

**THE RELATIONSHIP BETWEEN AUDITOR ACCURACY AND
AUDITOR SIZE: AN EVALUATION OF REPUTATION AND
DEEP POCKETS ARGUMENTS**

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ABSTRACT: Empirical results presented in this paper indicate that large auditors are more accurate than small auditors. DeAngelo (1981) has argued that large auditors have more incentive to maintain a reputation for accurate auditing because an audit failure may lead to a loss of rents due to auditor switching. In addition, Dye (1993) and Schwartz (1997) have shown that the depth of an auditor's pockets may be an important determinant of accuracy. The aim of this paper is to discriminate between these two explanations. In a deep pockets model, it is shown that large auditors may receive relatively more litigation despite having more incentive to issue accurate-reports. This is consistent with evidence presented in this paper. On the other hand, the evidence does not indicate that auditors suffer losses of clients or lower fees as a result of criticism. These findings suggest that deep pockets rather than reputation help to explain the superior accuracy of large auditors.

INTRODUCTION

This paper shows that auditor accuracy is positively correlated with auditor size and aims to discriminate between the reputation and deep pockets explanations for this relationship. DeAngelo (1981) has argued that large auditors have more incentive to avoid issuing inaccurate reports because of reputation effects. If it becomes public knowledge that an auditor has negligently issued an inaccurate report, the auditor could suffer a loss of rent due to auditor switching. Since large auditors have higher client-specific rents than small auditors, the loss of rent is likely to be greater for a criticised large auditor than a criticised small auditor. Therefore, large auditors should have more incentive to issue accurate reports.

Alternatively, large auditors may have more incentive to issue accurate reports because they have deeper pockets.¹ Previous research has shown how auditor accuracy is increasing in the size of the litigation penalty that is suffered when an auditor is sued for mis-reporting (Dye, 1993; Schwartz, 1997). This paper describes a deep pockets model which differs from previous models in two ways. First, the company's decision to sue the auditor is endogenised. This is important as one would expect auditors' wealth to affect the company's decision to sue the auditor. Secondly, the company's decision to hire a large or small auditor is endogenised. This is important because auditors' wealth may affect the hiring decision through its effects on accuracy and the size of the litigation penalty. The model shows that the deep pockets of large auditors not only give them more incentive to exert effort, but also make it more likely that a large auditor is sued conditional on an audit error occurring. Therefore, it is possible for large auditors to receive more litigation than small auditors despite their superior accuracy.

¹ The Economist writes (7th October, 1995). "As partnerships, the large accountancies operate under the legal principle of joint and several liability. This means that when a company collapses, its auditors who not only have deep pockets, but cannot abscond, may be hit for the entire bill if they were negligent, even if other parties were careless too. Moreover, if the claim amounts to more than an auditing firm's capital, all of the firm's partners are liable right down to their bootstraps for the bill - even if they had nothing to do with the error." Similarly, the Financial Times writes (4th July, 1996), "The big audit firms can find themselves targeted for lawsuits because of their 'deep pockets' - including their statutory insurance cover." Large auditors have frequently argued that they are more litigation-prone than small auditors, and this has led them to seek an amendment to the law on joint and several liability.

If either the reputation or deep pockets arguments are valid, one should find that large auditors issue more accurate reports than small auditors. This paper shows that the evidence for the UK supports this prediction. In the absence of a deep pockets effect, the reputation argument implies that large auditors are more accurate because they have more incentive to avoid reputation-damaging criticism. Therefore, according to the reputation argument large auditors should receive less criticism (and litigation) than small auditors. In the deep pockets model, large auditors may receive more litigation than small auditors despite their superior accuracy. An investigation of the relationship between auditor size and criticism (and litigation) provides one way in which to distinguish between the deep pockets and reputation effects. In the absence of a reputation effect, the deep pockets model predicts no relationship between criticism of auditors and auditor switching. In contrast, the reputation model predicts that a criticised auditor should suffer a fall in demand compared to similar uncriticised auditors. An investigation of the relationship between auditor criticism and the demand for an auditor's services provides a second way in which to distinguish between the reputation and deep pockets effects.

THE DEEP POCKETS MODEL

This section presents a model in which auditors have different levels of wealth. The framework is similar to Dye (1993) where it was shown that more wealthy auditors have more incentive to issue accurate reports because they suffer larger litigation penalties. However, the model differs from previous models by endogenising the company's hiring decision and endogenising the decision to sue the auditor. The timing of the model is shown in figure 1.

[INSERT FIG. 1 HERE]

First, nature determines the company's going-concern status. The company is non-failing (N) with probability p and failing (F) with probability $1-p$, where $0 < p < 1$. A non-failing company has a net present value Π_N , whilst a failing company has a net present value Π_F , where $\Pi_N > 0 > \Pi_F$. At the end of the game, the company is sold to an investor who does not observe the company's going-concern status but does observe the auditor's report.² Perfect competition is assumed amongst potential investors so that the company's selling price is equal to the expected value of the company given the content of the audit report.

A company is a high audit risk if the costs of suing its auditor are low (K_R), and it is a low audit risk if its litigation costs are high (K_N), where $K_N > K_R > 0$. The assumption that companies have different litigation costs captures the fact that client characteristics other than financial health help explain the amount of litigation incurred by auditors (Stice, 1991; Stice, 1993; Hall and Renner, 1988). A company has low litigation costs with probability h , where h is determined by nature and $0 < h < 1$.

Following the moves by nature, the owner decides whether to hire a large or small auditor - it hires a large auditor with probability l , and a small auditor with probability $1-l$. It is assumed that the owner does not observe the company's going concern status or litigation costs when the hiring decision is taken.³ The owner simply observes the prior probabilities, p and h .

Following the hiring decision, auditor j chooses effort e_j , where $e_j \in [e, 1]$ and $j = L, S$ (L denotes a large auditor and S a small auditor). It is assumed that the auditor does not observe the company's going-concern status prior to the effort decision - otherwise, there would be no need for the auditor to exert effort. In addition, it is assumed that the auditor does not observe the company's litigation costs.⁴ The auditor only observes the prior probabilities, p and h . Exerting effort imposes a non-pecuniary cost on the auditor of $C(e_j)$,

² The assumption that the company has to be sold at the end of the period avoids any adverse selection problems between the owner and potential investors.

