consequently unable to reflect the reality that in many markets too little concentration can be as damaging for consumers as too much.

1.15 In our view Oxera has paid too little attention to the factors that have driven the increase in market concentration over the years. Although audit fees and concentration have both risen, non-price competition has also intensified as auditors have competed to meet clients' demands for higher quality in the face of greater awareness about risk and regulation, and the greater complexity of clients' businesses in an increasingly global and IT based economy. As Oxera themselves note, the minimum efficient scale of providing high quality audit services in this market has increased over time, which inevitably brings pressures for increased concentration in an industry.

1.16 Modern industrial economic theory predicts that in markets where non-price competition is effective in winning market share, markets can become increasingly concentrated as firms

compete by escalating their expenditure on product quality, and prices rise to enable the higher costs to be recovered. More generally, markets may become more concentrated as firms compete to deliver economies of scale (which Oxera acknowledge are a feature of the audit market). So, in these types of markets, increased concentration is associated with an increase in price, but also with an *increase* in competition.

1.17 Furthermore, the audit market is essentially a bidding market, in that audit firms essentially take part in an auction to secure the audit contract. In these types of markets competition is typically very intensive, and 2 or 3 firms in a market will often be sufficient to ensure that there is effective competition[2]. The HHI is a poor indicator of competitive pressure in a bidding market as competition depends much more on the number of effective competitors in a market than on their market shares. This makes it difficult to interpret any observed relationship between price and the HHI.

1.18 The inclusion of both market share and HHI as explanatory variables adds to the difficulties in interpretation. The HHI is most often used in markets where the product or services are relatively homogeneous and firms charge similar prices, whereas a market share premium is associated with markets where there are important quality differences between firms. Essentially, the two variables are associated with very different oligopoly models. By combining the HHI and market share, Oxera has adopted a model that is not consistent with any particular theory of oligopoly behaviour.

1.19 In addition, Oxera's market shares are based on 12 market segments. The intuition behind their approach is that an audit firm's share of audit client fees in a particular segment reflects its sector expertise, for which there is a possibility of extracting a fee premium. Whilst sector expertise is undoubtedly a factor in client choice, the use of only 12 market segments for the entire UK economy means that each sector is drawn far too widely to reflect the kind of individual sector expertise that clients seek.

1.20 Finally, price-concentration models are not designed to make predictions, and so cannot readily address the likely impact on competition and prices of a specific merger. The reason for this is that these models are only designed to explain what happens *on average* when concentration increases. However, the impact of a merger on prices would depend not just on the change in concentration, but also on the extent to which the merging parties overlap, and the impact of the merger on efficiencies (including quality).

Technical review of Oxera's econometric modelling

1.21 Given their choice of a price-concentration model, at first sight this appears a sound piece of econometric modelling. In particular the data set of over 7000 observations generates what appears to be a very strong and significant positive relationship between market structure (as measured by market concentration and market share) and the audit fee.

1.22 However, on closer inspection, our analysis suggests that the Oxera model is not as robust as is claimed. We have found a series of technical problems with the way in which the Oxera model has been specified which we believe has led to the impact of concentration and market share on audit fee being overstated. In particular:

- Oxera make mistakes in constructing their model.

[2] This is consistent with the evidence that clients typically only invited three companies to pitch for the audit when the market was less concentrated i.e. when the market was characterised by the big 8 or big 6.

- There are a number of important omitted variables, including quality, risk, market size, and restrictions on non-audit services, the effects of which we do not believe have been adequately controlled for by using dummy variables.

- Oxera's conclusion that their model is robust is based on flawed analysis.

1.23 Thus, our technical review suggests that Oxera's econometrics is flawed, and is not therefore sufficiently robust to support Oxera's conclusions concerning the UK audit market. In order to gauge the impact on Oxera's results of the errors we identified we also carried out some modelling of our own. Because we were denied access to Oxera's dataset, and were unable to replicate Oxera's results precisely with the dataset we compiled, the results of our own modelling must necessarily be regarded as indicative of the practical importance of the issues we have identified in principle. With this caveat, our own modelling confirms that Oxera's econometric modelling cannot support Oxera's conclusions concerning concentration, market share and audit pricing.

Oxera make mistakes in constructing their model

1.24 Oxera commit a basic error in two of their model specifications by measuring the lagged audit fee in levels when it should have been measured in logs. Whilst this directly affects only two of the six model specifications presented by Oxera, we nevertheless believe that this error undermines the overall reliability of Oxera's econometrics for four key reasons.

1.25 First, the two specifications affected (Oxera's models III and IV in Table 5.4 on page 76) are amongst the three models on which Oxera place most emphasis[3]. In particular, model III appears to be Oxera's preferred specification, since Oxera use this model to illustrate both the predicted price impact of the PW/C&L merger and the predicted price increase associated with the big 4 becoming the big 3.

1.26 Secondly, of the four model specifications not directly affected, Oxera state that three of them (specifications I, V and VI) *"are included to confirm the robustness of the results"* in the other three (page 75). Oxera do not, therefore, attach direct importance to them. Our own analysis of these models also suggests that they are not reliable.

1.27 Thirdly, the remaining model preferred by Oxera, model II, does not include the lagged audit fee in its specification. This is contrary to Oxera's own finding that lagged audit fee is an important explanatory variable because *"Oxera has learned that the determination of audit fees for any given year (current year) is often closely related to the agreed audit fee for the last year"* (page 139).

1.28 Fourthly, the error with models III and IV casts significant doubt on the validity of model II. Whilst we cannot be absolutely certain of the effect the error has on Oxera's findings because we were not given access to their dataset, if we correct for this mistake in our own modelling, which produces very similar results to those of Oxera, we find that the coefficients for market share and especially HHI are substantially reduced. The market share coefficient falls from 0.05 to 0.028, and the HHI coefficient falls from 0.17 to 0.06[4]. This is important because it implies that, once the error has been eliminated, these coefficients differ between specifications III and IV on the one hand, and specification II on the other. Oxera state that *"under the assumption of autocorrelation, results from models with and without the lagged*

[3] Oxera state (pages 75 and 78) that "specifications II to IV in Table 5.4 are theoretically preferable".
[4] Using specification III - the model Oxera use to calculate the effects of the PW/C&L merger and the exit of one of the big 4.

dependent variable would be expected to be different" (page 150), so this raises the possibility that the model suffers from autocorrelation. When we control directly for autocorrelation in our version of Oxera's model the coefficients change, indicating that there is indeed autocorrelation present.

1.29 Oxera have also made a technical error by effectively including the audit fee on both sides of the equation (audit fee is used to compute market share as well as being the price variable). This is likely to have led to overstated estimates. For example, if an individual auditor has a single client in a sector, then there is a one-to-one relationship running from its audit fee to the market share calculated for it. The Oxera model suggests the relationship is reversed, since it is set up with audit fee being dependent on market share. It is notable that we have been unable to find any other academic research which models the relationship between market share and audit fee in this way. To explore the practical implications of this problem, we performed some indicative analysis using our own dataset, limiting the dataset only to clients of the big 4 auditors (for whom this issue is likely to be of somewhat less significance). When we did so, the market share parameter in our model was reduced significantly from 0.05 to 0.032.

Oxera have omitted key variables

1.30 The omission of key explanatory variables in any econometric model leads to biased estimates. Key variables that may drive audit fees, and may therefore have been incorrectly omitted, include quality, regulation, risk, market size, and the loss of economies of scope resulting from the prior provision of now restricted non-audit services.

1.31 Oxera's approach to this problem is to include dummy variables: one for each year and one for each sector. This structure is not sufficiently flexible to deal with different trends over time between different sectors. For example, suppose that over the period examined, regulation in the financial services sector increased more significantly than in the average sector, thus driving up the relative effort involved in audits and hence audit fees. With only a single time dummy to cover all sectors together, this differential growth in regulation and complexity would not be fully captured by the time dummy. Nor would it be captured fully in the financial services sector dummy (which is at one level for all years). The model would therefore seek to associate the observed differential growth in audit fees in financial services with other explanatory variables in the model. If there were above average increases in concentration amongst audit firms in the financial services sector then the model would erroneously ascribe the price effect of increased regulation to the change in concentration. The impact of this is even more pernicious if the increase in regulation itself causes the increase in concentration as the sector becomes more specialised and fewer firms are able to provide the requisite quality.

1.32 The impact of independence restrictions on the ability to access economies of scale and scope from joint provision of audit and non-audit services further illustrates the potential for omitted variables bias. In recent years audit firms have faced increased restrictions on their ability to sell non-audit services to audit clients. As Oxera acknowledge, this is likely to have affected audit pricing policy. It should be clear that this effect is entirely separate from changes in concentration: had the market remained unconcentrated, increased restrictions on providing non-audit services would nevertheless have influenced directly the evolution of audit pricing. It should also be clear that this will definitely impact differently on different firms depending on their mix of audit and non-audit services and of individual clients. It is unlikely, therefore, that the uniform time and sector dummies will adequately capture the effects of these factors. Indeed, it is notable that Oxera do not assert that this effect is accounted for in the time and sector dummies.

1.33 Oxera have not adequately tested for omitted variables bias. They argue that the high R^2 their model displays *"points at the fact that the variables included do indeed explain a large part of the variation in audit fees, hence suggesting that the impact of any omitted variables would not significantly affect the results" (page 140)*. This is not correct: merely considering the R^2 is not an adequate test for omitted variables. We have conducted a number of indicative tests using our own dataset and model to attempt to check whether the omitted variables are adequately controlled for by Oxera's dummy variable approach. Our conclusion from this indicative modelling is that they are not, suggesting that the Oxera model may suffer from bias.

Oxera's robustness analysis is flawed and incomplete

1.34 Oxera's statement that the results of their model are robust does not appear to stand up to close scrutiny.

1.35 Oxera's first test for robustness is to point to the similarity of the coefficients generated by different specifications of their model. However, as noted above, in two of their preferred specifications, including the specification on which they appear to place most emphasis, they commit the error of measuring the lagged audit fee in levels rather than logs (all the other variables in their equation are expressed in logs). As already noted, our indicative modelling based on our own dataset suggests that if this error is corrected the coefficients for the affected models change significantly, reversing the inference that should be drawn from this approach to testing for robustness.

1.36 Secondly, Oxera draw the wrong inference from their stepwise analysis of robustness. This test involves examining how the explanatory power of the model improves as explanatory variables are added to the model one by one. Oxera note that the size and statistical significance of the estimated coefficients does not vary greatly as additional explanatory variables are included in the equation, and conclude that the coefficient estimates are robust. In our view this is the wrong inference to draw from the stepwise test. The test should more correctly be whether adding an additional variable increases the ability to explain i.e. predict, the level of the audit fee. Looking at Oxera's own data (page 143), the R^2 statistic shows that nearly all of the variation in audit fees (72.1%) can be explained by the turnover of the firm, and the prior year's audit fee. Adding market share only explains a further 1.4%, whilst then adding the HHI actually *reduces* the explanatory power by 0.1%.

1.37 Thirdly, the functional form chosen by Oxera has not been appropriately tested. For indicative purposes we tested for this in our own model, using a general specification test (Ramsey RESET test). This strongly showed evidence of non-linearity and omitted variables. This implies that the results of our version of Oxera's model are biased.

1.38 Fourthly, Oxera have not tackled the problem of autocorrelation in the error terms (a further potential cause of bias). This is partly because they believe that inclusion of the lagged dependent variable (i.e. the previous year's audit fee) controls for this. However, as already noted, Oxera incorrectly included the lagged dependent variable in levels form rather than as a log value, thus drawing false comfort from the apparent consistency of coefficient estimates. As an indication of the possible effect of this, using our own dataset and model, when we control for autocorrelation directly, the estimated impact of concentration on audit fees falls considerably (from 0.17 to 0.10). This shows that our model suffers from autocorrelation, and this may also be a problem in the Oxera model.

Interpretation of Oxera's analysis

1.39 As discussed, fundamentally the Oxera econometric model is not designed to predict the price impact of mergers and concentrations. The model predicts the same price rise whatever the reason for the change in concentration, be it a merger (which may involve significant efficiencies), the exit of a firm or an intensification of non-price competition. As a result, such models are not very helpful in predicting the effect of changes in the market.

1.40 The inference that Oxera appear to draw from their model is that more concentration leads to higher prices due to less competition. However, such an inference implies that the presence of more audit firms would unambiguously benefit customers, which suggests the optimal market structure is atomistic competition. This is clearly incorrect as audit firms in such a market would have substantially higher unit costs, as well as being unable to deliver the quality benefits that customers demand (including global reach).