³ The key insights of the model are robust to relaxing this assumption.

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where $C'(e_j) > 0$, $C''(e_j) > 0$, $C(e) = 0$ and $C(1) = +\infty$.⁵ The accuracy of audit reports can be measured in terms of type I and II errors. A type I error occurs if a failing company is given a report of "N"; a type II error occurs if a non-failing company is given a report of "F". The auditor's gain from exerting effort is that the audit report is more likely to be accurate. It is assumed that the company receives an accurate report with probability e_j .

$$\text{Prob}["F" | F, e_j] = \text{Prob}["N" | N, e_j] = e_j$$

The selling price of the company depends on whether the report is "F" or "N" and whether the report is given by a large or small auditor. The selling price of the company given a report of "N" by auditor j is:

$$S_j^{"N"} = \frac{pe_j \Pi_N + (1-p)(1-e_j) \Pi_F}{pe_j + (1-p)(1-e_j)}$$

The selling price of the company given a report of "F" by auditor j is:

$$S_j^{"F"} = \frac{p(1-e_j) \Pi_N + (1-p)e_j \Pi_F}{p(1-e_j) + (1-p)e_j}$$

An increase in auditor effort (e_j) increases $S_j^{"N"}$ and reduces $S_j^{"F"}$. The minimum level of effort (\underline{e}) occurs where $S_j^{"N"} = S_j^{"F"}$ implying that $\underline{e} = 0.5$. In this case, the audit report is completely uninformative about the company's going-concern status.

The threat of litigation if the company fails deters the auditor from always shirking. It is assumed that auditors can only be sued for committing type I errors; this raises the question as to why auditors would not choose to always shirk and report "F". Following previous

⁵ The assumption that the cost of effort is non-pecuniary simplifies the analysis as it implies that effort does not affect the auditor's wealth.

research, it is assumed that this is not possible - there are three possible justifications for this. First, if auditors always shirk audit reports are completely uninformative about the probability of bankruptcy. Hence, there would be no voluntary demand for an auditor's services and there would be no point in having a mandatory audit. Secondly, it has been argued that the non-failing company might sue an auditor who reports "F", and that the threat of litigation would deter the auditor from always reporting "F" (Dye, 1993).⁶ Finally, empirical evidence indicates that a company is more likely to switch its auditor if it receives a qualified report (Chow and Rice, 1982; Craswell, 1988; Citron and Taffler, 1992; Krishnan and Stephens, 1995). This suggests that auditors have an incentive to avoid always reporting "F" because a conservative report is likely to trigger a switch of auditor and a loss of rent.

It is assumed that the company observes its going concern status and its litigation costs when deciding whether to sue its auditor. This is realistic because many litigation claims against auditors occur after companies enter bankruptcy. The litigation penalty suffered by an auditor who is sued for committing a type I error is assumed to equal the auditor's wealth (W_j) (Dye, 1993). The assumption that large auditors have deeper pockets than small auditors ($W_L > W_S$) reflects the legal reality of joint and several liability for audit firms.

Previous deep pockets models have assumed that auditors are always sued for committing type I errors. Proposition 1 demonstrates that this is true if litigation costs are sufficiently low.

Proposition 1

When $W_L > W_S > K_N > K_R$, both large and small auditors are sued for committing type I errors, large auditors exert more effort than small auditors ($e_L > e_S$), and large auditors are less likely to be sued compared to small auditors. Equilibria exist in which the company only

⁶ However, this argument appears to conflict with evidence indicating that auditors are only sued for issuing reports which are insufficiently conservative rather than for reports which are too conservative (St. Pierre and Andersen, 1984).

hires a large auditor ($l = 1$), only hires a small auditor ($l = 0$) or adopts a mixed hiring strategy ($0 < l < 1$).

Since litigation costs are lower than auditors' wealth, the failing company always sues an auditor who issues a report of "N" - this is true irrespective of the auditor's size. The auditor chooses effort to minimise the total expected cost of effort and litigation (TC).

$$\min_{e_j} TC_j = C(e_j) + (1-p)(1-e_j) W_j \quad (j = L, S)$$

This gives the first order condition, $C'(e_j) = (1-p) W_j$. Since $W_L > W_S$ and $C''(e_j) > 0$, it must be true that $e_L > e_S$. Therefore, large auditors' reports are more accurate than small auditors' reports and large auditors are less likely to be sued. When making its hiring decision, the superior accuracy of large auditors means that the company has an incentive to choose the less accurate small auditor - doing this increases the probability of a type I error. However, conditional on a type I error occurring, the company would prefer to sue the large auditor who has deeper pockets. Therefore, it is ambiguous whether the company prefers to hire the less accurate small auditor or the large auditor who has deeper pockets. The company's hiring decision depends on the numerical values of the model's parameters. Proposition 2 considers levels of litigation costs where auditors are not always sued for committing type I errors.

Proposition 2:

1. When $K_N > K_R > W_L > W_S$, neither the small nor large auditor face the threat of litigation. Therefore, both auditors choose the minimum level of effort ($e_L = e_S = 0.5$)

and audit reports are completely uninformative about the probability of bankruptcy. Companies are indifferent between hiring large and small auditors ($0 < l < 1$).

2. When $W_L > K_N > K_R > W_S$, the large auditor is always sued for committing type I errors whilst the small auditor is never sued. Since the small auditor faces no litigation threat it chooses the minimum level of effort ($e_S = 0.5$). In contrast, the large auditor chooses to exert effort such that $C'(e_L) = (1-p) W_L$. The company always hires the large auditor ($l = 1$), because it can sue the auditor if it fails whereas it never sues the small auditor [$(1-p)(1-e_L)W_L > 0$].

3. When $W_L > K_N > W_S > K_R$, the large auditor is always sued for committing type I errors whilst a small auditor is only sued by companies that have low litigation costs. The large auditor exerts effort such that $C'(e_L) = (1-p) W_L$, whilst the small auditor exerts effort such that $C'(e_S) = h(1-p) W_S$. Whilst small and large auditors' reports are informative about the probability of bankruptcy, large auditors' reports are more accurate ($e_L > e_S > 0.5$). Equilibria exist in which the company only hires the large auditor ($l = 1$), only hires the small auditor ($l = 0$) or adopts a mixed hiring strategy ($0 < l < 1$). As in Proposition 1, the company's hiring decision depends on the numerical values of the model's parameters.

The deep pockets model is consistent with the reputation models in predicting a positive correlation between auditor accuracy and auditor size. However, the deep pockets model predicts an ambiguous relationship between auditor size and litigation. The superior accuracy of large auditors means they are less likely to commit type I errors and this reduces the probability of litigation for large auditors. However, their deep pockets mean that a large auditor is more likely to be sued conditional on a type I error occurring. The appendix provides numerical examples where large auditors are less likely to be sued because of their

superior accuracy, and where large auditors are more likely to be sued because of their deep pockets.

THE EMPIRICAL EVIDENCE

The evidence for this paper consists of 1036 UK publicly quoted companies over the period 1987-94. Data were collected on each company's auditor, audit report, shareholdings and assets from annual reports kept on microfiche at Warwick University - the sample was selected on the basis of microfiche availability. Between 1987-94, there were 123 companies that entered bankruptcy and 913 companies that did not fail. A company is defined as failing if it entered administration, liquidation or receivership.⁷

Previous studies have calculated the type I and type II error rates of audit reports as a way of measuring auditor accuracy (Altman and McGough 1974; Deakin 1977; Koh 1991). The type I error rate is the proportion of failing companies that are given unqualified reports, whilst the type II error rate is the proportion of non-failing companies that are given qualified reports. The overall accuracy rate measures the proportion of accurately classified observations. The key assumption of this approach is that auditors give qualified reports to those companies that they believe have the highest probabilities of bankruptcy.⁸ The type I and type II error rates for small and large audit firms are shown in Table 1.

[INSERT TABLE 1 HERE]

The high type I error rates and low type II error rates reflect the low frequency of audit qualifications. For general qualifications, large auditors had a type I error rate of 75.32% and a type II error rate of 2.31%. In contrast, small auditors had a type I error rate of 84.78% and

⁷ This corresponds to the definition used by the Stock Exchange Financial Yearbook.

⁸ This approach does not imply that a qualified report is equivalent to a prediction of bankruptcy by the auditor.

a type II error rate of 3.06%. Large auditors also had lower type I and type II error rates for going-concern qualifications. The higher accuracy rate of large auditors is statistically significant at the 95% confidence level - this is true for both going concern and general qualifications. Therefore, the evidence supports the view that large auditors are more accurate than small auditors.

The Financial Times, the Economist, Accountancy Age magazine and Department of Trade and Industry (DTI) investigations were searched for evidence of auditor criticisms and these are listed in Table 2.

[INSERT TABLE 2 HERE]

Auditors appear to be most susceptible to criticism when one of two events occurs. First, auditors are sometimes criticised for not giving adequate warnings of bankruptcy. Secondly, auditors are sometimes criticised following takeover battles - the auditor of a target company may be criticised by an acquiring company for allowing the target's value to be over-stated.

Table 2 also shows that large auditors received much more criticism than small auditors. Larger auditors tend to audit more companies than small auditors and they also tend to audit larger companies. This tends to increase the amount of criticism received by large auditors compared to small auditors. Table 3 shows the number of criticisms, the number of clients and the average asset size of clients for auditors.

[INSERT TABLE 3 HERE]

If the reputation argument is valid, one would expect to find a significant negative relationship between auditor size and criticism (and litigation). If the deep pockets effect is important the relationship between auditor size and litigation is ambiguous. Therefore, the

EVALUATING THE REPUTATION ARGUMENT

finding of a weak or positive relationship between auditor size and litigation would be consistent with the deep pockets argument. Unfortunately, it is difficult to investigate the relationship between litigation and auditor size because most cases appear to be settled in undisclosed out-of-court agreements. To address this problem, evidence on auditor criticisms is used as a proxy for litigation. Table 4 shows the results from a model explaining the amount of criticism received by auditors.⁹

[INSERT TABLE 4 HERE]

Models 1 and 2 indicate that Stoy Hayward (SH_j) and Ernst and Young (EY_j) were much more likely to receive criticism compared to other audit firms. When these outliers are controlled for, the number of clients ($CLIENT_j$) and auditor size (AUD_j) are both significant in explaining the amount of criticism incurred by auditors. Whilst the client size variable ($ASSETS_j$) has the expected positive sign, its effects are not statistically significant in models 1 or 3. When the (SH_j) and (EY_j) dummy variables are omitted, the coefficient on the number of clients ($CLIENT_j$) remains positive and statistically significant; the coefficient on auditor size (AUD_j) also remains positive but its level of significance falls. Overall, the weak positive relationship between auditor size and criticism suggests that large auditors are more prone to litigation despite their superior accuracy.¹⁰

Since one cannot publicly observe whether an auditor has been negligent, the reputation argument rests on the assumption that there are observable signals of auditor accuracy such as criticisms against auditors. Two studies have sought to test reputation theories by investigating the effects of criticism on the demand for auditors' services (Firth, 1990; Wilson and Grimlund, 1990 [WG]). If the reputation models are valid one would expect to find that criticised auditors suffer falls in demand for their services.

Firth investigated the effect of criticisms by Department of Trade investigators against UK audit firms.¹¹ However, there are reasons to believe that Firth's claims - that criticised auditors tend to lose market share compared to uncriticised auditors - may be misleading. First, although the criticised auditors lost more clients compared to 'control groups' of similar uncriticised auditors, there was no net loss of clients for the group of criticised auditors.¹² Although the control groups of uncriticised auditors experienced net client gains, the uncriticised auditors left out of the control groups must have lost clients assuming the total number of clients was fairly constant. Therefore, Firth's results may be sensitive to which uncriticised auditors were included in the control groups. Secondly, Firth found no evidence to suggest that criticised auditors tend to receive lower fees.