1.41 Notwithstanding this, Oxera use the model to carry out a retrospective "prediction" of the impact of the PW/C&L merger. Oxera take advantage of *"the benefit of hindsight"* (page 79), and use actual observed pre- and post-merger market shares in their dataset in order to analyse the price impact of the PW/C&L merger. This use of actual market shares is important. According to Oxera's dataset, after the merger the market share of PwC was higher at 42.2% in 1998 than was the combined market share of PW and C&L of 37.5% in 1997 (page 62). This increase in PwC's market share is actually inconsistent with Oxera's model, as the model predicts a relative price increase for PwC which would be expected to reduce PwC's market share, not increase it. Therefore we do not agree with Oxera that the calculations they have performed demonstrate *"the effects the model predicts"* (page 78) – the model would have predicted a reduced market share for PwC and this in turn would have led to lower predicted price increases.

1.42 The approach adopted by Oxera leads to a projected price rise over 2 percentage points higher than an alternative approach of assuming that the combined PW/C&L market share was maintained post-merger. Taking account of reasonable demand responses to price rises would reduce this by a further 1-2 percentage points. Separately, Oxera are inconsistent in how the HHI is calculated (using listed companies only for their projection, even though parameters were estimated using all firms). We estimate that this accounts for a further exaggeration of the price increase by 1 percentage point. We therefore believe that, even if we accept that the Oxera model is an appropriate tool for assessing the price implications of the PW/C&L merger, which for the many methodological and technical reasons already set out we do not, Oxera's estimates of the increase in fees following the PwC merger are exaggerated by 4-5 percentage points when compared to a more consistent application of their own model.

1.43 In any event, and more fundamentally, Oxera's finding is not consistent with the evidence. We examined what actually happened to audit fees and found no evidence of a price rise. Indeed, our analysis suggests that the audit fee paid by the average PwC client was actually lower in real terms in the years following the merger. On average PwC clients paid a lower audit fee in real terms in 1998, 1999 and 2000 compared to 1997 (the last full year before the PwC merger). Adjusting audit fees for the general upwards trend in turnover (using Oxera's preferred coefficient of 0.43) shows that fees were also significantly below the prices that Oxera's own model would have predicted even if it was assumed that there was no merger.

1.44 Oxera's finding is therefore inconsistent with the evidence regarding both the evolution of actual audit fees and of PwC's actual market share. Indeed the evidence is more consistent with our view of the correct direction of causality in this market i.e. increased competition on

non-price factors (particularly quality) has caused the sector to become more concentrated. Firms that provide the higher quality demanded by clients are successful and achieve increased market share. Over time, this has also resulted in higher audit fees to reflect the increased quality and scope of audits.

Consistency with the literature

1.45 Oxera make some strong statements about the consistency of their findings with the relevant academic and empirical literature. They list a number of academic studies which they say show similar results to their findings. In the time available we were unable to carry out a full and thorough review of all the relevant academic literature. However our own review found that there are many more studies in the literature than those mentioned by Oxera. Furthermore, contrary to the impression that may be formed by reading the Oxera report, amongst the papers that we considered there appears to be very little consensus regarding the impact of audit mergers on prices and how technically to test for this.

1.46 In terms of econometric techniques nearly all studies we saw use (log) audit fee as a proxy for price (consistent with Oxera). Most studies have one or more measures to proxy the complexity of the audit, which Oxera do not attempt to measure directly. In particular, a number of studies attempt to control for the risk of the audit (e.g. through the gearing ratio of the client). Again this was an area not included by Oxera. Most importantly, none of the studies we considered use both market share (as constructed by Oxera) and audit fees in a regression model.

1.47 Moreover, the literature regarding the effect of an increase in concentration on audit prices appears to be essentially inconclusive based on what we reviewed, as is the literature that explicitly investigates the PW/C&L merger. Indeed, the only paper quoted by Oxera as examining the relationship between concentration and price is deemed by Oxera to have found that *"auditors' mergers lead to increased audit fees"* (page 79) – however the same paper actually finds with regard to the PW/C&L merger that *"…audit fees fell on average after the 1997 merger between Price Waterhouse and Coopers & Lybrand."*[5]

[5] Abstract, from: McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA Auditing SIG conference 2005.

2 Oxera's findings

2.1 The Oxera study on competition and choice in the audit industry was commissioned by the DTI and the FRC in September 2005. The motivation for the report was the high level of concentration in the audit industry and a perceived lack of choice for audit clients. In particular, concerns have been raised about the lack of effective choice for FTSE 100 firms, and the implications should the big 4 become the big 3.

2.2 The main aim of the study was to provide an assessment of the effectiveness of competition in the audit market. The study examined both the current level of competition, as well as the likely impact on competition should the market become more concentrated in the future.

Approach

2.3 The Oxera report seeks to examine these issues through:

- A series of structured interviews with large firms.
- A strategic entry model, examining the likelihood of entry into the market should the big 4 become the big 3.
- An econometric model, to determine the relationship between market concentration and the price of an audit.

2.4 The three workstreams address different but complementary issues. The interviews were mainly used to gain an in-depth understanding of the nature of competition in the audit market, e.g. the importance of price versus non-price competition, how contracts are awarded, what causes audit clients to switch, and what aspects of an audit they particularly value. The interviews were also used to obtain feedback from firms about whether they believed there to be sufficient competition in the market at present, and, more generally, whether the market is working well for consumers. Information gathered from the interviews also helped Oxera in their choice of which variables to include in their strategic entry and econometric models.

2.5 The aim of the entry model was to obtain an understanding of the likely speed and extent of new entry, including expansion by mid-tier firms into the sectors currently primarily supplied by the big 4, should there be a major change in market structure, such as the exit of one of the big 4.

2.6 Finally, the econometric study aimed to provide a quantitative estimate of the extent to which audit fees are correlated with changes in the structure of the audit market and the level of concentration. The model was then used to answer the key question as to whether a further increase in market concentration would be likely to lead to a significant increase in the price of an audit.

Oxera's findings and conclusions

2.7 Oxera argue that the evidence that they have obtained indicates that there are existing competition concerns in the audit market relating to the high levels of market concentration and the lack of choice for consumers.

2.8 Oxera report their key findings as follows:

- Market concentration has increased significantly over the last 10 years, with their preferred measure of concentration, the HHI, increasing from 1762 in 1995 to 2561 in 2004.
- Controlling for other factors, this higher concentration has led to significant increases in audit fees.
- Even amongst the big 4, there is evidence that audit firms with higher market shares in a particular sector are on average able to command higher audit fees.
- Audit fees have also increased due to other factors such as the increasing complexity of conducting audits, increased risk, and the higher costs of meeting tougher regulatory standards.
- For larger audit clients in particular, the big 4 are perceived to provide a higher quality service in terms of the technical audit, value added services, and an increased ability to detect catastrophic events concerning internal financial management. This is reflected in a price premium for the big 4 estimated at an average of 18% over the period.
- Competitive tendering is limited, and switching rates are relatively low (4% per annum).
- Entry barriers are very high, and the threat of entry or expansion by mid-tier firms into the sectors currently primarily supplied by the big 4 (most notably the FTSE 100 firms) is unlikely to act as a significant constraint on current prices, or to remove wider concerns about the increase in market concentration.
- Conflicts of interest, regulation issues, and specialisation in certain sectors mean that many large firms do not currently have an effective choice of auditor. This lack of choice could be exacerbated by further increases in market concentration.

2.9 Oxera use their econometric model to estimate how a change in market structure, and in particular an increase in market concentration, impact on the audit fee. The following two estimates are made:

- According to Oxera's model, the merger between PW and C&L led to an average increase in PwC prices of 12%, and 8% for other auditors.
- The future exit of KPMG would be expected to lead to a 7% price increase for the new big 3, and 5.5% for the remainder of the audit industry.

2.10 In light of this Oxera conclude as follows:

"….higher concentration has led to higher audit fees (in line with economic theory and several other recent empirical studies)" (page i).

"competition is not working as well as it would with a greater number of competitors in the markets for auditing FTSE 100 and FTSE 250 companies" (page vi).

2.11 A further specific conclusion that can be found in the Oxera report is that:

> "a limited *number of UK-listed companies, primarily in the financial services sector of the FTSE 100, have no effective choice of auditor in the short run. This elimination of choice is driven by high market concentration, auditor independence rules, supply-side constraints, and the need for sector expertise"* (page i)

2.12 These conclusions depend to a significant degree on Oxera's empirical investigation of the relationship between concentration and audit prices and in particular on their econometric study of audit fees paid by a sample of more than 700 listed and private UK companies over the period 1995 to 2004. The purpose of this paper is to review Oxera's econometric analysis in order to assess whether it is sufficiently robust to support Oxera's conclusions.

3 Observations on Oxera's general approach

3.1 In providing a review of Oxera's econometric approach to the remit set by the DTI and FRC on the extent of competition and choice in the audit market, three main questions need to be addressed:

- Is Oxera's modelling approach the right one?
- Given the choice of approach, how well has it been applied?
- Do Oxera draw the right inferences from their econometric modelling?

3.2 To answer these questions in this section we first consider the conceptual appropriateness of their general approach from an economic perspective. In section 4 we then carry out a technical review of their econometric modelling. In part, this review involves attempting to replicate their results, which allows us to carry out indicative appropriate robustness checks, and to determine what appear to be the key factors driving Oxera's results. Drawing together both of these elements, in section 5 we critically appraise the inferences Oxera have drawn from their analysis.

Concentration and Competition

3.3 Oxera state that their finding of a positive correlation between market concentration and price is consistent with economic theory in general, and oligopoly models in particular.

3.4 This is a misleading statement. Modern economic theory strongly rejects the notion that there is any causal link between market concentration and price.

3.5 The economic theory that an increase in market concentration leads to an increase in price dates back to the 1950s and the writings of Mason and Bain.[6] The theory, known as the structure-conduct-paradigm (SCP), is based on the notion that the more concentrated a market becomes, the greater are the incentives to collude, and the higher are prices and profits.

3.6 The theory is however largely discredited, having been exposed to challenges on a number of fronts.

3.7 First, as first pointed out by economists of the Chicago School[7], the theory does not provide any explanation as to *why* a market might become concentrated. The SCP theory suggests that the most efficient market structure is to have a very large number of small firms. However, this is rarely the most efficient market structure. If there are economies of scale for example, costs will be much lower if there are fewer firms, and the market will inevitably become more concentrated as a result.

[6] Bain, J.S (1956), "Barriers to new competition", Harvard University Press.
[7] For example, Demetz, H.(1973), "Industry structure, market rivalry, and public policy", Journal of Law and Economics 11, 55-66.

3.8 A second and more fundamental challenge is that the *intensity of competition* in a market will often be unrelated to the number of firms in a market. For example, contestability theory[8] emphasises that if barriers to entry are very low, even firms with very high market shares will not have the power to raise prices above competitive levels. More generally, it is easy to think of markets where two or three firms compete very intensively with each other e.g. in bidding markets, and conversely, markets where there are a large number of firms, but where competition is very limited e.g. cartels in the ready-mixed concrete industry.

3.9 A third challenge is that the causality often runs in the opposite direction. For example, the expectation of higher prices and profits can cause a reduction in market concentration as new firms enter the market.

3.10 Finally, and most importantly, a number of authors, most notably Sutton[9], have emphasised that the market structure of an industry depends upon the intensity of price competition. If price competition is relatively weak, more firms will be able to operate in an industry, and the market structure will be relatively unconcentrated. Conversely, if the intensity of competition between firms is very strong, then only a few firms will be able to survive in the market.

3.11 More simply, if a firm seeks to compete by offering lower prices, or providing a higher quality product, this can lead to an increase in market concentration if the firm offering better value for money previously had a relatively high market share, or if their new offer is so good that a large number of customers choose to switch.

3.12 Increasing market concentration can also be associated with an intensification of non-price competition, for example competing on quality and reputation. Sutton[10] has written extensively on this subject, providing both a theoretical backdrop and strong empirical support. The basic premise is that if customers attach value to non-price factors (e.g. quality) and are therefore willing to pay for them and switch to firms that provide them, then firms will escalate their spending on non-price competition such as R&D and advertising. Smaller firms, particularly middle-ranking firms, typically are unable to compete on this basis, and will be forced to exit the market, or to provide a lower level of quality at a lower price. In these models, concentration increases as a direct consequence of increased competition, whilst prices will rise as firms need to recover their additional expenditure on activities associated with the more intense non-price competition. So, in these types of models increased concentration is associated not only with an increase in price, but also with an increase in competition.

3.13 The above examples illustrate that there is no direct link therefore between market concentration and price, or more generally, between market concentration and competition.