Using US data, WG found that large and small audit firms tend to lose market share following disciplinary actions carried out by the Securities and Exchange Commission (SEC). However, in the group of criticised large auditors, no comparison is made to uncriticised large auditors because of a lack of data. Although WG found that the market share performance of small criticised auditors was worse than that of a group of small uncriticised auditors, no evidence is presented for the sensitivity of the results to control groups or time periods.

⁹ Unfortunately, microfiche copies of annual reports were unavailable for most of the companies cited in Table 2. This prevents a more detailed investigation of the causes of criticism.

¹⁰ This finding contrasts with empirical work by Palmrose (1988) who found a negative relationship between auditor size and litigation using US data between 1960-85. The difference in results could be due to differences between the UK and US or large auditors may have become more prone to deep pockets actions in recent years.

¹¹ At the time of Firth's study the 'DTI' was called the 'Department of Trade'.

¹² The group of criticised auditors lost 11 clients but also gained 11 clients over the three year period following each public criticism.

In contrast to previous studies, this paper shows the number of clients gained and lost and total fees received for each auditor in each year. Thus, one can be confident that the conclusions are not sensitive to control groups or to time periods. Moreover, the study takes into account more sources of criticism and the severity of criticisms. Arguably, the most serious criticisms involved Polly Peck, Astra Holdings (both audited by Stoy Hayward) and BCCI (audited by Price Waterhouse and Ernst and Young).¹³ When one takes into account the number of criticisms received by each auditor and the severity and timing of these criticisms, one can make three predictions based on the reputation theories. These predictions relate to the market shares of criticised auditors over time, and compared to other uncriticised auditors.¹⁴

1. Stoy Hayward received more criticism than other small auditors between 1990-94. One therefore expects to find that Stoy Hayward lost more clients than other small auditors and/or suffered lower growth in audit fees between 1990-94. Moreover, Stoy Hayward received much more criticism after 1990 than it did before 1990. One therefore expects to find that Stoy Hayward lost more clients and/or had lower growth in audit revenue between 1991-94 than it did between 1988-90.

2. Ernst and Young received more criticism than any other large auditor between 1988-94. One therefore expects to find that Ernst and Young lost more clients and/or had lower growth in audit revenue compared to other large auditors.

3. The BCCI affair created serious criticism of Ernst and Young and Price Waterhouse between 1991-93. One therefore expects to find that Ernst and Young and Price Waterhouse lost more clients and/or had lower growth in audit revenue in 1991-93 than in other periods. One also expects to find that Ernst and Young and Price Waterhouse lost more clients and/or had worse growth in audit revenue compared to other large auditors between 1991-93.

¹³ The allegations of audit failure in the case of BCCI were particularly serious. This can be seen by the size of the writ and the news coverage that the case created (occupying many more column inches than any other story).

¹⁴ This analysis is subject the caveat that many factors may influence the effects of criticism - for example, the nature of the case, visibility, whether the criticism is perceived as being justified or unjustified, etc.

Table 5 shows the audit revenues and net gains (+) and losses (-) of clients as a result of auditor switching. The evidence indicates that publicly quoted companies tend to switch from small to large auditors. This may reflect the fact that as companies grow they are more likely to require the services of large auditors; alternatively, companies may know large auditors are more accurate despite the fact that large auditors are also more prone to criticism.

[INSERT TABLE 5 HERE]

The evidence weakly contradicts the first prediction - Stoy Hayward did not suffer greater losses compared to similar uncriticised auditors. Stoy Hayward had a net loss of 1 client between 1990-94, whilst other medium-sized auditors had average net losses of 1.7 clients. Between 1990-94, audit fee income fell by 24.9% for Stoy Hayward, whilst for other small auditors it fell by 25.9%. Thus, the market share performance of Stoy Hayward was at least as good as that of similar uncriticised auditors between 1990-94. Moreover, the evidence does not indicate that Stoy Hayward suffered larger losses between 1991-94 than 1988-90 compared to other small auditors. Although Stoy Hayward's market share performance was worse between 1991-94 than it had been between 1988-89, the same is true for Grant Thornton, Panell Kerr Forster, Kidsons Impey and Hacker Young. Between 1988-89, Stoy Hayward gained 2 clients and had a 35% increase in audit fee revenue, whilst between 1991-94 Stoy Hayward lost 3 clients and suffered a 24.9% fall in audit revenue. Between 1988-89, other medium-sized auditors lost 5 clients and had a 18.2% increase in audit revenue, whilst between 1991-94 other medium-sized auditors lost 13 clients and suffered a 25.9% fall in revenue. Overall, the evidence does not indicate that Stoy Hayward experienced a larger fall in demand compared to similar uncriticised auditors.

The evidence is rather ambiguous regarding the second prediction, that Ernst and Young suffered greater losses than other large auditors. Between 1988-94, Ernst & Young gained 8

clients whilst other large auditors had average net gains of 13.4 clients. Over the same period, audit revenue rose by 50.0% for Ernst & Young - for other large auditors audit revenue rose by 40.4%. This suggests that Ernst & Young did not gain as many clients as other large auditors because of a relative increase in its fees.

Finally, the evidence does not support the prediction that Price Waterhouse and Ernst and Young suffered falls in demand as a result of the BCCI affair. Between 1991-93, Ernst & Young lost 1 client and had a 7.2% increase in revenue, while Price Waterhouse gained 4 clients and experienced a 8.9% increase in revenue. Over the same period, other large auditors gained an average of 6 clients whilst audit fee revenue increased by 6.0%. The worse performance of Ernst & Young and Price Waterhouse in terms of client gains appears to have been offset by a relative increase in fees.

To examine the effects of criticism in more detail, a model of auditor switching is estimated. Previous research indicates that companies are more likely to switch following qualified reports and when they are in financial distress (Chow and Rice, 1982; Menon and Schwartz, 1985). Moreover, event study evidence indicates that a switch may signal unfavourable news to investors (Fried and Schiff, 1981; Eichenseher et al., 1989; Albrecht, 1990). Therefore, one would expect to find that a company is less likely to switch when agency costs are high. Agency costs are assumed to be high when directors and other large investors have small shareholdings. Therefore, the shareholdings of directors ($MGTSH_{it}$) and large investors ($MAJSH_{it}$) are used as proxies for agency costs. To test whether companies tend to switch away from criticised auditors, a reputation variable (REP_{it}), is included in the model.

[INSERT TABLE 6]

Consistent with previous research, the evidence indicates that lagged reports and financial health help to predict auditor switching. In addition, the positive coefficients on the shareholding variables ($MGTSH_{it}$ and $MAJSH_{it}$) indicate that companies have less incentive to switch when agency costs are high. However, the lack of significance for the coefficient on the reputation variable (REP_{it}) shows that companies do not tend to switch away from criticised auditors.

CONCLUSION

This paper outlined a deep pockets model in which large auditors are more accurate than small auditors and in which a large auditor is at least as likely to be sued, conditional on a type I error occurring. In contrast, the reputation argument implies that large auditors are less likely to incur criticism because of their superior accuracy. Using auditor criticism as a proxy for unobserved litigation, the evidence indicates that large auditors are more susceptible to litigation despite their superior accuracy - this conflicts with the reputation argument and is consistent with the deep pockets explanation. The main limitation of this finding is that because most litigation cases never become public, it is difficult to accurately test the relationship between auditor size and litigation.

The evidence indicates that criticised auditors do not suffer falls in demand compared to uncriticised auditors. This suggests that reputation does not help explain the superior accuracy of large auditors. This is unsurprising if the deep pockets argument is valid as litigation is an unreliable signal of auditor accuracy for two reasons. First, since auditors are never sued for committing type II errors, litigation does not signal the type II error rates of auditors. Secondly, a large auditor is more likely to incur litigation conditional on a type I error occurring. Therefore, litigation is a noisy signal of auditors' type I error rates.

APPENDIX

Proposition 1:

When $W_L > W_S > K_N > K_R$, the company is indifferent between hiring a large and a small auditor ($0 < l < 1$), when the expected selling price plus net litigation payoff from hiring a large auditor is equal to the expected selling price plus net litigation payoff from hiring a small auditor.

$$pe_L\Pi_N + (1-p)(1-e_L)\Pi_F + p(1-e_L)\Pi_N + (1-p)e_L\Pi_F + h(1-p)(1-e_L)(W_L-K_R) + (1-h)(1-p)(1-e_L)(W_L-K_N) = pe_S\Pi_N + (1-p)(1-e_S)\Pi_F + p(1-e_S)\Pi_N + (1-p)e_S\Pi_F + h(1-p)(1-e_S)(W_S-K_R) + (1-h)(1-p)(1-e_S)(W_S-K_N)$$

Since $0 < p < 1$, this can be written as:

$$h(1-e_L)(W_L-K_R) + (1-h)(1-e_L)(W_L-K_N) = h(1-e_S)(W_S-K_R) + (1-h)(1-e_S)(W_S-K_N)$$

Proposition 2:

(a) When $W_L > K_N > W_S > K_R$, the company is indifferent between hiring a large or a small auditor ($0 < l < 1$) when:

$$h(1-e_L)(W_L-K_R) + (1-h)(1-e_L)(W_L-K_N) = h(1-e_S)(W_S-K_R)$$

Since $e_L > e_S$, it must be true that large auditors are less likely to commit type I errors ($(1-p)(1-e_L) < (1-p)(1-e_S)$). However, large auditors are always sued for committing type I errors whilst small auditors are only sued with probability h for committing type I errors.

The probability of litigation given that the auditor is large = $(1-p)(1-e_L)$

The probability of litigation given that the auditor is small = $h(1-p)(1-e_S)$

It is easy to show that there are numerical examples where the large auditor incurs more litigation ($(1-p)(1-e_L) > h(1-p)(1-e_S)$) and where the small auditor incurs more litigation ($(1-p)(1-e_L) < h(1-p)(1-e_S)$). Consider the following cost function, $C(e_j) = (0.5 - e_j) / \ln(e_j)$. It is easy to verify that for $0.5 \leq e_j \leq 1$, $C'(e_j) > 0$, $C''(e_j) > 0$, $C(0.5) = 0$ and $C(1) = +\infty$.

The following numerical example satisfies conditions (a) and (b):

- (a) $(1-p)(1-e_L) > h(1-p)(1-e_S)$
- (b) $h(1-p)(1-e_L)(W_L-K_R) + (1-h)(1-p)(1-e_L)(W_L-K_N) = h(1-p)(1-e_S)(W_S-K_R)$

$p = 0.9$	$e_L = 0.8$	$e_S = 0.6$	$C(e_L) = 12.01$	$C(e_S) = 2.60$
$W_L = 120$	$W_S = 80$	$K_N = 105.56$	$K_R = 10$	$h = 0.325$

The following numerical example satisfies conditions (a*) and (b*):

- (a*) $(1-p)(1-e_L) < h(1-p)(1-e_S)$
- (b*) $h(1-p)(1-e_L)(W_L-K_R) + (1-h)(1-p)(1-e_L)(W_L-K_N) = h(1-p)(1-e_S)(W_S-K_R)$

$p = 0.9$	$e_L = 0.8$	$e_S = 0.6$	$C(e_L) = 12.01$	$C(e_S) = 2.60$
$W_L = 120$	$W_S = 80$	$K_N = 110.75$	$K_R = 35$	$h = 0.649$

Nature determines the company's going-concern status and litigation costs.