3.14 Oxera's statement that their finding of a positive correlation between market concentration and price is consistent with economic theory in general, and oligopoly models in particular, can only be considered to be correct in the very narrow sense that in some basic oligopoly models, *all things being equal*, an increase in market concentration will lead to an increase in price. However, there are many oligopoly models where an increase in concentration leads to

[8] See , for example, Baumol, W.J (1982) "Contestable markets, and uprising in the theory of industrial structure" American Economic Review.
[9] "Sutton, J, "Sunk costs and market structure" (1991), MIT Press.
[10] Ibid.

a reduction in price, e.g. because it reduces the incentives to collude,[11] or because it allows firms to achieve greater economies of scale.

3.15 However, what modern economic theory tells us is that we cannot simply assume that all things are equal. In particular, the impact of an increase in concentration on price depends crucially upon what economic forces are causing the market to become more concentrated. Whilst the SCP theory predicts a one-way relationship from increased concentration to higher prices, modern economic theory emphasises that the causality often runs the other way and that markets can become more concentrated as a direct result of increased price or non-price competition.

3.16 If we consider the reasons why the audit industry has become progressively more concentrated over the last 15 years, increases in non-price competition seem very likely to provide a large part of the explanation. For example, it seems probable that many auditors were able to survive in the past precisely because they faced limited competitive pressures, e.g. because they had well established relationships with clients who had limited interest in shopping around, or because they were much more specialised than audit firms are today (many of the major audit mergers were aimed at filling gaps in their service portfolio). It also seems likely that non-price competition has increased significantly to match consumer demands, e.g. the provision of international reach, offering a wide range of non-audit services and investing in high quality staff. Increased regulation and increased awareness of risk, will also have caused an increase in audit market concentration given that the big 4 firms are generally perceived to offer a higher quality service, as the Oxera report confirms.

Is Oxera's modelling approach the right one?

3.17 The econometric model posited by Oxera is to all intents and purposes a price-concentration study in that it attempts to explain the observed differences in audit fees across sector and over time primarily in terms of differences in the level of market concentration (and market share). Although a number of other variables enter into the equation, including turnover, international presence, and the number of mergers, these essentially act as controls to enable the pure impact of concentration on price to be identified.

3.18 Price-concentration models of this type are most commonly used in merger analysis, most famously in the US Office-Staples case where prices in superstores selling office equipment and supplies in different geographical locations across the USA were evaluated and checked for differences in local market structure. Such studies are ideally suited to uncovering whether there is a relationship between price and concentration for essentially the same set of products sold in different locations, and to measuring how strong such a relationship is. They work by isolating the effect that increased concentration has on price from other drivers of price such as complexity, risk, quality, market size, and pricing strategy. They are less well suited to situations where the set of products or services that are compared are not similar or where the locations are subject to significant differences that cannot be easily controlled for.

3.19 Not surprisingly, price-concentration models have been exposed to considerable criticism.[12] Criticisms range from technical issues, including the risk of providing biased estimates

[11] For example, Kuhn and Motta (2004), "The co-ordinated effects of mergers in differentiated product markets" John M Olin Centre for Law and Economics, Working Paper Series 34.
[12] For a good summary of the issues. See, "Price concentration studies: there you go again" Craig M. Newark, 2004 Prepared for DOJ/FTC merger workshop http://www.usdoj.gov/atr/public/workshops/docs/202603.htm

through failure to include omitted variables[13] to the models' lack of predictive power, to difficulties in interpreting the output of these models[14].

3.20 The root cause of these issues is that such models are of "reduced form". That is, whilst they explain price with respect to the level of concentration, they do not explain what drives the level of concentration[15].

3.21 What reduced form models of this type tell us, is that, on average, an x% increase in market concentration, all things being equal, is associated with a y% increase in price. However, the price response to an increase in market concentration is likely to be quite different if the increase in concentration results from an anti-competitive merger compared to the situation where a market becomes more concentrated through an intensification of price or non-price competition. Because of this, such models have no real predictive power.

3.22 A further limitation of price-concentration models is that they do not provide an answer to the question as to whether there is effective competition in the market at present, or indeed, at what level of market concentration are competition concerns likely to emerge. Indeed, a model of the form that Oxera uses is bound to conclude either that prices will be lowest with an infinite number of firms (if there is a positive correlation between prices and concentration) or that they will be lowest with monopoly supply (if the correlation is negative). Because concentration is treated as exogenous and not linked to other aspects of supply such as quality and economies of scale, the model cannot look at trade-offs between, for example, the possible effects on choice and intensity of competition of increasing the number of firms on the one hand, and the implications for reduced economies of scale and quality on the other hand. All Oxera are able to conclude is that, according to their equation, if there were more firms in the market, audit prices would be lower, all things being equal. What they are unable to tell us is whether more firms would have a positive or negative impact on audit quality or indeed competition where non-price competition is important.

3.23 To address the specific question of whether a 4 to 3 merger would raise competition concerns, a much better approach would have been to employ a merger simulation model which takes into account how audit customers react to changes in price and quality as well as how audit firms take advantage of cost synergies. These models are explicitly set up for the purpose of predicting the impact of a change in market concentration on price. As such, they emphasise that the impact of a change in concentration on prices very much depends upon the context. In a typical merger simulation model, the impact of a change in market concentration will depend on, amongst other things, the closeness of competition between the merging parties, the effectiveness of competition from rival firms, whether the market is a bidding market, and the cost savings that are likely to be attained following the merger. None of these factors are taken into account in Oxera's assessment using its econometric model of either the impact of the withdrawal from the market of one of the big 4, or the effect that the PwC merger was likely to have had on audit fees.

[13] See, for example, "Measuring market power in input and output markets – an empirical application to banking", Adams, Roller, Sickles 2000. http://www.econometricsociety.org/meetings/wc00/pdf/1466.pdf
[14] For a summary of technical issues, see OFT 17, "Quantitative techniques in competition analysis" pp. 86-92.
[15] In other words, the level of concentration is treated as an exogenous variable. This is consistent with Bain's structure-conduct-performance paradigm, but is at variance with modern industrial economic theory which stresses the endogeneity of market structure.

4 Technical review of Oxera's econometric modelling

Introduction

4.1 Oxera collected financial data from over 700 UK listed and private companies over the period 1995-2004, making extensive use of the FAME database[16]. The main information collected for each firm was the audit fee, the company turnover, and the identity of the auditor. The companies were then split into twelve different sectors (according to SIC code definitions) allowing sector market shares and HHIs to be computed.

4.2 The aim of the econometric model was to identify the impact of audit market concentration and the market share of the individual auditor on the price of the audit (as measured by the audit fee). To isolate the impact of concentration on price, Oxera attempted to control for other factors which influence the price of an audit. The most important of these controls is the turnover of the company being audited. However, Oxera also included controls for international turnover and for whether a firm had recently made an acquisition as proxies for the complexity of the audit. Oxera also included a variable which measured the cumulative number of times that a firm had switched auditor over the 10 year period to test whether companies which switched auditor more frequently on average paid higher or lower audit fees. Finally, Oxera included sector specific and time dummies, as well as company type (e.g. FTSE 100) dummies, to control for a number of other factors that they considered were likely to influence the audit fee.

4.3 Oxera then attempted to model the relationship between the audit fee and market shares/HHI. The results of six different specifications of model are reported. These variations include using audit fee/turnover as a proxy for the price of an audit, using a big 4 dummy instead of market share, and looking at the change in, (as opposed to the level of), the audit fee. In four of the six specifications, Oxera include the lagged dependent variable as an explanatory variable.

4.4 Oxera find that there is a strong, and statistically significant, positive correlation between the audit fee and both market share and the HHI in each of the six variations of their model that they present in their report. The estimated values of the market share and HHI parameters also vary little between their different models, appearing to suggest that their findings are highly robust.

4.5 Oxera also conduct a number of further statistical tests, each of which appears to confirm the robustness of their model. As a final check, they run their model using only data from the "big 4" auditors[17]. The results of this exercise are not presented in any detail, but Oxera note that they are consistent with their general finding that, on average, the higher the values for HHI and market share, the higher are audit fees.

4.6 In this section we explore in detail whether the evidence supports the powerful claims made for the Oxera model. Many of our conclusions are based purely on examination of Oxera's reported findings, and analysis of these compared with standard econometric practices and other econometric studies of the audit sector. However, in addition, to supplement this analysis, we also attempted to recreate the Oxera dataset (because we were refused access to the Oxera dataset) and used our dataset to attempt to reproduce the Oxera results. We could not exactly reproduce Oxera's results because of the many judgements involved in

[16] The FAME (Financial Analysis Made Easy) database contains information on 3.1m companies in the UK and Ireland.
[17] The "big 4" actually relates to the major high quality auditors, and so includes Arthur Anderson, and separately, PW and CL.

setting up the dataset. Thus, any results which we report based on our dataset and model need to be regarded as indicative, rather than definitive, because we cannot be sure that the same results would be attained if the Oxera dataset was used. Nevertheless, we believe that carrying out our own modelling was a valuable exercise, as it has allowed us to understand Oxera's analysis better, and also allows us to examine the data in more detail, and to carry out robustness checks of our own. Our results are sufficiently close to those of Oxera that we believe that the conclusions we reach based on them should be reliable. In addition we note that were there to be substantial differences between the results using our dataset and the equivalent results using the Oxera dataset, that in itself would cast doubt on the validity of Oxera's findings, as this would mean that they were not robust to small differences in the precise dataset used.

4.7 Our analysis suggests that the Oxera model is not as robust as is claimed. We have found a number of technical problems with the way in which the Oxera model has been specified which our indicative modelling suggests leads to the impact of concentration and market share on audit fee being overstated. The most important of these are:

- Oxera make mistakes in constructing their model. Specifically:
    - In two of the versions of Oxera's model where the lagged audit fee is included as an explanatory variable, it is erroneously included in levels form whereas all the other variables are in log form.
    - Oxera's approach to calculating market share introduces endogeneity – i.e. there is automatic correlation because effectively the same variable is included on both sides of the equation.
- There are a number of important omitted variables, including quality, risk, market size, and the effect of restrictions on the provision of non-audit services, the effects of which may not be adequately controlled for.
- Oxera fail adequately to test the robustness of their model. In particular:
    - Oxera state that important evidence that their model is robust is that the coefficients do not vary across the different specifications of their model, and that their results are stable to the inclusion or exclusion of the lagged audit fee. However, this evidence is undermined by the error of measuring the lagged audit fee in levels, rather than in logs.
    - Oxera draw the wrong inference from their other main test for robustness, as adding market share and HHI variables adds little or no explanatory power.
    - Oxera did not carry out some other tests that we consider important. Our own version of the model fails tests for functional form and autocorrelation which were not reported by Oxera.

4.8 Of course our analysis does not necessarily show that there is no relationship between the audit fee and HHI and market share, or even that the relationship is not of the magnitude claimed by Oxera. However, our technical analysis of Oxera's work, supplemented by our own indicative econometric analysis, suggests that Oxera do not present sufficient evidence to support their claims.

Reproduction of Oxera results

Replicating Oxera's dataset

4.9 In order to reproduce the Oxera results we asked Oxera to supply us with their dataset, but permission was refused. We therefore set about compiling it ourselves following guidance from their report. Oxera has collected a sample of data from FAME including more than 700 companies.

4.10 The following two tables compare the descriptive statistics of our sample and Oxera's. We find that our dataset is essentially consistent with that of Oxera's.