Company chooses to hire a large or small auditor

Auditor decides how much effort to exert

Company decides whether to sue the auditor

Figure 1

Table 1
Correlations between Financial Health and Audit Qualifications for Large and Small Audit Firms

Panel A	Large Audit Firms ($AUD_{it} = 1$)			
	$Q_{it} = 0$	$Q_{it} = 1$	$GCO_{it} = 0$	$GCO_{it} = 1$
$FAILS_{it} = 0$	4743	112	4789	66
$FAILS_{it} = 1$	58	19	62	15
Accuracy rate (%)	96.55		97.40	
Type I error (%)	75.32		80.52	
Type II error (%)	2.31		1.36	

Panel B	Small Audit Firms ($AUD_{it} = 0$)			
	$Q_{it} = 0$	$Q_{it} = 1$	$GCO_{it} = 0$	$GCO_{it} = 1$
$FAILS_{it} = 0$	2061	65	2089	37
$FAILS_{it} = 1$	39	7	40	6
Accuracy rate (%)	95.21		96.45	
Type I error (%)	84.78		86.96	
Type II error (%)	3.06		1.74	

H_0 : The accuracy rate of general qualifications is the same for small and large auditors, ($z = 2.54$ - therefore reject H_0 at 95% confidence level).

H_0 : The accuracy rate of going concern qualifications is the same for small and large auditors. ($z = 2.09$ - therefore reject H_0 at 95%).

$FAILS_{it} = 1$ if company i receives its final audit report in year t prior to entering bankruptcy; = 0 otherwise.

$Q_{it} = 1$ if company i receives a 'general' qualification in year t ; = 0 otherwise.

$GCO_{it} = 1$ if company i receives a 'going-concern' qualification in year t ; = 0 otherwise.

In this paper, a qualification given for going-concern reasons is called a 'going-concern' qualification (GCO_{it}), whilst a qualification given for going-concern reasons, fundamental uncertainties, and non-compliance with Statements of Standard Accounting Practice is called a 'general qualification' (Q_{it}).

$AUD_{it} = 1$ if company i hires a 'Big-Six' audit firm in year t ; = 0 otherwise.

The 'Big Six' are KPMG Peat Marwick, Coopers & Lybrand, Price Waterhouse, Touche Ross, Ernst & Young and Arthur Anderson.

Table 2
Criticisms of UK Audit Firms (1988-94)

Auditor	Date	News
Stoy Hayward	19:2:90	The bankrupt AT Trust serves writ for audit.
	23:12:90	ICAEW announces investigation into audit of bankrupt Levitt Group.
	22:11:90	Stoy faces criticism from shareholders over its audits of Polly Peck and Astra Holdings.
	10:1:91	Labour Party criticises Stoy for its audit of the Levitt Group.
	8:4:91	Amber Day decides not to retain Stoy as its auditor because of concern shown by some City institutions over Stoy's audits of Polly Peck, Sock Shop, Levitt Group and Homes Assured.
	29:4:93	Stoy served with writ for its audit of Polly Peck.
	18:6:93	Stoy criticised in DTI investigation of Astra Holdings.
	21:6:93	Stoy served with writ in connection with audit of Beverley Group (formerly known as Petrocon).
	30:11:93	Financial Reporting Review Panel criticises the accounts of Chrysalis which were unqualified.
	14:5:94	Stoy served with writ for audit of Astra Holdings.
Ernst and Young	27:7:88	Ruberoid serves writ for £8.9m against Ernst and Whinney for audit of Camrex.
	22:10:88	Arthur Young pays £12m in settlement to the Bank of England for its audit of Johnson Matthey Bank.
	27:10:88	Arthur Young criticised by DTI over audit of Milbury Plc.
	30:6:89	Stoddard Sekers considers legal action against Arthur Young for its audit of Sekers International, with which it had merged.
	2:3:89	Arthur Young criticised by shareholders and creditors over its audit of Sound Diffusion.
	4:8:89	Arthur Young admits that two sets of accounts for Budgens (1986 and 1987) which it had audited were incorrect.
	19:10:89	Ernst and Young face legal action from a Lloyd's syndicate for its audit of Warrilow.
	30:11:89	Arthur Young and Ernst and Whinney receive a writ for their work on Sound Diffusion.
	29:8:90	Arthur Young criticised by DTI for its audit of Alexander Howden Holdings.
	1:5:91	Arthur Young and Ernst and Whinney criticised by DTI for its audit of Sound Diffusion.
	6:7:91	BCCI is liquidated - speculation begins over the role of Ernst and Young.
	24:7:91	Arthur Young criticised by DTI for its audit of Rotaprint.
	12:9:91	Arthur Young served with writ for its audit of Magnet.
	18:2:92	Arthur Young fined £100,000 by Joint Disciplinary Scheme for its work on Milbury.
7:3:92	Ernst and Young (and Price Waterhouse) receive writ from the liquidators of BCCI for £7.5 bn.	
25:4:92	Joint Disciplinary Scheme announces investigation into Ernst and Young for its audit of BCCI.	
1:10:92	Claim made by Walker Greenbank for £15m against Arthur Young regarding the acquisition of Alkar.	
18:2:93	Ernst and Young criticised by DTI regarding its work on Edencorp Leisure.	
19:6:94	Magnet makes claim against its auditor Arthur Young for £50m.	
Price Waterhouse	7:4:88	UniChem makes official complaint over a report PW prepared for its audit client Macanthy in its bid for UniChem.
	2:5:90	PW accused in court of misleading Guinness directors.
	12:4:91	PW reaches out of court settlement with Pifco for negligence in its audit of Salton - amount undisclosed.
	6:7:91	HCCI is liquidated - speculation begins over the role of Price Waterhouse.
	7:3:92	Price Waterhouse (and Ernst and Young) receive writ from the liquidators of BCCI for £7.5bn.
	29:1:94	Financial Reporting Review Panel criticises the accounts of Intercare which were not qualified by Price Waterhouse.
	1:2:94	Joint Disciplinary Scheme reprimands Price Waterhouse for failing to reveal a fraud it had uncovered 14 years previously during an audit of Brynston Finance.

Table 2 (contd.)
 Criticisms of UK Audit Firms (1988-94)

Auditor	Date	News
<i>Touche Ross</i>	23:10:88	ICAEW start investigation into Touche Ross's work on Barlow Clowes.
	19:10:89	Spicer and Oppenheim face legal action from a Lloyd's syndicate for its audit of Warrilow.
	20:3:91	Spicer and Pegler criticised by DTI for its work on Aldermanbury Trust.
	23:2:92	Joint Disciplinary Scheme re-opens Barlow Clowes investigation (the previous investigation was suspended following a request from the Serious Fraud Office).
	16:10:92	Financial Reporting Review Panel forces Trafalgar House to amend its 1991 accounts which were not qualified by Touche Ross.
	3:11:92	The Treasury and liquidators issue a writ against Touche Ross for Barlow Clowes.
<i>KPMG Peat Marwick</i>	21:7:94	Spicers criticised by DTI over its work on Atlantic Computers.
	18:11:89	Ferranti serves writ against Peat Marwick.
	13:9:90	Peat Marwick criticised for its audit of the N.U.M.'s accounts.
	10:4:91	Riva Group sues KPMG for negligence over its acquisition of Hugin Sweda.
	13:8:91	Peat Marwick pays out £40m in settlement to Ferranti.
	17:9:92	KPMG served with writ for its audits of HS Weavers.
	22:12:92	Adam & Co. announce they are considering legal action against KPMG.
	23:9:93	KPMG criticised by DTI for its work on London United Investments.
	30:11:93	Financial Reporting Review Panel argues that Chrysalis' accounts audited by KPMG in 1992 were contrary to SSAP1.
	23:12:93	KPMG sued over its valuation of Medway Ports.
<i>Coopers & Lybrand</i>	26:1:89	Coopers is issued with a writ for 1.96m pounds for its audit of Espley Trust.
	8:4:89	Laird Group dismisses Coopers after finding errors in the accounts of Metro-Cammell Weymann.
	18:3:89	Deloitte Haskins is criticised following its overvaluation of stocks and work-in-progress held by E&L Instruments.
	8:5:91	TGI dismisses Coopers following incorrect profit figures in the accounts of Tannoy Audix which were audited by Coopers.
	12:12:91	Coopers criticised for its role as auditor in Maxwell Communications.
	4:1:93	Guardian Royal Exchange issues a writ against Coopers in relation to its 1986-8 audits.
	11:8:93	Financial Reporting Review Panel criticises accounts of Royal Bank which were not qualified by Coopers.
	27:9:93	Financial Reporting Review Panel criticises accounts of Control Techniques which were not qualified by Coopers.
	21:7:94	Deloitte criticised by DTI for work on Atlantic Computers.
<i>Arthur Anderson</i>	11:3:88	UK government sues Arthur Anderson in U.S. courts over its audit of DeLorean Motor Company.
	12:9:91	Arthur Anderson served with writ for its audit of Magnet.
	23:2:93	Financial Reporting Review Panel criticises the accounts of Eurotherm which were not qualified by Arthur Anderson.
<i>Pannell Kerr Forster</i>	11:7:91	Pannell Kerr Forster pays £1.63m in settlement to Beaverco Kerr for its audit of Body Sculpture.
	29:1:92	Financial Reporting Review Panel criticises the annual report of Williams Holdings, which contravened SSAP3 yet Pannell Kerr Forster gave no qualification.
<i>Binder Hamlyn</i>	29:7:92	ADT issues a writ for £146m against Binder in connection with the takeover of Britannic Security.
<i>Grant Thornton</i>	1:2:90	Platinum serves a writ against Grant Thornton for its profit forecast.
<i>Moores Rowland</i>	31:7:91	SEET issues a writ against Moores Rowland in connection with past acquisition of Homemaker Shops.

Table 3
 Number of Criticisms, Number of Audit Clients and Average Client Size (1988-94)

AUDITOR	CRITICISMS	CLIENTS	ASSETS
KPMG Peat Marwick	9	238	305,308
Coopers and Lybrand	9	185	724,530
Ernst and Young	13	127	669,603
Price Waterhouse	6	116	465,768
Touche Ross	5	104	191,718
Arthur Anderson	3	58	158,138
Binder Hamlyn	1	70	90,254
Stoy Hayward	7	40	53,579
Grant Thornton	1	38	44,486
Pannell Kerr Forster	2	29	75,656
Robson Rhodes	0	23	28,720
Kidsons Impey	0	13	194,816
Hacker Young	0	13	23,649
Moores Rowland	1	11	25,119
Clark Whitehill	0	10	496,273
Neville Russell	0	9	18,211
Baker Tilly	0	5	152,494
All other auditors ¹	0	1.25	28,925

CRITICISMS = Number of individual criticisms cited in Table 2 for each auditor.
 CLIENTS = Number of quoted companies audited between 1987-94.
 ASSETS = Average book value of total assets for companies audited by each auditor (£ 000's)

¹ An audit firm falls into this category if it audited fewer than 5 of the publicly quoted companies in the data - there are 122 such audit firms. The CLIENTS and ASSETS values are averages for these audit firms.

Table 4
Model Explaining the Amount of Criticism Incurred by Auditors
(Dependent variable is CRITICISMS_j - t-statistics in parentheses)

Explanatory Variables	Model 1	Model 2	Model 3	Model 4
CLIENT _j	0.031 (7.196)	0.031 (6.619)	0.033 (2.862)	0.036 (3.006)
ASSETS _j	0.622e-06 (1.193)	.	0.242e-05 (1.284)	.
AUD _j	1.964 (2.959)	2.044 (2.922)	2.047 (1.238)	2.541 (1.225)
SH _j	5.817 (34.660)	5.794 (31.266)	.	.
EY _j	6.816 (18.282)	7.015 (21.852)	.	.
CONSTANT	-0.071 (-3.183)	-0.051 (-3.657)	-0.099 (-1.696)	-0.022 (-0.624)
R ²	0.9856	0.9849	0.8272	0.7681

Number of observations = 139.

CRITICISMS_j = Number of individual criticisms cited in Table 2 for auditor j.

CLIENT_j = Number of clients for auditor j.

ASSETS_j = Average asset size of clients for auditor j.

AUD_j = 1 if auditor j is one of the Big Six; = 0 otherwise.