Figure 1: PwC Dataset: Descriptive Statistics

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number of companies										
Listed	399	480	509	521	551	593	610	627	634	646
FTSE 350	140	183	195	202	219	230	240	250	260	268
Small Cap	136	159	172	175	185	201	205	209	210	213
Fledgling	121	136	140	142	145	160	163	166	162	161
Private	32	46	50	54	57	65	71	81	90	97
Total	431	526	559	575	608	658	681	708	724	743
Audit fees (£000)										
Average	311	312	300	318	338	365	388	410	428	473
Median	77	88	95	92	104	110	123	128	148	160
Standard deviation	668	650	640	850	774	1025	939	1015	998	1139
Turnover (£m)										
Average	665	743	696	689	775	909	995	989	1032	1078
Median	86	104	122	131	146	150	173	185	203	224
Standard deviation	2635	2783	2519	2393	2622	3932	4590	4232	4603	5040
Audit fees/turnover (%)										
Average	0.239	0.244	0.267	0.322	0.299	0.226	0.344	0.276	0.231	0.335
Median	0.112	0.097	0.097	0.097	0.091	0.086	0.086	0.093	0.088	0.094
Standard deviation	0.689	0.977	1.759	2.167	2.469	1.004	2.183	1.404	0.764	2.297

Figure 2: Oxera Dataset: Descriptive Statistics

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number of companies										
Listed	433	530	555	577	599	642	659	674	684	676
FTSE 350	140	195	205	215	228	241	249	259	266	272
Small Cap	151	177	185	192	201	219	222	228	232	233
Fledgling	142	158	165	170	170	182	188	187	186	171
Private	37	44	46	51	54	61	70	82	86	63
Total	470	574	601	628	653	703	729	756	770	739
Audit fees (£000)										
Average	282	294	296	320	336	374	398	408	454	534
Median	67	79	90	94	99	111	122	127	150	176
Standard deviation	592	628	648	860	782	1058	982	963	1094	1353
Turnover (£m)										
Average	552	687	667	690	770	936	1034	1027	1092	1198
Median	66	96	109	116	135	144	166	169	173	198
Standard deviation	2097	2652	2457	2393	2646	4054	4765	4409	4869	5589
Audit fees/turnover (%)										
Average	0.274	0.252	0.203	0.221	0.203	0.205	0.243	0.273	0.281	0.260
Median	0.116	0.102	0.098	0.098	0.093	0.089	0.091	0.095	0.093	0.100
Standard deviation	0.769	0.945	0.511	0.510	0.436	0.420	0.789	1.379	1.187	0.883

4.11 However, it has not been possible to reconcile our dataset with Oxera's exactly. This is not surprising as a large number of practical assumptions need to be made in transforming the raw data into a usable data set, and there will inevitably be some differences between Oxera's approach and our own. Some of the more important practical difficulties include:

- Oxera report only 63 private companies for 2004, even although they reported that they selected the top 100 private companies by turnover in 2004. We have included 97.
- The FAME database has some important missing information in 2004 (including the name of the auditor for some listed firms).
- The PwC merger took place in the middle of 1998 – should 1997 or 1998 be regarded as the base year for computing price effects of the merger?
- It is not clear in which sector to place data on public sector companies e.g. Public Administration, Education, Health, Social Work etc.
- Judgement needs to be exercised in correcting errors and excluding outliers.

4.12 Without knowing precisely what Oxera did it is not possible to reconcile the data exactly. Although our datasets appear to be very similar, the differences do need to be kept in mind

when interpreting the results. In particular, whilst we believe that our dataset and model are similar to those of Oxera, because there are some differences we cannot be certain that any conclusions we draw from changes we make to our model also apply in exactly the same way to the Oxera model. Therefore, all the results we present based on our model must be regarded as indicative of how the Oxera model might behave. Having made this caveat, it seems reasonable to believe that the datasets and models are sufficiently similar to allow broad conclusions to be drawn. It is also the case that if the discrepancies between the models are such that the results and conclusions differ widely, this in itself would affect our perception of the robustness of Oxera's conclusions (since it would imply that relatively small differences in the dataset and approach lead to very different results).

4.13 We should also note that some questions have been raised about the accuracy of the FAME dataset. Our attention has been drawn to a clear error with the reported audit fees for Prudential (£22m compared to actual fees of £1.9m for 2000). To look at this issue in more detail we compared the audit fees reported by the FAME database with those in the relevant annual accounts for a small sample of the UK's largest companies, for the period 1995-2004.

4.14 From just this small sample we uncovered a number of examples where there appear to be errors in the FAME data:

- FAME data on Danka Business Systems plc reports a rise of 157% in the audit fee from 2003 to 2004, equivalent to £2.8m. The financial accounts suggest instead a 52% increase.

- FAME data on Torotrak plc reports a rise of 1500% in the audit fee from 2000 to 2001. The financial accounts show this to be a clear error. Whilst FAME report that the audit fee was £32m in 1999, £2m in 2000, and £32m in 2001, the financial accounts report that the audit fee was consistent at £32m across all three years.

- FAME data on Uniq plc reports that the audit fee rose from £0.6m in 2000 to £6.5m in 2001 then fell back to £0.5m in 2002. Thus FAME suggests a rise of 983% in the audit fee in 2001. However, the financial accounts do not show any indication of this extreme variation, reporting instead that the audit fee was consistent at £0.6m across 2000 and 2001.

- FAME data on Brambles industries plc reports that audit fees rose by 100% from 2003 to 2004, from £1.3m to £2.6m. However, the financial accounts suggest an increase from £1.3m to £1.4m, or 7.7%.

4.15 We have also uncovered a number of examples where there are notes in the financial accounts as to why a large audit fee rise occurred:

- FAME data on Centrica reports a 74% increase in the audit fee between 2003 and 2004. The financial accounts report a similar increase but also note that this was almost entirely due to the implementation of International Financial Reporting Standards.

- FAME data on Unilever reports a 90% increase in the audit fee from 1999 to 2000, equivalent to £7.2m. However, the annual report for 2000 explains that €6m (roughly equivalent to £3.8m) of this was due to audit-related services associated with the acquisition of Bestfoods.

- Accounts data on Danka Business Systems plc shows a $2m fee in 2004 associated with tax filings and corporate restructuring. Removing this reduces the increase reported above from 52% to 19%.

4.16 Whilst this a small sample, it does cast some serious doubts about the accuracy of the FAME database. We have not carried out a full audit of the dataset nor have we carried out a detailed sensitivity analysis of the results of the econometrics to alternative choices regarding the cleaning of the data. Our indicative research into the accuracy of the dataset does imply that any results based on FAME, no matter how apparently robust, need to be treated with caution because the underlying data is not necessarily very accurate. In addition, we would question the use of audit related fees, in addition to audit fee, as the relevant price variable. This creates further scope for inaccuracy and differences in reporting standards. It also creates the possibility of a systemic bias if increased transparency has led to increased reporting of audit related fees (which Oxera's model would simply treat as price increases). In our view a more robust approach would be to identify for each observation in the dataset the actual audit fee paid.

Reproducing Oxera's results

4.17 With our completed dataset we attempted to replicate the panel data regression exercise carried out by Oxera. The following table shows the results of our replication exercise by comparing the coefficients from Oxera's specification III (one of the three models which Oxera state is *"theoretically preferable"* (pages 75 and 78), and the one used by Oxera to predict the impact of the PW/C&L merger and the withdrawal of one of the big 4) with an alternative model using Oxera's specification and our dataset (ALT).

Figure 3: Results of replication exercise

Specification	III	
Dependent variable	Audit fee	
	OXERA	ALT
Dependent variable lag (levels)	0.0001447 (13.74)***	0.0001193 (10.56)***
Turnover	0.427 (49.64)***	0.379 (43.52)***
Auditor market share	0.051 (10.34)***	0.050 (9.38)***
HHI	0.164 (6.03)***	0.171 (5.19)***
Number of switches	-0.057 (4.26)***	-0.024 (2.35)**
Mergers	0.051 (5.75)***	0.073 (7.35)***
International turnover	0.520 (8.07)***	0.555 (8.24)***
No. of observations	5,705	5,410
R^2	0.801	0.787

4.18 Using our dataset produces very similar parameter estimates (and similar significance of those estimates) to those of Oxera. In particular, the key parameters for market share and HHI are almost identical in magnitude and significance to those of Oxera.

4.19 Our main conclusion from this exercise is that the Oxera results are capable of being relatively closely reproduced, giving us the confidence that we understand what Oxera have done, and that we are working off broadly the same dataset. Nevertheless, as already stated, we cannot be certain that such differences as do exist, a consequence of us being denied access to Oxera's dataset, are important for the transferability of our modelling findings to Oxera's model, and our results must necessarily be regarded as indicative rather than fully reliable.

Technical review of Oxera's econometrics

4.20 We have found a series of technical problems with the way in which the Oxera model has been specified which we believe has led to the impact of concentration and market share on audit fee being overstated. In particular:

- Oxera make mistakes in constructing their model.
- There are a number of important omitted variables, including quality, risk, market size, and restrictions on non-audit services, the effects of which we do not believe have been adequately controlled for using dummy variables.
- Oxera's conclusion that their model is robust is based on flawed analysis.

Oxera make mistakes in constructing their model

4.21 Oxera's model construction contains two mistakes that affect the conclusions that can be drawn from their analysis. These are as follows:

- First, the inclusion of the lagged audit fee in two of their preferred specifications is erroneously carried out using levels rather than the log form used for all the other variables.
- Second, Oxera's calculation of the market share variable has introduced a problem of endogeneity whereby audit fee effectively appears on both sides of the equation. This imposes a correlation regardless of whether there is in fact any behavioural relationship between market share and audit fee and therefore biases their results.

Erroneous inclusion of lagged dependent variable in levels rather than logs

4.22 Oxera have erroneously measured the lagged audit fee in levels rather than logs in two of their specifications, contrary to what is stated in their report[18]. These specifications are the ones that Oxera appear to place most emphasis on[19]: for example, Oxera uses one of these specifications to illustrate the predicted impact of the PW/C&L merger and the exit of one of the big 4.

4.23 We cannot be absolutely certain of the effect this has on Oxera's findings because we were not given access to their dataset, but using our own dataset, which produces similar results to

[18] "The dependent variable is the **Audit fee** – the log of the audit fee…explanatory variables include…the log of the audit fee in the previous fiscal year" (page 140).
[19] Oxera state (pages 75 and 78) that "log specifications II to IV in Table 5.4 are theoretically preferable". The error identified here arises in respect of both specifications III and IV.

those of Oxera, when we correct for this mistake, we find that the coefficients for both market share and especially HHI are substantially reduced. In our version of specification III the market share coefficient falls from 0.05 to 0.028, and the HHI coefficient falls from 0.171 to 0.063[20]. In our version of specification IV the HHI coefficient falls from 0.17 to 0.065[21].

4.24 Whilst this error directly affects only two of the six model specifications presented by Oxera, we nevertheless believe that it undermines the overall reliability of Oxera's econometrics for four key reasons.

4.25 First, as already noted, the two specifications affected (Oxera's models III and IV in Table 5.4 on page 76) are amongst the three models on which Oxera place most emphasis. In particular, model III appears to be Oxera's preferred specification, since Oxera use this model to illustrate both the predicted price impact of the PW/C&L merger and the predicted price increase associated with the big 4 becoming the big 3.

4.26 Secondly, of the four model specifications not directly affected, Oxera state that three of them (specifications I, V and VI) *"are included to confirm the robustness of the results"* in the other three (page 75). Oxera do not, therefore, attach direct importance to them. Our own analysis of these models also suggests that they are not reliable.

4.27 Thirdly, the remaining model preferred by Oxera, model II, does not include the lagged audit fee in its specification. This is contrary to Oxera's own finding that lagged audit fee is an important explanatory variable because *"Oxera has learned that the determination of audit fees for any given year (current year) is often closely related to the agreed audit fee for the last year"* (page 139).

4.28 Fourthly, the error with models III and IV casts significant doubt on the validity of model II. As noted, when we correct this error in our versions of Oxera's models we find that the coefficients for market share and especially HHI are substantially reduced. This is important because it implies that, once the error has been eliminated, these coefficients differ between specifications III and IV on the one hand, and specification II on the other. Oxera state that *"under the assumption of autocorrelation, results from models with and without the lagged dependent variable would be expected to be different"* (page 150), so this raises the possibility that the model suffers from autocorrelation. When we control directly for autocorrelation in our version of Oxera's model the coefficients change (see below), indicating that there is indeed autocorrelation present.

Oxera's calculation of the market share variable has introduced a problem of endogeneity

4.29 In price-concentration studies it is quite common to include market share as an explanatory variable. This allows us to test whether, for a given level of concentration, firms with higher market shares on average charge higher prices. On the face of it Oxera's inclusion of market share as an explanatory variable is not controversial.

4.30 One caveat here is that including market share alongside HHI can make it difficult to interpret the results. A relationship between HHI and price is consistent with the Cournot model of competition, where firms produce homogeneous products, and higher market shares result from differences in marginal costs. However, the Cournot model is not consistent with a price premium for market share. Consequently, putting the HHI and market share together in this

[20] Using specification III - the one Oxera use to calculate the effects of the PW/C&L merger and the exit of one of the big 4.
[21] The big 4 dummy (which replaces the market share variable in this specification) drops from 0.16 to 0.067.

way is not consistent with any particular theory of oligopoly behaviour, which can make it difficult to interpret the projections of the model.

4.31 More fundamentally, in Oxera's specification of the model, the dependent variable is the audit fee rather than price. This matters because it means that the audit fee is included on both sides of the equation – on the left hand side as the dependent variable, and on the right hand side to estimate market share. In principle this can lead to what is known as an "endogeneity" problem, which can lead to parameter estimates which are biased and unreliable.