SH_j = 1 if auditor j is Stoy Hayward; = 0 otherwise.

EY_j = 1 if auditor j is Ernst and Young; = 0 otherwise.

A standard regression model was found to create heteroscedasticity problems - therefore, robust regression is used to estimate consistent standard errors.

Table 5
Changes in Clients and Total Audit Fees (£ 000's) for Auditors

		1988	1989	1990	1991	1992	1993	1994
<i>Big-Six Auditors</i>								
KPMG Peat Marwick:	Clients	+3	-1	+2	+2	+4	+3	+3
	Total audit fees	43,178	51,547	56,823	59,050	66,187	71,329	67,729
Coopers & Lybrand:	Clients	+3	+4	+1	0	+5	+5	-1
	Total audit fees	50,297	58,916	63,447	62,271	64,040	65,092	66,103
Ernst & Young:	Clients	+1	+3	-3	+2	-1	-2	+8
	Total audit fees	37,502	42,614	49,456	51,032	53,179	54,725	56,270
Price Waterhouse:	Clients	+4	+3	+6	0	0	+4	+1
	Total audit fees	21,384	25,871	30,005	31,719	34,859	34,540	33,744
Touche Ross:	Clients	+4	0	-2	-1	+1	+2	+1
	Total audit fees	15,446	18,318	21,114	19,177	18,556	15,741	15,670
Arthur Anderson:	Clients	+5	+1	+1	+1	+1	+1	+1
	Total audit fees	7,691	9,395	11,071	10,289	11,202	10,530	11,185
Total:	Clients	+20	+10	+5	+4	+10	+13	+13
	Audit fees	175,498	206,661	231,916	233,538	248,023	251,957	250,701
<i>Medium-Sized Auditors</i>								
Binder Hamlyn:	Clients	-3	-3	+3	0	+2	-2	0
	Total audit fees	4,213	5,080	5,663	6,654	5,802	6,003	5,684
Stoy Hayward:	Clients	+1	+1	+1	0	-2	+1	-1
	Total audit fees	2,340	3,163	2,648	2,327	1,809	1,800	1,747
Grant Thornton:	Clients	0	+1	0	+1	-2	-2	-2
	Total audit fees	1,642	2,220	2,602	2,766	2,193	2,047	1,719
Pannell Kerr Forster:	Clients	+1	+1	-2	+2	0	-2	-2
	Total audit fees	3,133	3,896	4,132	4,777	3,961	3,625	2,540
Robson Rhodes:	Clients	0	-1	0	0	0	-1	0
	Total audit fees	751	725	870	952	1,051	983	977
Kidsons Impey:	Clients	-1	+1	+1	-2	0	0	-1
	Total audit fees	2,339	3,052	2,915	3,188	3,572	3,183	4,246
Hacker Young:	Clients	-1	+1	-1	0	0	-2	0
	Total audit fees	538	860	552	567	427	188	188
Moores Rowland:	Clients	0	0	0	0	+1	0	0
	Total audit fees	436	556	654	760	634	550	587
Total:	Clients	-3	0	+2	+1	-2	-8	-6
	Audit fees	15,392	19,552	20,036	21,991	19,449	18,379	17,688
<i>Small Auditors</i>								
All other auditors:	Clients	-17	-11	-7	-5	-9	-5	-7
	Total audit fees	8,257	9,218	9,166	9,700	9,038	7,647	7,442

Table 6
Probit Model of Auditor Switching
(SW_{it} is the dependent variable - z-statistics in parentheses)

Explanatory Variables	Model 1	Model 2	Model 3	Model 4
Q _{t-1}	0.734 (5.414)	0.718 (5.386)	0.716 (5.480)	.
FAILS _{it}	0.457 (2.689)	0.556 (3.547)	0.571 (3.755)	.
MGTS _{it}	0.342e-02 (2.202)	0.485e-02 (3.405)	.	.
MAJSH _{it}	0.552e-02 (2.666)	0.812e-02 (4.274)	.	.
ASSETS _{it}	-0.216e-06 (-1.852)	.	.	.
REP _{it}	-0.003 (-0.031)	0.001 (0.013)	-0.022 (-0.268)	-0.036 (-0.451)
CONSTANT	-1.939 (-30.824)	-2.024 (-35.942)	-1.820 (-53.614)	-1.771 (-55.072)

Number of observations = 6052

SW_{it} = 1 if company i experiences a change in auditor in year t; = 0 otherwise.

FAILS_{it} = 1 if company i receives its final audit report in year t prior to entering bankruptcy; = 0 otherwise.

Q_{t-1} = 1 if company i receives a 'general' qualification in year t-1; = 0 otherwise.

MGTS_{it} = The percentage of ordinary shareholdings held by the directors.

MAJSH_{it} = The percentage of ordinary shareholdings held by other large shareholders.

ASSETS_{it} = Asset size of company-i in year t.

REP_{it} = 1 if company i hires Stoy Hayward (1990-94), Ernst & Young (1987-94), or Price Waterhouse (1991-93) in year t; = 0 otherwise.

Directors' ordinary shareholdings are expressed as a percentage of issued ordinary share capital. Shareholding data were not collected for all observations because of the high cost of collecting this information. For companies that did not switch auditor over the study period, shareholding information was only collected for 1990 and is used as a proxy for the missing observations in other years. In practice, this is unlikely to cause measurement error problems since ownership patterns typically exhibit little variation over time. For companies that did switch auditor, shareholding data were collected for all years because ownership patterns may be less stable for such companies. Large shareholdings held by individuals, companies and trust funds are only disclosed in the accounts if they exceed 5%. For each company, the sum of these excess shareholdings was calculated. For example, suppose that company i has the following large shareholders in year t:

Individual A: 8% Individual B: 10% Individual C: 5.5%

For this observation, MAJSH_{it} would be calculated as follows:

MAJSH_{it} = (8-5) + (10-5) + (5.5-5) = 8.5

This calculation was used so as to avoid putting undue weight on observations with a lot of shareholdings only slightly in excess of 5%.

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