4.32 The endogeneity problem can perhaps be seen more clearly by looking at how the market share variable is constructed. The market share of an auditor for firm i is written as:

$$MarketShare_i = \frac{Auditfee_i}{SumofAllAuditfee} + \frac{\sum_{\neq i} Auditfee_j}{SumofAllAuditfee}$$

The problem is particularly apparent where a firm audits only one client in a particular sector. In this scenario, there is a direct relationship between audit fee and market share:

$$MarketShare_i = \frac{Auditfee_i}{SumofAllAuditfee}$$

Therefore, the regression equation will be:

$$\log(auditfee)_i = b \log(marketshare)_i + \ldots$$

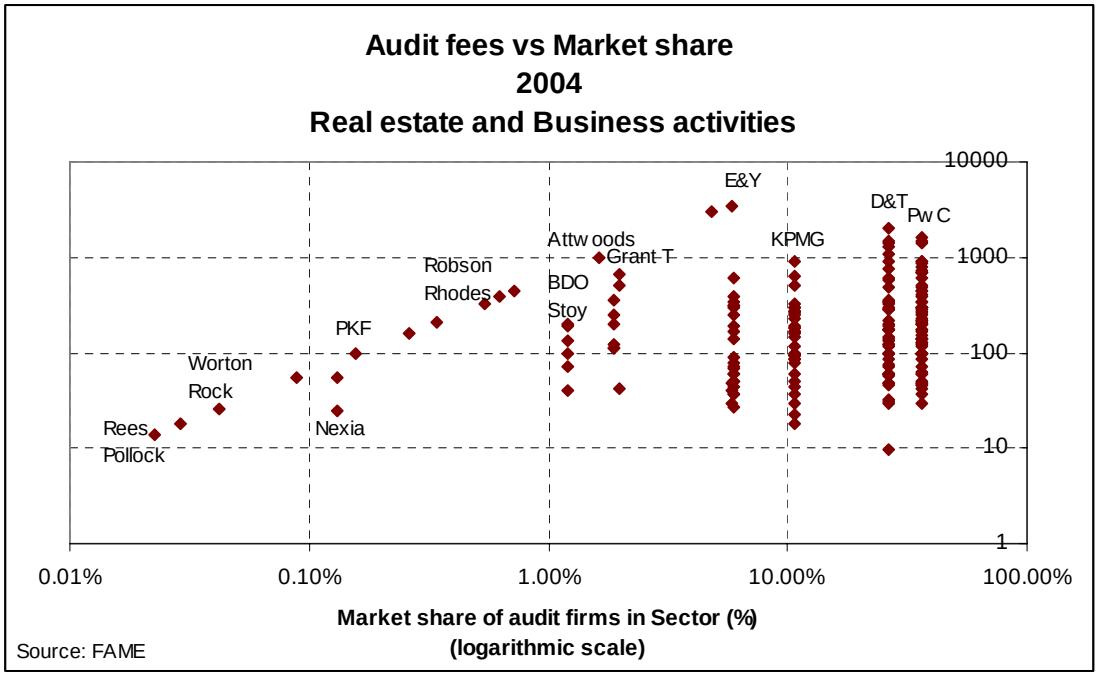
$$= b \log(auditfee)_i \underbrace{- b \log(\text{sum of all audit fee})}_{\text{which is a constant}} + \ldots$$

4.33 As a result a regression analysis will find a near one-to-one relationship between audit fees and market share[22].

4.34 Whilst endogeneity is a problem in theory, it may not be a problem in practice if most auditors have a large number of clients in a particular sector. To investigate this issue further we plotted the (log[23]) market share against the (log) price for individual auditors in different sectors. Figure 4 below shows market share plotted against audit fees for the real estate and business activities sector for 2004.

[22] This assumes that the denominator does not significantly change when the audit fee rises, which is approximately true provided the auditor has a low market share (which is likely if they audit only one client).
[23] Logs are used to focus on proportionate relationships between numbers and because interpreting the coefficients is more straightforward.

Figure 4: relationship between audit fees and market share



4.35 There are two points illustrated by the graph. The first is that there are several auditors in the sector who only audit one or two clients and for whom the endogeneity issue is likely to be a problem. For those firms with a market share of less than 10% there is a clear (log) linear relationship, much of which is likely to be entirely due to the endogeneity problem. For example, Worton Rock and Rees Pollock each only audit one client in this sector. The reason Worton Rock has a higher market share than Rees Pollock is solely because they charge a higher audit fee for this single audit. Essentially the Oxera model assumes the relationship is entirely in the opposite direction i.e. that Worton Rock's ability to extract a higher audit fee is because of its higher market share.

4.36 The second point illustrated by the graph is that for firms with market shares in excess of 10%, the relationship between market share and audit fees is considerably less clear, if it exists at all. It is conceivable therefore that a large part of the observed relationship between market share and concentration is driven by the observations from firms with low market shares.

4.37 It is conceivable that this would be less of a practical problem if it were associated only with the smallest firms. For example, Oxera report that *"the relationship is equally valid for sub-samples of companies audited by Big Four firms only. That is, differences in the market shares of the Big Four firms are similarly associated with variances in the audit fees among their clients, when clients of other firms are eliminated from the sample"* (page 78). If the endogeneity problem does not affect the big 4 firms then this suggests that, at least for these firms, there is a market share effect that is not automatically caused by the calculation of market share.

4.38 However, closer inspection of the data suggests that the problem exists even for the large firms. Using our dataset, and looking at data for 2004, there are 11 examples (out of a possible 48 – twelve sectors and four firms) where one of the big 4 firms has only between one and three audit clients in one of Oxera's sectors. For these firms in these sectors the

endogeneity problem is likely to bias the results even for the big 4. In one of the sectors Deloitte had two clients in 2004 and PwC had one, and the other two big 4 firms had no clients.

4.39 The above commentary is not a criticism of attempting to use market share as an explanatory variable. Rather it is a criticism of the particular way in which Oxera have set up their model that introduces an endogeneity problem, and which almost inevitably leads to an observed positive relationship between market share and audit fee, even if such a behavioural relationship does not exist. It is notable that we have been unable to find any other academic research which sets up the relationship between market share and the audit fee in this way.

4.40 One possible way of allowing market share to be an explanatory variable whilst avoiding the endogeneity problem is to use audit fee as a proportion of turnover (audit fee/turnover) as the price variable. Here, turnover provides a proxy for the quantity of audits supplied, breaking the direct link between market share and audit fee.

4.41 Oxera offer this as a variation of their model (specification V), and, as with their other specifications, they find a very significant positive correlation between market share and price. However, if we look closely at specification V we see that Oxera continue to use turnover as an explanatory variable on the right hand side of the equation. Once turnover is used as an explanatory variable it does not make a difference whether the dependent variable is audit fee or audit fee/turnover. Therefore specification V does not offer a solution to the endogeneity problem.

4.42 Whilst it might be possible to specify a model which used audit fee/turnover as the price variable, we agree with Oxera's comment that this is unlikely to be a fruitful line of research. The problem, as Oxera points out, is that an audit fee/turnover specification imposes a one-to-one relationship between price and turnover. If, as seems likely, there are significant economies of scale in auditing, then the one-to-one relationship is inappropriate.

4.43 To explore the practical implications of the market share endogeneity problem, we applied a sensitivity test to our version of the Oxera model, limiting the dataset to clients of the big 4 auditors. When we did so, the market share parameter was reduced significantly from 0.05 to 0.032. However, as noted above, whilst we believe the endogeneity problem is somewhat less acute for the larger firms, we believe that it still exists because of the existence of sectors where even the large firms have very few clients.

4.44 To conclude, in our view both of Oxera's attempts to model the market share effect suffer from the endogeneity problem, both in theory, and in practice. The endogeneity problem is likely to lead to the effect of market share on price being significantly overstated.

Oxera's analysis fails to control adequately for omitted variables

4.45 A well known problem in econometric modelling is that omitting key explanatory variables can lead to biased estimators. In a reduced form model, where there are relatively few explanatory variables, the likelihood that an important variable has been omitted is increased.

4.46 Oxera's approach to this issue has been to use time and sector dummies to pick up the various omitted variables such as quality and risk. This can work well where the impact of the omitted variables falls equally on all firms in the market. However, in practice this assumption is most unlikely to hold. For example, if we believe that market shares are driven to a large extent by differences in the *relative* quality of auditors, then time and sector dummy variables,

which only capture changes in the *average* quality of audits, will explain only a limited part of the quality story, and will lead to biased estimators.

4.47 Oxera's model includes 8 time dummies that reflect differences in the average level of audit fees across the ten years, and 12 sector dummies to reflect differences in average fees across sectors. Such an approach is capable of picking up omitted variables which affect all firms in the market uniformly and in a specific way over time. However, where the impact is different on different firms a bias might be introduced. This is why the first preference is to use actual data for key drivers of the dependent variable. In particular, econometrics is concerned with the direct impact of changes in variables; analysing relationships at the average level significantly hampers the ability to analyse these relationships.

4.48 Oxera's approach is not sufficiently flexible to deal with different trends over time between different sectors. For example, suppose that over the period examined regulation in the financial services sector increased more significantly than in the average sector, thus driving up the effort involved in audits and hence audit fees. With only a single time dummy to cover all sectors together, this differential growth in regulation and complexity would not be fully captured by the time dummy. Nor would it be captured fully in the financial services sector dummy (which is at one level for all years). The model would therefore seek to associate the observed differential growth in audit fees in financial services with other explanatory variables in the model. If there were above average increases in concentration amongst audit firms in the financial services sector then the model would erroneously ascribe the price effect of increased regulation to the change in concentration. The impact of this is even more pernicious if the increase in regulation itself causes the increase in concentration as the sector becomes more specialised and fewer firms are able to provide the requisite quality.

4.49 In our view the most important variables/factors omitted from the Oxera analysis are:

- Quality of the audit.
- Market size.
- Risk associated with the audit.
- Impact of independence requirements on economies of scale and scope achieved by the provision of non audit services by a single audit firm.

4.50 Oxera do not conduct any specific tests for omitted variable bias. In support of this they point only to the technical difficulty of this exercise, and to their robustness tests, which, in our view, are unsophisticated, as well as being mis-interpreted and mis-applied. Oxera do argue that the high R^2 their model displays gives them comfort that they have not omitted key variables. Oxera argue that the high R^2 *"points at the fact that the variables included do indeed explain a large part of the variation in audit fees, hence suggesting that the impact of any omitted variables would not significantly affect the results"* (page 140). This is not correct: merely considering the R^2 is not an adequate test for omitted variables. Consider the example where quality is in fact a key driver of choice such that firms invest in high quality, gain market share and seek to recover those extra costs in higher audit fees. In Oxera's model market share would pick up the explanatory power of the omitted quality variable and a high R^2 would still be maintained.

4.51 We accept that testing for the omitted variable bias in a panel data set is not straightforward. However, one relatively simple test that Oxera could have done is the Ramsey RESET test.

The results of this test show that there are likely to be important omitted variables that should have been included in Oxera's model, and, moreover, that their omission is likely to lead to biased coefficients. Importantly this suggests that Oxera's approach of only using time and sector (and firm type) dummy variables to pick up the other variables that influence the audit fee is inappropriate.

4.52 We now look at whether it is possible to correct for some of these omitted variables by using proxies. At the moment we are hampered by a lack of data, and this is an area where further work might be beneficial. However, it has been possible for us to consider the impact of audit quality. The results of this exercise are presented below.

Audit quality

4.53 One way of assessing whether the omission of a quality variable from the model has any significant impact is to restrict the dataset to just those clients who use the services of high quality auditors. Restricting the dataset in this way should make the remaining auditors more homogenous in terms of the quality of the audited services provided (although there will still be quality differences within this group), so that the time dummies are more likely to pick up changes in quality levels. This approach may also help to alleviate the problem caused by the endogeneity of market shares and the audit fee, as it would eliminate from the sample auditors with very low sector market shares.

4.54 The results of our modelling, using our dataset and our version of the Oxera model, are presented in figure 5 below. It can be seen that restricting the sample to the very large auditors has only a limited impact on the estimated HHI parameters. The market share parameter, however, is significantly lower when the dataset is limited to high quality auditors, falling from 0.05 to 0.032.

Figure 5: Effect of quality

Specification	III		
Dependent variable	Audit fee		
	OXERA	ALT (All sample)	ALT (Quality auditors)
Dependent variable lag (level)	0.0001447 (13.74)***	0.0001193 (10.56)***	0.0001042 (27.71)***
Turnover	0.427 (49.64)***	0.379 (43.52)***	0.432 (44.10)***
Auditor market share	0.051 (10.34)***	0.050 (9.38)***	0.032 (3.06)***
HHI	0.164 (6.03)***	0.171 (5.19)***	0.173 (4.80)***
Number of switches	-0.057 (4.26)***	-0.024 (2.35)**	-0.001 (0.10)
Mergers	0.051 (5.75)***	0.073 (7.35)***	0.065 (6.01)***
International turnover	0.520 (8.07)***	0.555 (8.24)***	0.565 (8.05)***
No. of observations	5,705	5,410	4,563
R^2	0.801	0.787	0.790

4.55 We note that restricting the dataset to quality auditors also introduces its own omitted variable problem by not directly modelling the impact of competition from auditors outside of the big

4[24]. We also know from the Ramsey test, and other robustness tests, that the Oxera model is likely to have omitted important explanatory variables. We therefore do not consider that the use of dummy variables can adequately capture the complexity of changes in quality.

Impact of independence restrictions on auditors providing non-audit services

4.56 An important reason for the recent increase in audit fees might be the reduced opportunities for auditors to provide non-audit services. The loss of economies of scale and scope afforded to both the audit firm and the client by the joint provision of these services would be expected to have an impact on audit pricing. If audit services have to stand on their own financially, then we would expect prices to rise across the industry. This effect is separate from any changes in concentration.

4.57 It is possible that Oxera's time dummies pick up some of this effect. However, the assumption that restrictions on cross-selling affect all auditors equally is unlikely to hold in this instance. It should be clear that this effect will definitely impact differently on different firms depending on their mix of audit and non-audit services and on individual clients. For example, we would expect prices to increase more in audit firms that were previously able to offer more extensive non-audit services.

4.58 It is notable that Oxera do not assert that this effect is accounted for in the time dummies. In light of this, the impact of restrictions on non-audit services on the pricing of audits is not being accounted for in Oxera's model.

Oxera's robustness analysis is flawed and incomplete

4.59 Oxera's model seeks to explain the audit fee (the dependent variable) with three key explanatory variables (HHI, market share, and client firm turnover). To check whether the model is well specified, Oxera carry out the following main robustness tests:

- Comparison of coefficients across the six specifications used.
- Stepwise inclusion of each individual explanatory variable.
- Comparison of the estimated coefficients using fixed and random effects.
- Comparison of the estimated coefficients, including, and excluding lagged audit fees.

4.60 These robustness tests are unsophisticated, and, in our view, inappropriate for the task at hand. Using our own model we have carried out what we believe to be more appropriate tests below. Assuming that the results from our model are reliable this indicates that the Oxera model is not robust.

4.61 However, even if we take Oxera's robustness tests at face value, the tests have been both mis-applied and mis-interpreted, so that even on Oxera's own terms, the evidence does not support their claim that their model is robust.

[24] Some of this effect is likely to be picked up by the time and sector dummy variables.

Comparison of coefficients in different specifications

4.62 In their robustness section Oxera state that *"The quality of the econometric model, and the reliability of the conclusions drawn from it, depends to a large extent on whether the model specification is correct. This can be analysed by inspecting the stability of the estimates using alternative specifications" (page 142).*

4.63 However, the flawed way in which the lagged dependent variable is included undermines the conclusion that coefficients are stable across different specifications of their model. In two of the six specifications, correcting for this error in our version of Oxera's model produces coefficients that are significantly reduced thereby undermining Oxera's conclusion from their own test.

Stepwise test

4.64 The idea of this test is first to examine the correlation between the most important explanatory variable and the audit fee. Further explanatory variables are then added. If these are capable of adding significantly to the explanation of the level of audit fees then they are included in the model, if not they are discarded.

4.65 Oxera report that the magnitude and statistical significance of the estimated coefficients does not vary by very much as additional explanatory variables are included in the equation. The conclusion they draw from this is that their coefficient estimates are robust.

4.66 In our view this is the wrong inference to draw from the stepwise test. The test should more correctly be whether adding an additional variable increases the ability to explain i.e. predict, the level of the audit fee. One measure of the predictive power of the equation is the R^2 statistic. When we look at this statistic we see that nearly all of the variation in audit fees (72.1%) can be explained by the turnover of the firm, and last year's audit fee. Adding market share only explains a further 1.4%, whilst then adding the HHI actual reduces the explanatory power by 0.1%[25].

Figure 6: Oxera's stepwise comparison

Lag audit fee	Turnover	Market share	HHI	R^2
Yes	No	No	No	39.4%
Yes	Yes	No	No	72.1%
Yes	Yes	Yes	No	73.5%
Yes	Yes	Yes	Yes	73.4%

[25] In principle, Oxera should test whether the increase in R^2 is significant, through, for example, conducting an F-test.

4.67 We should caution, however, that the R^2 statistic is unreliable in this instance because of the way that Oxera have set up their model[26].

Comparison of estimated coefficients using fixed and random effects

4.68 Fixed and random effects are two different ways of estimating coefficients. Oxera suggest that if the two approaches result in statistically similar estimates (as measured by the Hausman test), then their model is robust to the particular approach used. In this instance, the random effects approach is preferred, as it leads to more accurate (efficient) estimates.

4.69 We do not believe that this is a key robustness test in the sense of testing the specification of the model or testing for the existence of omitted variables[27]. Rather it addresses a more technical question of, having adopted a particular model, whether the fixed effects or random effects estimator should be used. If the model Oxera have adopted is in fact robust and well specified then we would agree with Oxera's conclusions regarding choice of estimator. However this robustness test does not shed light on that question.

Comparison of estimated coefficients including and excluding the lagged audit fee

4.70 Again we should preface our remarks by noting that in our view this is not a valid robustness test. Nonetheless, Oxera state that *"under the assumption of autocorrelation, results obtained from models with, and without the lagged dependent variable would be expected to be different. Oxera estimated the models using both specifications: including and excluding the lagged dependent variable. When these results are compared, the estimates look very similar, indicating that there is no ground to conclude that autocorrelation is present in the models" (page 150).*

4.71 However, taking the test at face value, Oxera make an error in two of the specifications of the model (i.e. by including the lagged dependent variable in levels as opposed to logs when all other variables are measured in logs) which undermines the inferences that they draw from this test.

4.72 To obtain an indicative analysis of the likely importance of this apparent error we applied Oxera's robustness test to our own model using the log of the lagged dependent variable, as the theory suggests. Figure 7 compares the results from our model with those presented by Oxera.

[26] The R^2 statistic does not provide a reliable estimate where, as here, a lagged dependent variable is included in the model.
[27] Modern industrial economic theory suggests that the HHI, and market share, are endogenous. If this is correct, neither the random nor the fixed effects estimators will lead to unbiased estimates, unless we instrument HHI and market share.

Figure 7 – Indicative impact of specifying lagged dependent variable in logs

Specification	III		
Dependent variable	Audit fee		
	OXERA	ALT 1	ALT 2
Dependent variable lag (level)	0.0001447 (13.74)***	0.0001193 (10.56)***	
Dependent variable lag (log)			0.670 (78.43)***
Turnover	0.427 (49.64)***	0.379 (43.52)***	0.156 (24.19)***
Auditor market share	0.051 (10.34)***	0.050 (9.38)***	0.028 (7.06)***
HHI	0.164 (6.03)***	0.171 (5.19)***	0.063 (1.95)*
Number of switches	-0.057 (4.26)***	-0.024 (2.35)**	-0.021 (2.57)**
Mergers	0.051 (5.75)***	0.073 (7.35)***	0.027 (4.19)***
International turnover	0.520 (8.07)***	0.555 (8.24)***	0.185 (7.77)***
No. of observations	5,705	5,410	5,410
R^2	0.801	0.787	-

4.73 ALT 1 is our attempt to replicate the Oxera specification, whilst ALT 2 expresses the lagged dependent variable in logs. Both ALT models use the alternative dataset that we have constructed, which cannot be relied upon necessarily to give exactly the same results as the Oxera model. A comparison of ALT 1 with ALT 2 illustrates the impact on our version of Oxera's model of expressing the lagged dependent variable in logs rather than levels.

4.74 Using our model, the results are highly significant. The market share parameter, in model III, is still statistically significant, but the value drops from 0.05 to 0.028, suggesting that a doubling of market share would now lead to only a 2.8% price increase rather than 5%.

4.75 The results for the HHI are even more striking. The estimated HHI parameter is no longer statistically significant at the 5% level, suggesting that the evidence does not support a positive relationship between the audit price and market concentration. The parameter falls from 0.17 to 0.06.

4.76 The key finding is that, if the results from our version of Oxera's model can be relied upon, based on the proper application and interpretation of their own tests, Oxera should have concluded that their model is not robust. The change in the value and significance of the main explanatory variables when a lagged dependent variable is introduced into our version of the model is consistent with Oxera's model being mis-specified, through, for example, omitting key explanatory variables.

Test for functional form

4.77 In our view Oxera should have carried out additional robustness tests. In particular a standard test for the appropriateness of the functional form chosen by Oxera was not carried out. The results of a general specification test (Ramsey RESET test) applied to our version of Oxera's model strongly shows evidence of non-linearity and omitted variables and implies that Oxera's results are biased.

4.78 Under this test if the estimates for the squared and cubed values of the predicted dependent variable are jointly significant[28] then this shows evidence of functional form mis-specification and/or omitted variables.

Test for autocorrelation

4.79 Oxera have also not tackled the problem of autocorrelation in the error terms (a further potential cause of bias). As discussed this is partly because they believe that inclusion or exclusion of the lagged dependent variable tests for this. However, as highlighted above, the evidence from this is not valid as Oxera erred in the way they included the lagged dependent variable. When we control for autocorrelation in our version of Oxera's model directly[29], the estimated impact of concentration on audit fees falls considerably (from 0.17 to 0.10). This shows that our version of the model suffers from autocorrelation.

[28] Test statistics for joint significance were 298 for Chi-square test.
[29] Parameters were estimated using XTREGAR.

5 Interpretation of Oxera's results

5.1 In many respects Oxera are careful about how they interpret the results of their modelling exercise. Although they find that concentration and market share are highly correlated with price, at no point do they claim that this results from either the market power of PwC individually, or the big 4 as a group. Implicitly this is an acknowledgment that whilst price may be positively *correlated* with concentration and market share, there are a number of reasons other than market power which could *cause* such a relationship, including the increasing importance and intensity of non-price competition.

5.2 However, Oxera are less careful when they make statements on the premium commanded by the big 4, and, more importantly, when using their model to make predictions of the price rise attributable to the merger of PW and C&L, and the expected price rise should the big 4 become the big 3. We have four main concerns with the manner in which Oxera interpret the findings of their model:

- We do not believe that Oxera have used their own model in the most appropriate way in reaching their conclusions, and as a result the predicted price increases are overstated even if we accept the validity of the Oxera model (which we do not).

- More importantly, Oxera's predictions regarding the impact of the PW/C&L merger are not supported by evidence of what actually happened.

- Oxera's model is deficient as a predictive tool and is not suitable for considering what would happen were one of the big 4 to withdraw.

- We do not believe that the findings of the Oxera model are as consistent with the academic literature as is stated.

Oxera's predicted price increase of a reduction of 4 firms to 3, and the price increase attributable to the PW/C&L merger

5.3 Oxera use their model to predict that the exit of one of the big 4 (KPMG) would lead to an increase in audit fees of 7% for the new big 3, and 5.5% for the remainder of the industry. They also argue that their model implies that the PW and C&L merger (6 firms to 5) led to a 12% increase in PwC's prices, and 8% for the remainder of the industry.

5.4 Oxera use a very basic method to make these predictions. A merger or an exit is simply assumed to cause a one off change in HHI and market share, with everything else held constant. There are a number of reasons why this method is likely to overstate the impact of the PW/C&L merger on price:

- If a merger does lead to an increase in relative price for the merged firm, then this would be likely to lead to a loss of some audit contracts, with market share and the HHI falling back. Oxera fail to take into account this "feedback" effect.

- A merger is likely to result in efficiency savings which have a tendency to cause prices to fall.

- Oxera use aggregate market shares, rather than sector market shares. If the merging firms specialise largely in different sectors this will overstate the increase in market concentration.

5.5 However, perhaps the most surprising aspect of Oxera's method is that they appear to use PwC's actual post-merger market shares (and HHI) rather than the market share that would have been predicted at the time of the merger. This matters a great deal because PwC's post-merger market share was significantly greater that the combined individual market shares of PW and C&L (42.2% compared to 37.5%[30]).

5.6 The impact of different assumptions on the predicted price rise of the PW/C&L merger, using Oxera's own model and underlying approach, is illustrated in the table below.

Figure 8: Model predictions of impact of PW/CL merger

	C&L price change	PW price change	Non-merging firms
Oxera estimate	11.5%	19.1%	7.8%
PwC estimate 1 (market shares retained)	9.4%	13.1%	5.9%
PwC estimate 2 (PwC loses 3.7% of their contracts)	7.8%	14.3%	5.4%

5.7 In order to undertake this exercise we first replicated Oxera's reported result in order to understand the assumptions they used to arrive at it. The PwC estimates in the table are based on different assumptions applied to Oxera's own model and basic approach, effectively assuming for the purposes of this exercise that Oxera's estimated model can be relied upon. As already noted, Oxera's results appear to be based on an assumption that price rises would be based on the actual increase in PwC's market share observed in Oxera's dataset. For PwC estimate 1 we changed this to an assumption that market shares did not change post-merger (i.e. PwC picked up all of PW/C&L's clients but did not win any more clients). On this basis, the predicted price increases would be 2 percentage points lower than Oxera's estimates for both C&L and the industry, and 6 percentage points lower for PW[31].

5.8 However, PwC would be expected to lose some contracts given that the Oxera model predicts that C&L's prices would increase by 3.7 percentage points more than the remainder of the industry. Assuming that this leads (conservatively) to a 3.7% loss of contracts, this leads to a price rise of only 7.8% for C&L and 5.4% for the industry.

[30] These are the market shares reported by Oxera (page 62) based on their dataset.
[31] The PW price rise is unreported in the Oxera report. The PW price rise is higher because Oxera's model predicts that pre-merger, PW prices were 7% lower than those of C&L because of PW's lower market share. As post-merger both firms charge the same price, the percentage price increase for PwC is significantly higher.

5.9 In reality, contrary to the predictions of the model, there was no apparent increase in PwC's prices (see below), and PwC increased rather than lost market share. Oxera's model predicts a relative price increase for PwC post-merger, which is inconsistent with Oxera's own market share data that shows that PwC's market share actually rose. Nevertheless, Oxera ignore this contradiction, using the inconsistent higher post-merger market share in their calculations, generating a higher implied relative price increase which simply emphasises the inherent inconsistency of both their model and their approach to simulating the likely price change following a merger.

5.10 The manner in which Oxera use their model to predict the impact on audit fee of the loss of one of the big 4 firms is also controversial, and several of their assumptions can be questioned:

- The calculated HHI is based only on listed firms only. Arguably this overstates the HHI, leading to higher predicted price increases.
- All the clients of the firm exiting the market are assumed to migrate only to the remaining big 3 auditors, again, potentially overstating the predicted price effects.
- Oxera assume that KPMG exits the market. Predicted price increases are significantly lower if the exiting firm is PwC or E&Y.

5.11 We have attempted to reproduce Oxera's analysis, using the HHIs from our own version of Oxera's dataset, and based on the assumption that if a big 4 firm exits the market, all other firms pick up these clients in proportion to their market shares. This assumption is potentially too extreme if, for example, there are some small audit firms which do not compete with the big 4 and therefore would not realistically expand their market share as a result of a big 4 market exit, but it illustrates the potential impact of alternative assumptions.

Figure 9: Model predictions of exit of big 4 firm

	HHI effect	**Market Share Effect**	**Total Effect**
Oxera – KPMG exit	5.5%	1.5%	7.0%
PwC – KPMG exit	5.1%	1.3%	6.4%
PwC – PwC exit	1.9%	3.1%	5.0%
PwC – Deloitte exit	4.9%	1.2%	6.1%
PwC – E&Y exit	4.9%	1.1%	6.0%

5.12 Our results show that the impact of using the PwC dataset is to reduce the predicted price rise for the remaining big 3 from 7% to 6.4%.

5.13 It also shows that Oxera's choice of KPMG leads to the highest predicted price increases. Interestingly, the lowest predicted price increase would be if PwC were to exit the market.

The reason for this is that the effect of the loss of a major competitor on the HHI is significantly offset by the remaining three firms in the market now having approximately equal market shares. This perhaps illustrates better than anything else why the HHI does not provide a good measure of the effectiveness of competition in a bidding market.

5.14 As stated elsewhere in this report, price-concentration models like Oxera's do not have predictive power because they only examine correlation, not causality and market structure. In order to examine the likely impact on the market of a future reduction in the number of high quality audit firms it would be necessary to examine a wide range of factors not included in Oxera's analysis, including the response of the largest audit clients who currently tend to purchase audits only from one of the big 4 firms. Such large companies are accustomed to managing their supplier base very proactively. It seems likely that if they were concerned that with only 3 firms there would be inadequate competition, potentially leading to higher prices and/or lower quality, they would have an incentive to sponsor new entry. This might well be feasible as the only existing barriers to entry for the tier of firms below the big 4 are commercial, and the big audit clients could help overcome these by awarding contracts. In these circumstances the resources of the exiting big 4 player might be acquired largely by a new entrant so that 4 firms would be maintained.

5.15 Of course it is also the case that the big clients might be satisfied with a choice of 3 top quality firms. It is also the case that if the big clients were currently concerned that competition and choice was too limited with 4 high quality firms they could sponsor entry in a similar way to create a big 5; and that if prices have indeed risen with concentration and reduced competition as Oxera suggest, there would be every commercial incentive for smaller audit firms to make the investments necessary to break into the top tier to earn the high rewards apparently available there. That the market has not reacted in this way is consistent with there being no fundamental problem currently with choice, competition, fees and quality.

Is there evidence of price increases attributable to the PW/C&L merger?

5.16 Oxera's model predicts that prices would have risen following the merger of PW and C&L. However we find that there is no conclusive evidence from our sample that audit fees actually did rise as a result of the merger.

5.17 Oxera's report suggested that the merger would have led to a 12% increase in fees for PwC clients, and 8% for the audit market. One of the studies quoted by Oxera in support of their analysis, however, claimed that *"audit fees fell on average after the 1997 merger between Price Waterhouse and Coopers & Lybrand."* [32] Looking at the audit fees as a percentage of turnover for our sample, we find that audit fees for the big 4 appear to have been largely unaffected in the period 1997-1998. In fact looking at subsequent years there appears to be a slight fall in average audit fees.

5.18 Working out whether the PwC merger actually led to clients paying higher or lower fees is not straightforward. The main difficulty is that we do not know what would have happened to those fees in the absence of the merger. Whilst we can observe actual fees, there are many other factors that will have caused fees to have changed from the previous year other than the merger. To control for this, our approach has been to compare the actual audit fees paid with those that the Oxera model would predict would have been paid if there had been no increase in the HHI and no change in market share. In effect, this means that we are predicting what

[32] Abstract, from: McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA auditing SIG conference 2005.

fees would have been paid in the years following the merger just on the basis of the change in the client firms' turnover.

5.19 A further problem is that we cannot know which clients PW and C&L would have won and lost in the absence of the merger. To control for this, we have tracked those companies who were clients of either PW or C&L before the merger, and who afterwards were retained by PwC. We have therefore excluded from the dataset those clients who switched away from PwC, together with the new clients gained by PwC.

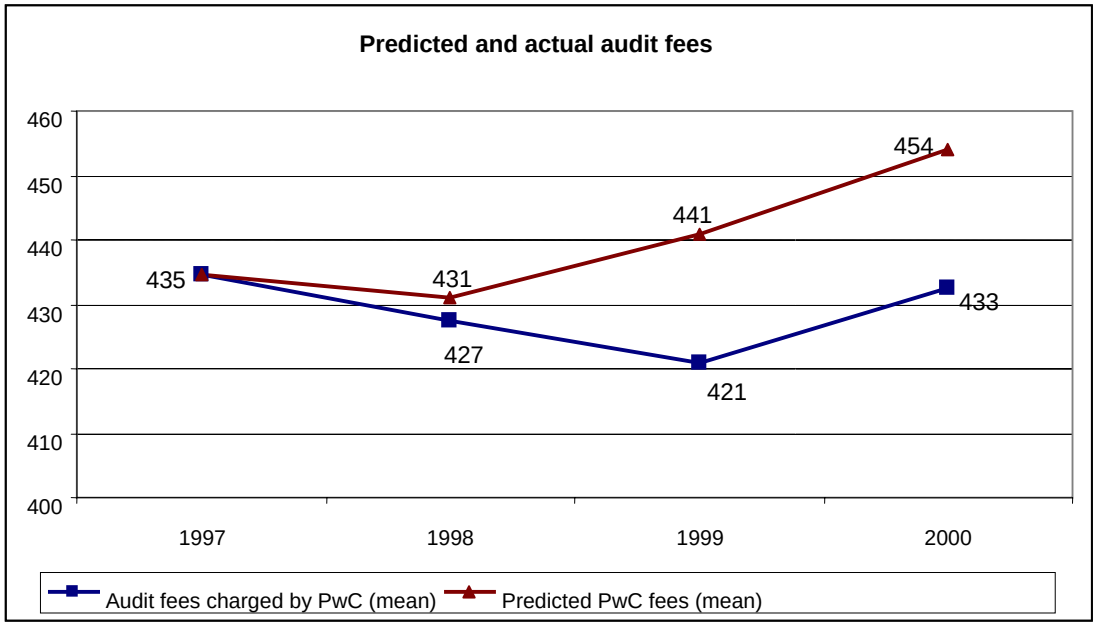
5.20 There is also the question as to the year to start and end our analysis of the impact of the merger. The merger took place in the middle of 1998, and the database shows that some clients were audited by PW or C&L in that year and some by PwC. Also, as audit fees may be negotiated for more than one year in advance, the effect of the merger on prices may not have been felt until 1999, 2000, or even beyond. Our approach to this problem is to take 1997 as the base year, as it was the last full year in which PW and C&L existed as separate entities. We compare this with the actual and forecast prices paid in 1998, 1999, and 2000.

5.21 Our analysis is set out in figures 10 and 11 below.

Figure 10: PwC clients (observed in all four years, 1997-2000) – unadjusted

PwC	1997	1998	1999	2000
Average audit fee (£000 1995 prices)	435	427	421	433
Average turnover (£000 1995 prices)	1171	1147	1209	1293

Figure 11: Predicted PwC fees (turnover adjusted) v actual PwC audit fees



5.22 This shows that, contrary to the impression given by Oxera, the PwC merger actually led to a slight reduction in the average audit fee charged to clients both in 1998 and 1999. The average real audit fee for PwC clients was £435k in 1997, falling to £427k in 1998 and £421k in 1999. The average fee in 2000 rose to £433k, but was still below the level for 1997 in real terms.

5.23 Furthermore, we would have expected real audit fees to increase over this period as turnover increased. When we use the Oxera model to control for this[33], we find that real audit fees were lower in 1998, 1999, and 2000 than those predicted by the Oxera model (see figure 11). Importantly, the predicted fees in figure 11 assume no merger – so, despite the merger going ahead, which according to Oxera's analysis should have resulted in PwC's prices increasing significantly, audit fees actually fell in real terms and were significantly below the level that Oxera's model would have predicted in 1997 even if no merger was assumed. In view of this, there is no evidence of any price increase resulting from the merger, and, if anything, the merger is associated with lower PwC prices. This is inconsistent with Oxera's model, but consistent with PwC increasing its market share after the merger.

5.24 A relevant issue is why our results are so different to those obtained by Oxera. The answer is that Oxera's approach to estimating the impact of the merger is based on the average effect they believe a change in HHI and market share would have had on prices, whereas our approach is to consider what actually happened to prices. We have also considered what we would have expected to have happened, controlling for changes in turnover. The inability of the Oxera model even to predict the *direction* of change of market share and price following the PwC merger illustrates the limitations and weakness of their approach.

Are Oxera's findings consistent with the academic literature?

5.25 Oxera list a number of academic studies which they state show similar results to their findings. Such studies include some which find that audit mergers lead to higher prices, studies which show a big 4 pricing premium, and studies which reach the same conclusions as Oxera on the significance of certain explanatory variables such as turnover and international presence.

5.26 To check whether Oxera's findings are, as they suggest, generally supported by the literature, we looked in detail at a number of recent (post-2000) studies. Carrying out a comprehensive literature review was beyond the scope of our work but we looked at a larger sample of studies than those referred to by Oxera. In our sample there appears to be very little consensus on whether audit mergers raise prices, or whether there is a significant big 4 premium.

5.27 Whilst most of the papers we considered find a big 4 premium, none convincingly account for why this occurs. In some papers, the premium disappears when risk and other variables are accounted for.

5.28 In our sample the literature regarding the effect of an increase in concentration on audit prices appears to be split, as is the literature that explicitly investigates the PW/C&L merger. Indeed, one of the papers quoted by Oxera as finding that *"auditors' mergers lead to increased audit*

[33] Using the coefficient for turnover (0.43) from Oxera's model III.

fees" (page 79) finds that *"…audit fees fell on average after the 1997 merger between Price Waterhouse and Coopers & Lybrand."*[34]

5.29 There is more literature on switching than has been reported by Oxera. The sample analysed tends to support the existence of discounts for switching auditors. However, one sample suggests that this has not been in effect since 1987[35], and another study suggests a discount of only 4% for switching between the big auditors, in contrast to a 24% discount for switching between small auditors.[36]

5.30 The econometric techniques and equation structure appear to be fairly consistent across the literature we reviewed. In particular, nearly all the studies we saw use (log) audit fee as a proxy for price (consistent with Oxera), and nearly all the sample of studies have one or more measures to proxy the complexity of the audit, which Oxera do not attempt to measure. In addition, a number of the studies we looked at appear to attempt to control for the risk of the audit (e.g. through the gearing ratio). Again this was an area not covered by Oxera. Most importantly, none of the studies we considered use both market share (as constructed by Oxera) and audit fees in a regression model.

5.31 In summary, the literature we reviewed is inconclusive regarding the source of any premium for the large auditors. In addition, there is little consensus that changes in concentration, such as the PW/C&L merger, lead to increased prices. This suggests that other factors, such as complexity, risk, and quality, not directly considered in the Oxera model, may be responsible for any rise in observed audit prices. Further details of the academic literature we reviewed are contained in the appendix.

[34] Abstract, from: McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA auditing SIG conference 2005.
[35] Ibid.
[36] Ghosh, Lustgarten (2005), "Pricing of Initial Audit Engagements by Large and Small Audit Firms", Contemporary Accounting Research, July 2005.

6 Appendix 1: Literature Review

Introduction

6.1 Below is reported an overview of the literature on audit fee pricing. We have looked at a number of recent (post-2000) studies. There appears to be further literature in the areas of switching and industry specialisation that is not explicitly considered here. The key conclusion to arise from this literature survey is that there is relatively little consensus.

Premium for Big Auditor

6.2 Most of the studies use data predating the collapse of Andersen and the PW/C&L merger and so investigate a Big Six premium. Hence, the existence of such a premium cannot provide evidence that a reduction in the number of large auditors to four is responsible for the observed premium.

6.3 Basioudis and Ellwood (2005)[37] investigate price competition in the market for NHS audit services. Given that this is data from a single highly regulated sector, it is questionable how far the results of this study should be generalised to the rest of the market. This is important as this paper is one of only five papers cited by Oxera as supporting its results regarding concentration and audit pricing. The paper finds that big auditors earn a premium of 9.7% on NHS audits, and that a large proportion of this is accounted for by PwC, who earn a 15.7% premium over small auditors. The report states that results "can be interpreted as price competition with differentiated products by the Big Five firms prevailing in the NHS trust audit market."[38]

6.4 Oxera also cite Beattie, Goodacre, Pratt and Stevenson (2001)[39] in support of their results. This study finds a Big Six premium of 18.5% in the charity sector audit market. However, there is only robust evidence for a Big Six premium in fund-raising charities, not grant makers. In addition, the study reports that the charity sector audit market is characterised by lower prices than the company audit market. This suggests that prices in this market may be set by different mechanisms than in the company audit market (for instance, underpricing charity audits as a means to "donate"), and suggest that caution should be exercised in generalising the findings to the much larger company audit market.

6.5 The other paper cited by Oxera as supportive of its results is Sankaraguruswamy and Whisenant (2003)[40] which does not appear to quantify its finding of a big auditor premium. This paper also does not focus on this issue.

6.6 McMeeking, Peasnell, Pope (2000)[41] and McMeeking, Peasnell, Pope (2003)[42] both find evidence of a big auditor premium. The 2000 paper suggests a premium in the range 10.3% to 23.2% and the 2003 paper suggests a premium of 15% that disappears when allowance is

[37] Basioudis, Ellwood (2005), "An Empirical Investigation of Price Competition and Industry Specialisation in NHS Audit Services", Financial Accountability & Management, 21:2, 219-50, May 2005.
[38] Ibid., p.244.
[39] Beattie, Goodacre, Pratt, Stevenson (2001), "The Determinants of Audit Fees - Evidence from the Voluntary Sector", Accounting and Business Research, 31:4, Autumn 2001, 243-74.
[40] Sankaraguruswamy, Whisenant (2003), "Pricing Initial Audit Engagements: Empirical Evidence Following Public Disclosure of Audit Fees", Singapore Management University, School of Accountancy.
[41] McMeeking, Peasnell, Pope (2000), "UK evidence of auditor brand name and industry specialisation"
[42] McMeeking, Peasnell, Pope (2003), "The Determinants of the UK Big Six Premium".

made for size, risk and non-audit services. The 2003 paper also suggests that prior literature on a Big Six premium in the UK is mixed.

6.7 Hence, whilst a majority of recent papers are supportive of a premium paid to big auditors, there is a concern as to whether some of the studies can be generalised from specific sector studies to form conclusions regarding the whole audit market. In addition, there is evidence that the finding of a premium is highly dependent on the variables controlled for in the regression equation.

Has increased concentration raised prices?

6.8 Oxera cite McMeeking, Peasnell and Pope (2005)[43] in support of their findings that increased concentration has increased audit prices. However, the evidence provided by this paper is far from conclusive. Instead of a general finding that increased concentration has raised prices, this paper finds that…

"…After the mergers in 1989/90 between Coopers & Lybrand and Deloitte and between Arthur Young and Ernst & Whinney, audit fees tended to increase. In contrast, audit fees fell on average after the 1997 merger between Price Waterhouse and Coopers & Lybrand. The merger between Deloitte and Andersen in 2002 appears not to have materially affected audit fees to date."[44]

6.9 This does not seem to be convincing evidence that increased concentration has increased audit prices.

6.10 A number of other papers find evidence that audit prices have not risen as concentration has increased. Baskerville and Hay (2006)[45] and Ivancevich and Zardkoohi (2000)[46] both find that prices have not risen due to increased concentration, and Menon and Williams (2001)[47] find only a short-term effect, with no long term effect. The Ivancevich and Zardkoohi, and Menon and Williams papers are both widely cited in other papers.

6.11 Baskerville and Hay (2006) investigate audit pricing in New Zealand. It is questionable therefore how much we should apply these results to the UK market. A large sample of data is used but no econometric techniques are applied.

6.12 Ivancevich and Zardkoohi (2000) uses mostly descriptive methods but find that:

"While largely descriptive in nature, the evidence suggests that the net effect of the mergers was predominantly the creation of productive efficiency. Despite the fact that audit-market concentration increased subsequent to the mergers, no evidence was found in this study that suggests that anti-competitive effects resulted from the megamergers. Instead, the results suggest that the megamergers actually had pro-competitive effects on the market for audit services."

[43] McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA auditing SIG conference 2005.
[44] Ibid. (Abstract)
[45] Baskerville, Hay (2006), "The Effect of Accounting Firm Mergers on the Market for Audit Services: New Zealand Evidence", ABACUS, Vol. 42, No. 1, 2006.
[46] Ivancecvich, Zardkoohi (2000), "An Exploratory Analysis of the 1989 Accounting Firm Megamergers", Accounting Horizons, Vol. 14 No. 4, December 2000, pp. 389–401.
[47] Menon, Williams (2001), "Long-Term Trends in Audit Fees", Auditing: A Journal of Practice & Theory, Vol. 20, Issue 1, March 2001.

6.13 Menon and Williams (2001) find that the 1989 megamergers had a short-term, but not a long-term impact on audit fees in the US. This paper is also notable in making explicit the importance of controlling for variables such size, complexity and risk. A link is also identified with the introduction of more demanding standards, and audit fees.

6.14 In summary, there appears to be little evidence from the literature that changes in concentration have increased audit fees. In fact the weight of evidence would seem to suggest that, once other factors such as size, complexity, risk, and the introduction of more demanding standards, have been accounted for, audit fees have not risen as a result of audit firm mergers.

Did the Price Waterhouse/Coopers & Lybrand merger raise prices?

6.15 There has been little direct study of this merger directly. Two studies provide evidence, both broadly supportive of the hypothesis that the merger did not lead to higher prices.

6.16 McMeeking, Peasnell and Pope (2005)[48] suggest that, whilst concentration did increase, audit fees actually fell following the PW/C&L merger. Pong and Burnett (2006)[49] investigate the merger in more detail and find no increase in prices charged by PwC as a result of the merger. Whilst they do not provide evidence of the effect on the price set by other auditors, it seems unlikely that prices could have risen far, given that PwC's prices were unchanged.

Price discounts from switching between auditors

6.17 The sample of the literature is again inconclusive regarding whether switching auditors tends to achieve lower prices. Three of the papers cited by Oxera provide evidence on switching.

6.18 Ghosh and Lustgarten (2005)[50] find a 24% initial discount from lateral switching between small auditors, but only a 4% discount for switching between large auditors. They attribute this to lower price competition between large auditors than between small auditors. However, they do not justify this assertion, instead relying on a claim that "price competition is known to be less intense in oligopolistic compared to atomistic markets"[51]. The extent to which this claim is correct depends greatly on the specific market, and the economic model used to represent the market.

6.19 McMeeking, Peasnell and Pope (2005) find that "significant discounts were offered by audit firms to attract new business in 1986 and 1987 but fee discounting ceased to be material in subsequent years."[52]

6.20 Sankaraguruswamy and Whisenant (2003) suggest that auditors discount initial audit engagements in the first two years of engagements, with fee discounts fading to normal levels by the third year. They also find that fee discounting occurs for both lateral and upgrade (non-Big Five to Big Five) auditor realignments.

[48] McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA auditing SIG conference 2005.
[49] Pong, Burnett (2006), "The implications of merger for market share, audit pricing and non-audit fee income: The case of PricewaterhouseCoopers ", Managerial Auditing Journal, 21:1, pp. 7 – 22.
[50] Ghosh, Lustgarten (2005), "Pricing of Initial Audit Engagements by Large and Small Audit Firms", Contemporary Accounting Research, July 2005.
[51] Ibid., (Abstract).
[52] McMeeking, Peasnell, Pope (2005), "The effect of audit firm mergers on audit pricing in the UK", paper presented at the BAA auditing SIG conference 2005, p. 22.

6.21 Lower prices upon switching would be consistent with a hypothesis that the threat of switching is not particularly credible, since the threat is not sufficient to force incumbent auditors to discount their prices to the same extent after a number of years. On the other hand, a switch of auditor is likely to entail a drop in quality, as the auditor "gets to know" the firm. It would be expected that companies would only be willing to pay a lower price in order to receive a lower quality audit. On the other hand, low pricing of initial audit engagements tends to suggest that there exists effective price competition when audits go out to tender.

6.22 Hence, whilst the empirical evidence is weighted in favour of fee discounting for initial audit engagements, there is no consensus within the literature on this issue. In addition it is not clear what this evidence implies for competition within the industry.

Econometric Techniques

6.23 All of the studies using econometric techniques use a standard audit pricing equation, with pricing proxied by (log) audit fee. There is some difference over the extent to which exogenous variables such as risk and complexity are controlled for.

6.24 More recent papers have tended to try and control for these factors since they are clearly reasons why some audits may be more costly to conduct than others. This would suggest that analysis conducted without these variables could be biased.

6.25 It seems likely that audit complexity could be correlated with size of auditor. Larger auditors may have the expertise to take on particularly complex audits that smaller firms may lack. In addition, complexity is likely to be related to size of auditee (larger firms will have more different products, subsidiaries, forms of finance and so on), but this may not be completely accounted for by controlling for auditee size (normally proxied by turnover). Since larger auditors generally audit larger firms, using auditee size as the only control for complexity will tend to bias results on pricing of audits by large auditors versus smaller auditors.

6.26 Large auditors may also tend to conduct more risky audits, possibly because the large size of the auditee increases the potential cost to the auditor of an error leading to collapse of the auditee, or because of the high profile nature of many clients of large auditors. Large auditors are also inherently more able to take on risky audits, since they can absorb any adverse consequences more easily, but they will still need compensation to take on more risky audits.

6.27 None of the studies we looked at appear to use a market share variable constructed in the same manner as Oxera's to explain audit fees. For example, McMeeking, Peasnell and Pope (2005) constructed market share as the number of audit clients by the auditor.

Summary

6.28 There is little agreement within the literature over many of the areas where Oxera cited the literature as supporting its case. Evidence is probably weighted in favour of a premium earned by large auditors, though it is unclear whether this might relate to brand, complexity, risk, quality or other factors. Evidence on increased concentration raising prices is weaker still, and there is no evidence that the PW/C&L merger in particular led to higher prices. There is stronger evidence to suggest that initial fee discounting may exist for firms that switch auditor, although there are different ways to interpret this evidence. In terms of the econometric techniques employed, it seems clear that there is potential bias arising from the omission of variables such as risk and complexity that may affect audit pricing and be potentially correlated with auditor size.